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BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

Order Instituting Rulemaking to Address Utility Cost and Revenue Issues Associated with Greenhouse Gas Emissions.	R. 11-03-012 (Filed March 24, 2011)

SUPPLEMENTAL MATERIALS IN SUPPORT OF THE REVISED PROPOSAL OF THE NATURAL RESOURCES DEFENSE COUNCIL (NRDC) SIERRA CLUB CALIFORNIA, THE GREENLINING INSTITUTE (GREENLINING), UNION OF CONCERNED SCIENTISTS (UCS), LOCAL GOVERNMENT SUSTAINABLE ENERGY COALITION (LGSEC), NATIONAL CONSUMER LAW CENTER (NCLC), CLIMATE PROTECTION CAMPAIGN (CPC), CALIFORNIA HOUSING PARTNERSHIP CORPORATION (CHPC), AND COMMUNITY ENVIRONMENTAL COUNCIL TO ALLOCATE GREENHOUSE GAS ALLOWANCE REVENUES

January 6, 2012

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Pursuant to the direction of Administrative Law Judges (ALJs) Semcer and Hecht at the workshop held on November 1-2, 2011, the Natural Resources Defense Council (NRDC), Sierra Club California (Sierra Club), Greenlining Institute, Union of Concerned Scientists (UCS), Local Government Sustainable Energy Coalition (LGSEC), National Consumer Law Center (NCLC), Climate Protection Campaign (CPC), California Housing Partnership Corporation (CHPC), and the Community Environmental Council (collectively “Joint Parties”) respectfully submit these Supplemental Materials in Support of the Revised Proposal of the Joint Parties to Allocate Greenhouse Gas Allowance Revenues. These materials are a collection of scholarly works. With this filing, the Joint Parties respectfully request that these documents be made a part of the official record as support for various aspects of the Joint Party proposal. The materials are identified below.

Exhibit 1: *The Climate Gap: Inequalities in How Climate Change Hurts Americans & How to Close the Gap*, Rachel Morello-Frosch, Manuel Pastor, James Sadd, Seth Shonkoff.

Exhibit 2: *Climate Change, Extreme Heat, and Electricity Demand in California*, Prepared for California Energy Commission Public Interest Energy Research Program, Prepared by Lawrence Berkeley National Laboratory, Texas Tech University, University of California, Berkeley, August 2007.

Exhibit 3: *Pie In the Sky? The Battle for Atmospheric Scarcity Rents*, Peter Barnes, Marc Breslow, Political Economy Research Institute, University of Massachusetts Amherst, 2001.

Exhibit 4: *Cap and Dividend: How to Curb Global Warming While Protecting the Incomes of American Families*, James K. Boyce & Matthew Riddle, Political Economy Research Institute, University of Massachusetts Amherst, November 2007.

Exhibit 5: *Clear Economics: State-Level Impacts of the Carbon Limits and Energy for Americas's Renewal Act on Family Incomes and Jobs*, James K. Boyce and Matthew E. Riddle, Political Economy Research Institute, University of Massachusetts Amherst, Revised July 2011.

Exhibit 6: *Schools of the Future Report,* Prepared for State Superintendent Tom Torlakson by the State Superintendent of Public Instruction Schools of the Future Advisory Team, September 2011.

Exhibit 7: *Improving California's Multifamily Buildings: Opportunities and Recommendations for Green Retrofit and Rehab Programs: Findings from the Multifamily Subcommittee of the California Home Energy Retrofit Coordinating Committee,* Final Report, April 11, 2011.

The Joint Parties respectfully request that these supplemental materials in support of our revised proposal be considered as part of the official record.

Dated: January 6, 2012

Respectfully submitted,

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EXHIBIT 1

THE CLIMATE GAP

Inequalities in How Climate Change Hurts Americans & How to Close the Gap

Rachel Morello-Frosch, Ph.D., MPH | Manuel Pastor, Ph.D. | James Sadd, Ph.D. | Seth B. Shonkoff, MPH

Acknowledgments

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INTRODUCTION

Climate change is real. The climate gap is real.

What we used to think was tomorrow's climate crisis is here today. Heat waves, wild fires and floods are making headlines more often. **What hasn't made headlines—yet—is the climate gap: the disproportionate and unequal impact the climate crisis has on people of color and the poor.** Unless something is done, the consequences of America's climate crisis will harm all Americans—especially those who are least able to anticipate, cope with, resist and recover from the worst consequences. This analysis is of California, which in many ways is a microcosm of the entire United States.

Climate change is an issue of great importance for human rights, public health, and social fairness because of its profound consequences overall and the very real danger that poor neighborhoods and people of color will suffer even worse harms and hazards than the rest of Americans. This "climate gap" is of special concern for California, home to one of the most ethnically and economically diverse populations in the country.

The climate gap means that communities of color and the poor will suffer more during extreme heat waves. For instance, African Americans in Los Angeles are nearly twice as likely to die from a heat wave than other Los Angeles residents, and families living below the poverty line are unlikely to have access to air conditioning or cars that allow them to escape the heat.

The climate gap means that communities of color and the poor will breathe even dirtier air. For example, five of the smoggiest cities in California also have the highest densities of people of color and low-income residents. These communities are projected to suffer from the largest increase in smog associated with climate change.

The climate gap means that communities of color and the poor will pay more for basic necessities. Low-income and minority families already spend as much as 25 percent of their entire income on just food, electricity and water—much more than most Americans.

The climate gap is likely to mean fewer job opportunities for communities of color and the poor. The climate crisis may dramatically reduce or shift job opportunities in sectors such as agriculture and tourism, which predominantly employ low-income Americans and people of color.

This report—an analysis and synthesis of available data—explores disparities in the impacts of climate change and the abilities of different groups to adapt to it. It also offers concrete recommendations for closing the climate gap, starting with insuring that climate solutions don't leave anyone behind.

METHODOLOGY

This report analyzes currently available data on the disparate impacts of climate change and climate change mitigation policies on low socioeconomic status (SES) groups in the United States that is relevant to the California context (Shonkoff, Morello-Frosch et al. 2009). We have also drawn information from climate change policy, human health, and environmental justice literature to provide background and context for these issues. Our goal was to address some of the prominent public health, equity, and regulatory issues that are pertinent to the policy deliberations surrounding the implementation of AB 32, The Global Warming Solutions Act as well as federal climate change policy.

There is a Climate Gap

KEY FINDINGS

There is a climate gap. The health consequences of climate change will harm all Americans—but the poor and people of color will be hit the worst.

The Climate Gap in Extreme Heat Waves

Extreme weather events, such as heat waves, droughts, and floods are expected to increase in their frequency and intensity in the next hundred years due to climate change (IPCC 2007), which could increase the risk of illnesses and deaths linked to extreme heat.

Extreme Heat Leads to Increased Illnesses and Deaths—Particularly Among the Elderly, Infants and African Americans.

In a study on nine California counties from May through September of 1999–2003, researchers found that for every 10°F (5.6°C) increase in temperature, there is a 2.6 percent increase in cardiovascular deaths. The risks were higher for persons at least 65 years of age, infants one year of age or less (Figure 1), and African Americans (Figure 2).

A study on the 2006 California heat wave (July 15–August 1, 2006) showed that emergency room visits increased by 16,166 and that there were 1,182 additional hospitalizations statewide, compared to a similar time period when there was no heat wave. In particular, the magnitude of heat-related illnesses on emergency department visits was dramatic. Statewide, there was a six-fold increase in heat-related emergency department visits and a more than 10-fold increase in heat-related hospitalizations (Knowlton et al. 2009). Another study on seven counties impacted by the 2006 heat wave indicated a nine percent (95 percent CI = 1.6, 16.3) increase in daily mortality per 10 degrees Fahrenheit change in apparent temperature for all counties combined. This estimate is almost three times larger than the effect estimated for the full warm season and 1.3 times higher than during July in previous years (non heat wave years 1999 to 2003). The estimates indicate that actual mortality during the July 2006 heat wave was two or three times greater than initial coroner estimates of 147 deaths (Ostro et al. 2009).

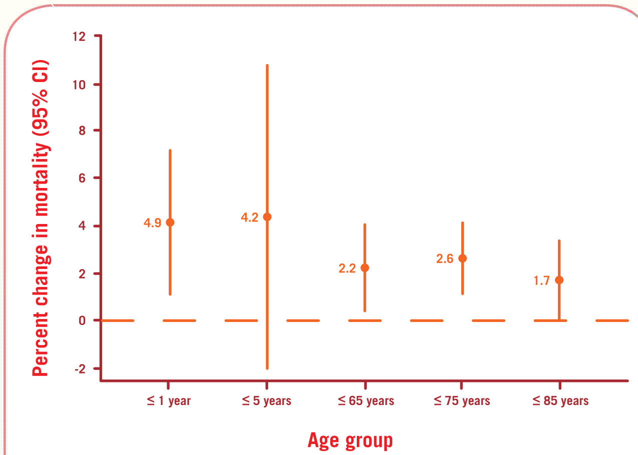


Figure 1. Percent change in mortality associated with 10˚F increase in mean daily temperature by age group in nine California counties. May through September, 1999–2003 (Source: Basu and Ostro 2008).

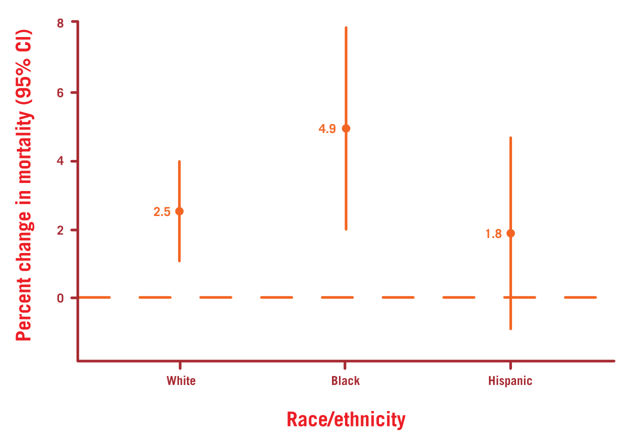


Figure 2. Percent change in mortality associated with 10˚F increase in mean daily temperature by race/ethnicity in nine California counties. May through September, 1999–2003 (Source: Basu and Ostro 2008).

Emergency department visits for heat-related illnesses increased across California, especially in the Central Coast, including San Francisco. Further, emergency department visits showed statistically significant increases in acute renal failure, diabetes, cardiovascular diseases, electrolyte imbalance, and nephritis (Knowlton et al. 2009). Children (0–4 years of age), the elderly (≥ 65 years of age) (Knowlton et al. 2009), and low-income African Americans (Basu and Ostro 2008) appear more likely to get sick or die from heat wave effects than others.

Risk Factors for Heat-Related Illness and Death Are Higher for Low-Income Neighborhoods and People of Color.

Although heat exposure alone can cause illness or death, physiological, social and economic factors are integral in explaining the uneven distribution among diverse populations (Epstein and Rodgers 2004). Risk factors for heat-associated illness and death can be categorized as natural factors (i.e., age, disability) or external factors resulting from social or economic conditions (e.g., housing quality, access to cooling centers, transportation).

In terms of natural factors, people suffering from chronic medical conditions have a greater risk of dying during heat waves (Epstein and Rodgers 2004; Kovats and Hajat 2008; Kilbourne 1997). In fact, a study on the heat-specific mortality during the 2003 heat wave in France reported that over 70 percent of the home victims had medical pre-conditions, particularly cardiovascular and/or psychological illness (Poumadere et al. 2005). Low-income individuals are disproportionately affected by medical conditions due to their lack of access to technological, informational, and social resources to cope with these conditions (Phelan et al. 2004). Further, epidemiologic studies of heat-associated mortality show an increased risk among the elderly; especially among those older than 50 years of age (Kovats and Hajat 2008).

THE HEAT ISLAND EFFECT: The increased heat created by a lack of tree cover in an urban area exacerbated by an abundance of dark-colored materials used to construct roads and buildings. The roads and buildings absorb the heat, creating a heat island effect.

In terms of external factors, low-income urban neighborhoods and communities of color are particularly vulnerable to increased frequency of heat waves and higher temperatures because they are often segregated in the inner city (Schultz et al. 2002; Williams and Collins 2001), which is more likely to experience the "heat-island" effect. The heat-island effect occurs in urban areas because dark-colored materials used to construct roads, buildings, and other structures absorb heat and do not allow it to dissipate at the same rate as soil, grass, forests, and other less-industrial materials (Oke 1973).

Research has shown a positive relationship between the presence of concrete, heat-trapping surfaces and community poverty, and a negative relationship between the amount of tree cover and the level of community poverty in four California urban areas (Figure 3). This suggests the potential for a disproportionate burden of heat-island exposure to low-income populations compared with higher-income populations. This trend is extended to people of color that reside in a given neighborhood: there is a positive relationship between the proportion of people of color and proportion of concrete, heat-trapping surfaces and a negative relationship between proportion of people of color and amount of tree cover (Figure 4). (Morello-Frosch and Jesdale 2008)

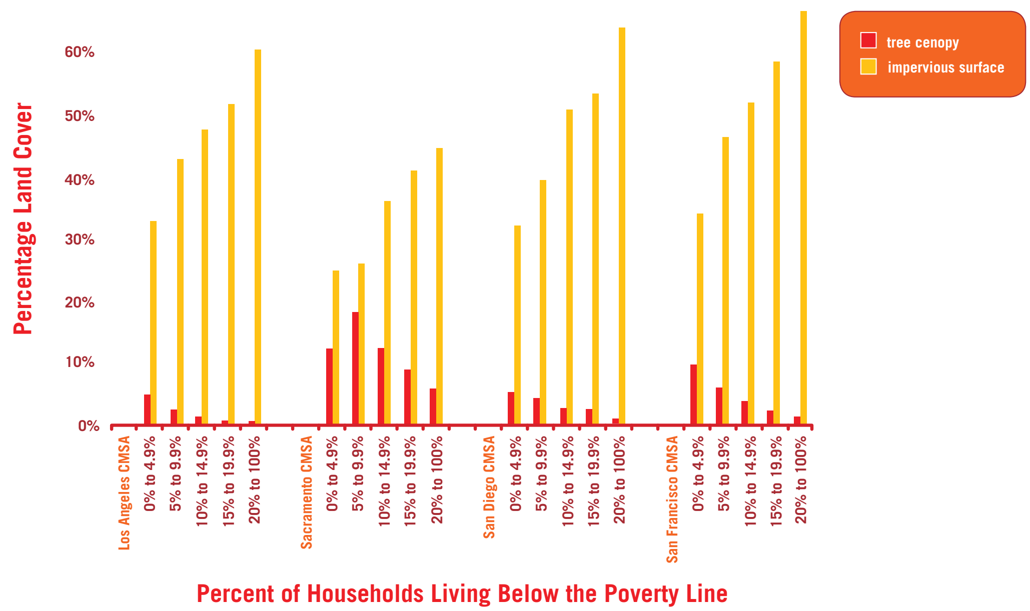


Figure 3. Land cover characteristics by percent of households living below the poverty line (Los Angeles, Sacramento, San Diego, San Francisco metro areas). Adapted from: Morello-Frosch and Jesdale 2008.

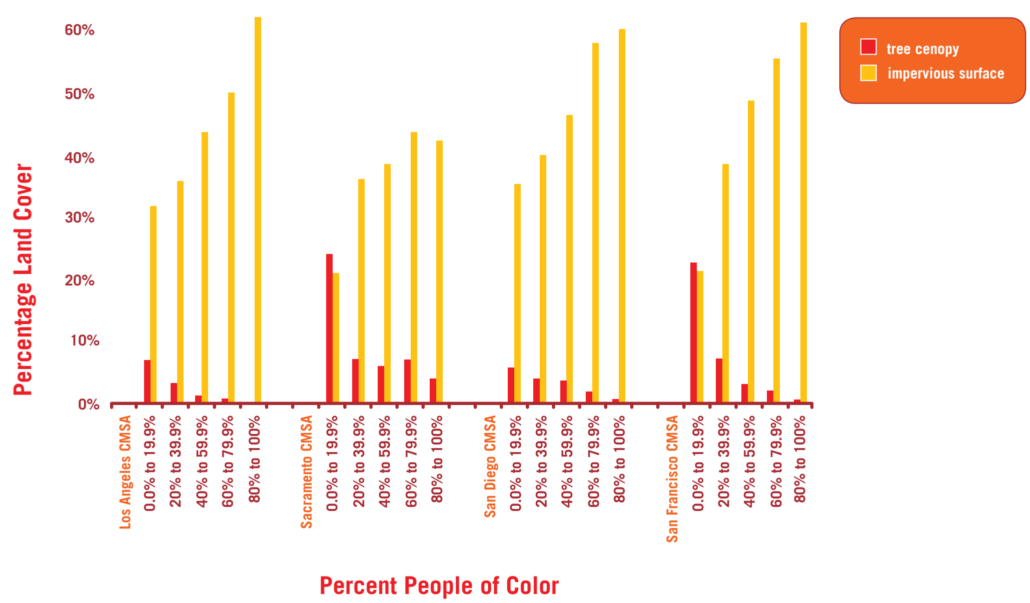


Figure 4. Land cover characteristics by percent of residents of color living in the neighborhood (Los Angeles, Sacramento, San Diego, San Francisco metro areas Adapted from: Morello-Frosch and Jesdale 2008.

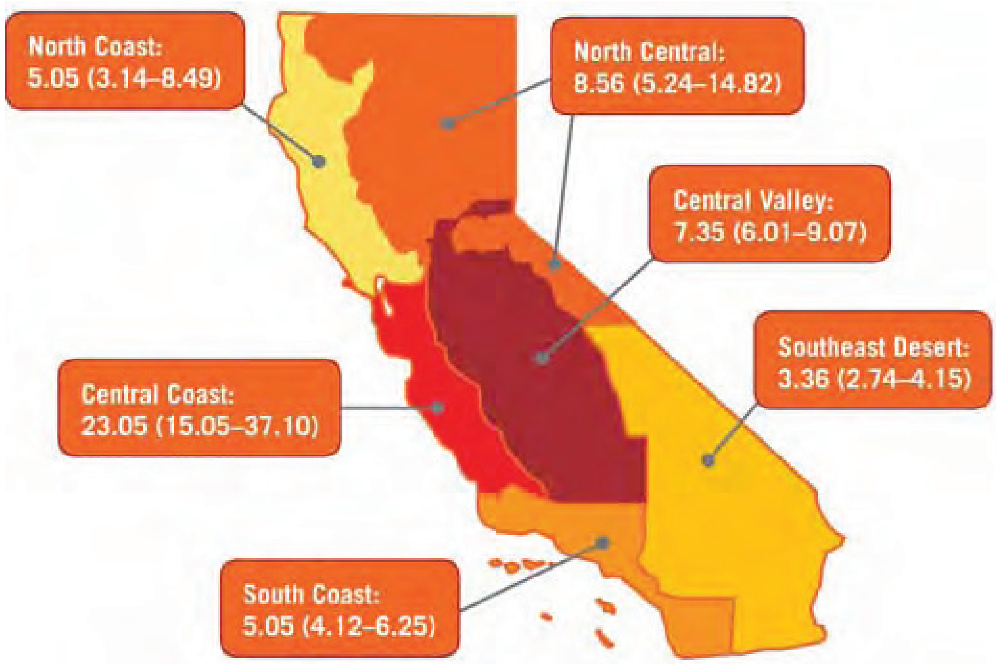


Figure 5. Map showing realtive risk of emergency department visit for heat-related illnesses during the summer 2006 heat wave (July 15–August 1 2006) compared with a reference period (July 8–14 and August 12–22, 2006) for six California regions (Source: Knowlton et al. 2009).

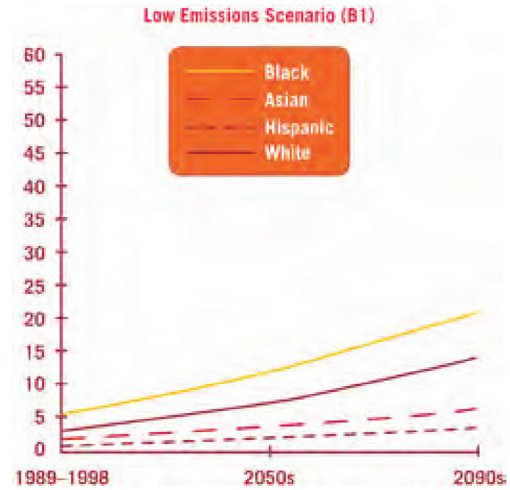
Figure 6. Geographic location of deaths due to heat wave. July 2006 (Source: English et al 2007)

African Americans in Los Angeles Nearly Twice as Likely to Die from a Heat Wave

Another indicator that African Americans may bear a disproportionate burden of heat-wave mortality is the fact that African American Los Angeles residents have a projected heat-wave mortality rate that is nearly twice that of the Los Angeles average (Figure 7).

Agricultural and Construction Workers also at Increased Risk of Death

California's agricultural and construction workers have experienced severe heat-related illness and death with data pointing towards possible increasing trends in recent years (English et al. 2007; Luginbuhl 2008). The socioeconomic status of predominantly Mexican and Central American immigrants who come to California to work in the agricultural and construction sectors makes them particularly vulnerable because of the cumulative impacts of their long workdays under strenuous conditions, limited capacity to protect their rights, and exposure to chemicals such as pesticides. Between the



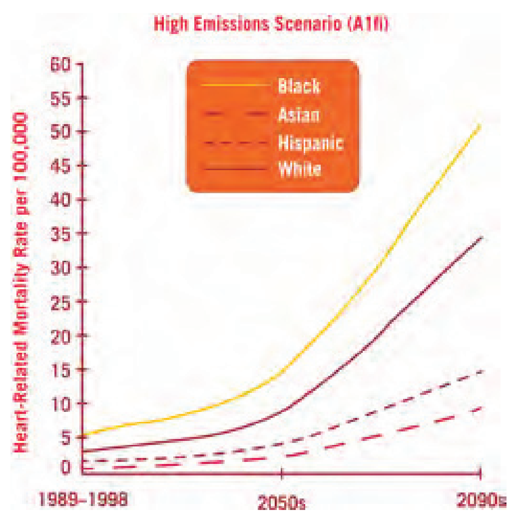


Figure 7. Relative heat-wave mortality rates by race/ethnicity for Los Angeles* (Source: cited from Cordova et al. 2006)

* Actual historical values (1989–1998) and projected future values (2050s and 2090s) for high-emissions (A1fi) and low-emissions (B1) scenarios. (HadCM3 projections only.)

years 1992–2002, 40 percent of the crop workers who died due to heat-associated complications were identified as Mexican or Central or South American (Luginbuhl 2008) and 72 percent of these deaths were among adults aged 20–54 years, a population typically considered to be at low-risk for heat illnesses (Luginbuhl 2008). A recent study of the 2006 California heat wave found significantly increased rates of emergency department visits and hospitalizations for cardiac-related illnesses statewide only among Latinos/Hispanics (Knowlton et al. 2009), which may be related to occupational heat exposures among Latino/Hispanic crop workers (Luginbuhl et al. 2008). As heat-wave incidence and intensity increases with climate change, these disparities will persist, if not increase.

Air Conditioning a Critical Coping Tool for Heat Waves—but Not Everyone Has Access

Studies have documented that lack of access to air conditioning is linked to the disproportionate risk of heat-related illness and death among the urban elderly in the United States—particularly those who are low-income or of color (Kovats and Hajat 2008; Semenza et al. 1996).

Overall, low-income families and people of color are less likely to have access to air-conditioning (English et al. 2007). In the Los Angeles-Long Beach Metropolitan Area, for example, many more African American households do not have access to air conditioning compared to the general population. Similar trends hold for Latinos and communities living below the poverty line (UCSB 2004) (Table 1). This disparity is important particularly because some communities are instructed to stay indoors and avoid outdoor pollution exposures on particularly hot days.

Moreover, a thorough analysis based on several different studies using heat-wave data from Chicago, Detroit, Minneapolis, and Pittsburgh shows that for each 10 percent increase in central air conditioner (AC) prevalence, heat-associated mortality decreased by 1.4 percent. The overall effect of heat on mortality was a 10.2 percent increase. African Americans were found to have a 5.3 percent higher prevalence of heat-related mortality than Whites and 64 percent of this disparity is potentially attributable to disparities in prevalence of central AC technologies (O'Neil, Zanobetti et al. 2005).

Transportation Is also a Critical Coping Tool During a Heat Wave—but African Americans, Latinos and Asians Less Likely to have Access to a Car

In the Los Angeles-Long Beach Metropolitan Area, higher proportions of African-American (20 percent), Latino (17.1 percent), and Asian (9.8 percent) households do not have access to a car (UCSB 2004), compared to White households (7.9 percent), thus restricting their capacity to move to cooler areas and government-sponsored cooling stations during extreme heat events.

	Total Number of Households	Total Occupied Units	Black (not Hispanic)	Hispanic	Elderly (65 years or older)	Below Poverty Level
All Occupied Units	3,131,000	39.7%	58.5%	54.6%	37.5%	51.5%
Renters	1,608,900	48.1%	59.1%	58.4%	38.7%	56.3%
Homeowners	1,522,100	30.9%	57.4%	48.9%	36.8%	38.8%

Table 1. Percent of households without access to any air conditioning by race and SES – Los Angeles-Long Beach Metropolitan Area, California (2003)*

* Percentages are likely an underestimate of the true value due to the fact that more than one category may apply to a single unit in the dataset.

Adapted from: American Housing Survey for the Los Angeles-Long Beach Metropolitan Area 2004 (USCB 2004).

The Climate Gap in Health Hazards from Increased Air Pollution

Research suggests that the majority of the health effects due to air pollution are caused by ozone (O3) and particulate matter (PM) (Drechsler et al. 2006). However, it should be noted that many other pollutants that are associated with climate change, such as nitrogen dioxide, sulfur dioxide, and carbon monoxide, also have health consequences (Drechsler et al. 2006).

Five of the ten most ozone-polluted metropolitan areas in the United States (Los Angeles, Bakersfield, Visalia, Fresno, and Sacramento) are in California (Cordova et al. 2006; ALA 2008). Because of this, Californians already suffer a relatively high disease burden from air pollution – including 18,000 premature deaths each year and tens of thousands of other illnesses (CARB 2008a).

But climate change threatens to exacerbate California's dirty air problem. Higher temperatures hasten chemical interactions between nitrogen oxide, volatile organic gases and sunlight that lead to increases in ambient ozone concentrations in urban areas (Jacobson 2008). In California, five of the smoggiest cities are also the locations with the highest projections of ambient ozone increases associated with climate change, as well as the highest densities of people of color and low-income residents.

People of color and the poor in these urban areas are likely to lack health insurance (Cordova et al. 2006). A lack of health insurance among vulnerable populations that are exposed to elevated levels of air pollutants may lead to greater health impacts from air pollution—particularly compared with those who have health insurance.

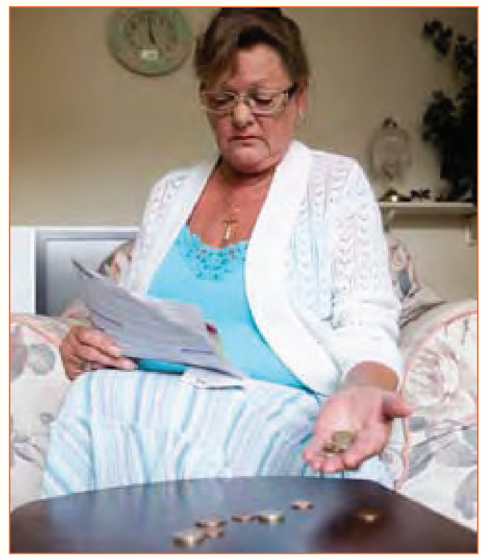
Moreover, a recent study found that for each 1 degree Celsius (1°C) rise in temperature in the United States, there are an estimated 20–30 excess cancer cases, as well as approximately 1000 (CI: 350–1800) excess air-pollution-associated deaths (Jacobson 2008). About 40 percent of the additional deaths may be due to ozone and the rest to particulate matter annually (Jacobson 2008; Bailey et al. 2008). Three hundred of these annual deaths are thought to occur in California (Bailey et al. 2008).

There is a climate gap. The economic consequences of climate change will hit low-income neighborhoods and minorities the hardest.

The Climate Gap in How Much Some People Pay for Basic Necessities

Prices for Basic Necessities Expected to Skyrocket as a Result of Climate Change

The Natural Resources Defense Council (NRDC) estimates that under a business-as-usual scenario, between the years 2025 and 2100, the cost of providing water to the western states in the United States will increase from $200 billion to $950 billion dollars per year, representing an estimated 0.93–1 percent of the United States' gross domestic product (GDP) (Ackerman and Stanton 2008). Further, it is predicted that, under the same scenario, annual U.S. energy expenditures (excluding transportation) will be $141 billion higher in 2100 than they would be if today's climate conditions continued throughout the century. This increase is equal to approximately 0.14 percent of the United State's GDP (Ackerman and Stanton 2008). Four climate change impacts—hurricane damage, energy costs, real estate losses, and water costs—alone are projected to cost 1.8 percent of the GDP of the United States, or, just under $1.9 trillion in 2008 U.S. dollars by the year 2100 (Ackerman and Stanton 2008).



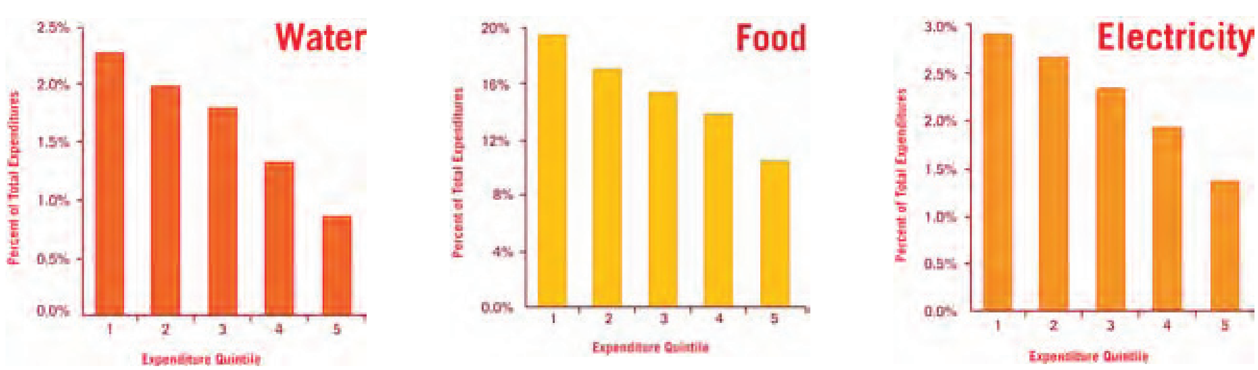


Figure 8. Household expenditures on water, electricity, and food by income bracket (as percentage of total expenditures)* (Source: Adapted From BLS 2002 and cited from Cordova et al. 2006)

* Expenditure quintile is a proxy for income with quintile 1 representing the lowest-income households and quintile 5 representing the highest-income households.

Low-Income Families Already Spend a Bigger Proportion of Their Income on Food, Energy and Other Household Needs Than Higher-Income Families. With Climate Change, That Spending Gap Will Grow.

These price increases will disproportionately impact groups that spend the highest proportion of their income on these necessities (BLS 2002). There is a nearly three-fold difference in the proportion of the sum of expenses allocated to water between the lowest- and the highest-income brackets. Households in the lowest income bracket use more than twice the proportion of their total expenditures on electricity than do those households in the highest income bracket. Similarly, food, the commodity that represents the largest portion of total spending out of all the basic necessities in the expenditure brackets, shows a two-fold discrepancy between the lowest and the highest income households (Figure 2) (Cordova et al. 2006). Because in the coming decades climate change impacts are projected to increase the prices of necessities (Ackerman and Stanton 2008), low-income people who already are paying a higher proportion of their income for necessities will potentially be subjected to increasingly disproportionate economic impacts of climate change.

The Climate Gap in Job Opportunities

Climate Change Will Dramatically Reduce Job Opportunities or Cause Major Employment Shifts in Sectors that Predominately Employ Low-Income People of Color.

The majority of jobs in sectors that will likely be significantly affected by climate change, such as agriculture and tourism, are held by low-income people of color (UCSB 2005; EDD 2004). These workers would be the first to lose their jobs in the event of an economic downturn due to climatic troubles.

Fewer and Also More Dangerous Agriculture Jobs

Impacts on the agricultural sector will fuel the climate gap in California. Latinos comprise 77 percent of the workforce in this sector and the majority of these men and women are also categorized as low-income (EDD 2004). In California, as of 2003, agriculture provided approximately 500,000 jobs with 315,000 of them being held by Latinos (EDD 2004). The majority of these jobs are seasonal, do not pay more than $7.50 per hour, and do not provide health insurance or job security. Because of the low wages and the seasonality of the work, agricultural counties are among the poorest in the state (Cordova, Gelobter et al. 2006).

Research suggests that climate change will affect employment within the agricultural sector in three main ways:

1. Increases in the frequency and the intensity of extreme weather events will expose agriculture to greater productivity risks and (Lee et al. 2009) possible revenue losses that could lead to abrupt layoffs.

2. Changing weather and precipitation patterns could require expensive adaptation measures such as relocating crop cultivation, changing the composition or type of crops and increasing inputs such as pesticides to adapt to changes in ecological composition that lead to economic denigration and job loss (Cordova et al. 2006).

3. As climate change adversely affects agricultural productivity in California, laborers will be increasingly affected by job loss. For example, the two highest-value agricultural products in California's $30 billion agriculture sector are dairy products (milk and cream, valued at $3.8 billion annually) and grapes ($3.2 billion annually) (CASS 2002). Climate change

is expected to decrease dairy production by between 7–22 percent by the end of the century (Pittock 2001). It is also expected to adversely affect the ripening of wine grapes, substantially reducing their market value (Hayhoe 2004).

Communities in the Central Valley, where agriculture is most concentrated and with a significant proportion of low-income Latino residents, would be the hardest hit by these projected declines in agricultural productivity linked to climate change.

Fewer Jobs in Tourism, an Industry Employing a High Number of Low-Income People of Color

Tourism is already quite vulnerable to market conditions because the ability to travel is heavily based on access to disposable income. Although there are no formal predictions of changes to leisure travel that exist beyond the year 2020 (UNWTO 2007), there is concern that climate change may lead to jobs being retracted and downsized (Cordova et al. 2006; UNWTO 2007). Effects of climate change on the tourism industry could be seen in the form of shorter employment periods and lower wages as the industry struggles to deal with physical, temporal, economic, and climatic issues.

In California, sea-side destinations and mountainous regions are likely to be particularly impacted (IPCC 2007; UNWTO 2007). Because of shifts in the types of recreational opportunities that will likely remain available in California due to climate change, the jobs of current tourism laborers may be at risk. In all of the major industries that have been generated by tourism—with the exception of the entertainment industry—people of color make up the majority of the workforce and could be vulnerable to layoffs and decreased pay (Figure 9) (Cordova et al. 2006). The tourism employment category comprised of the greatest proportion of people of color is "traveler accommodations" which consists of hotel and motel

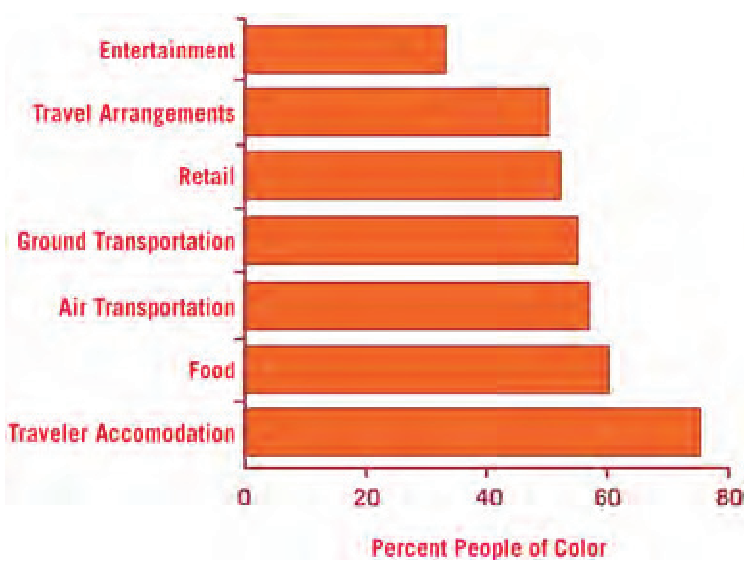


Figure 9. Percent of people of color in tourism-generated jobs, by sector, 2003 (Source: cited from Cordova 2006).

workers. It is uncertain whether these same workers, or these same demographics in general, would be hired to work in new tourism activities if the industry shifts to other geographic locations or shrinks in size.

Even excluding agriculture and tourism, industries in California that are considered heavy emitters of greenhouse gases have a workforce that is sixty percent people of color; the non-heavy emitting industries are fifty-two percent workers of color. These heavy emitting industries tend to pay slightly higher wages and be more unionized. Addressing greenhouse gas emissions without an adequate transition plan for incumbent workers and targeting opportunities for communities of color in the new "green jobs" sector could widen the racial economic divide (Buffa, et. al).

The Climate Gap in Extreme Weather Insurance

As extreme weather events such as wildfires, hurricanes and floods become more common, severe damage and destruction to homes will also increase. Swiss Re (2006) indicates that insurance losses have been on an upward trend since 1985. During the years 1987–2004 property insurance losses due to natural disasters averaged $23 billion per year and in 2005, losses rose to $83 billion, of which $60 billion was due to hurricanes Katrina, Rita, and Wilma alone (Swiss Re 2006).

Households that have home or renters' insurance can, relatively rapidly, recuperate and resume living much in the same way as prior to the disaster. In contrast, low-income communities—which are often under-insured—may spend the rest of their lives struggling to recover from property damage related to an extreme weather event (Fothergill and Peek 2004; Blaikie et al. 1994; Thomalla et al. 2006).

Further, the frequency and intensity of extreme weather events due to climate change will increase the price of disaster insurance, making it prohibitively expensive for low-income people and decreasing their ability to cope with future losses.

Finally, the disproportionate impact of extreme weather events on low-income families and people of color could exacerbate homelessness, especially in urban areas. This would be largely due to the lack of access to insurance and emergency credit, less savings, fewer personal resources, and disproportionate suffering from previous economic stress and problems (Fothergill and Peek 2004; Bolin and Bolton 1986; Tierney 1988). Moreover, increased governmental spending on infrastructure protection could directly affect low-income communities because funds may be diverted away from education, social programs, public transportation programs, health, and other economic sectors (CRAG 2002; Cordova et. al).

How to Close the Climate Gap

HOW TO CLOSE THE CLIMATE GAP

Closing the Climate Gap Begins with Policy that Leaves No One Behind.

At the federal and state level, the United States is developing comprehensive strategies to reduce climate change. Currently, the primary goal of such policy is strictly to reduce carbon emissions, the leading cause of our deteriorating atmosphere. Yet closing the climate gap also needs to be a priority. Implementing policies that protect the most vulnerable communities will better protect all Americans.

Currently, federal and state policymakers appear to be moving forward with a framework that includes capping the total amount of greenhouse gas emissions, lowering the cap over time and issuing permits as a way to ensure no one goes over the limit. Yet few of the most prominent climate change mitigation strategies close the climate gap, and in some cases, policies may potentially widen the gap.

For example, one major concern with carbon emission reduction policies is that they will be regressive because the burden of rising costs will fall disproportionately on lower-income households (Walls and Janson 1996; Hassett et al. 2008). A study by the Congressional Budget Office (2007a) shows how a program implemented to cut carbon dioxide (CO_2) emissions by 15 percent would cost 3.3 percent of the average income of households in the lowest income bracket as opposed to only 1.7 percent of the average income of households in the top income bracket.

Other policies that raise substantial climate gap issues are pollution credits allocated to facilities as well as how revenues generated from fees on carbon emissions or the auctioning of emission credits will be distributed to society and individual consumers.

Close the Climate Gap by Auctioning Permits or Establishing a Fee and Invest in Communities That Will be Hardest Hit

If emission credits are allocated for free, there is concern that these policies will be regressive. (Dutzik et al. 2007). Alternatively, under cap-and-auction or fee-based strategies, the sale of emission credits to polluters could generate sizable revenues that could be used to offset higher costs—particularly for those who can least afford it (Hepburn et al. 2006). Revenues could be distributed to the public through tax cuts, investments in clean energy, high-value investments such as transportation, or through direct periodic dividends to consumers (CBO 2007a).

Other reasons auctioning permits or establishing fees helps close the climate gap:

- Eliminates the need for emissions trading in comparison to free-allocation programs because industry is likely to buy only what it needs (Hepburn et al. 2006).
- Decreases financial incentives to keep old polluting facilities open by eliminating the grandfathering of old facilities.
- Decreases the problem of over-allocation and excessive banking and trading of emission credits.

Close the Climate Gap by Maximizing Reductions in Greenhouse Gas Emissions and Toxic Air Pollution in Neighborhoods with the Dirtiest Air.

There is enormous potential to get more for our investments in climate change reduction by focusing on the dirtiest sources that cause both climate change and health problems locally. These sources are often concentrated in neighborhoods with the highest populations of low-income families and people of color with local toxic air emissions that contribute to poor health. Policymakers have an opportunity to be efficient and effective stewards of taxpayer dollars by focusing on climate polluters disproportionately responsible for regional greenhouse gas emissions and dirtying the air in highly impacted neighborhoods.

Right now, most policymakers at the federal and state levels are missing this opportunity to close the climate gap, and may even exacerbate inequalities between affluent and poor neighborhoods by instituting greenhouse gas reduction policies that clean up the air in some places while unintentionally leaving the most vulnerable behind.

In certain circumstances, cap-and-trade, the most prominent climate policy under consideration, may reduce climate emissions and toxic pollution regionally. Yet there are no guaranteed reductions at any one source (O'Neill 2004). Communities with the dirtiest air are concerned that with the wrong approach, some polluters may maintain or increase their emissions, creating localized dirty-air hotspots even if there are regional greenhouse gas reductions overall.

Instead, if directed in the right way, measures to reduce climate emissions could also reduce other types of dangerous pollution in the neighborhoods that need it most. In California, efforts should be directed to neighborhoods in close proximity to highways, ports and other sections of the transportation and goods-movement corridors where air quality has been noted as among the worst in the state (CARB 2006; CARB 2008c; Morello-Frosch and Jesdale 2006; Morello-Frosch and Lopez 2006).

Low-income families and communities of color have a lot to gain from greenhouse gas reduction strategies because of the added local benefit of lowering toxic pollution from those same sources—but only if greenhouse gas reductions are targeted to those facilities that are located in these neighborhoods. More careful studies should be conducted to assess which climate policies would hold the greatest benefits for communities that suffer most from local air pollution (Elliott et al. 2005).

Additionally, research should characterize patterns of population exposure resulting from local sources of pollution in a variety of settings, especially in urban areas. Although methodologically difficult to develop, this could include analytical tools to track where carbon credits are being allocated and traded in order to assess the subsequent amounts of co-pollutant emissions that may increase or decrease at the local level.

Such an approach might complicate the planning and implementation of market or fee systems but the benefits for fairness and public health far outweigh the modest costs of extra complexity in the system. To facilitate this, a starting point would be developing mapping and analytical tools that allow policymakers to identify the neighborhoods with the greatest opportunities to maximize greenhouse gas emission reductions while also cleaning up toxic air pollution.

Why We Can't Afford to Focus Only on Regional Greenhouse Gas Reductions

Today, most climate policy strategies focus exclusively on lowering greenhouse gases, without regard to what other benefits we can achieve if we focus on reducing greenhouse gases from sources that also emit dangerous and toxic pollutants. In a struggling economy where most Americans continue to rank air pollution as a leading concern, working to get more health and environmental benefits from one policy protection should be a goal of efficient, effective governments.

Failure to take under strong consideration sources that contribute to both climate change and toxic air pollution can also lead to a widening of the climate gap between the health benefits achieved by some and the health consequences faced by others. It can mean that while regional air improves, the air in some neighborhoods gets dirtier.

For example, a study of the Regional Clean Air Incentives Market (RECLAIM), an emission trading system designed to lower nitrogen oxide emissions in Southern California, indicates that the program may have increased nitrogen oxide emissions in Wilmington, California, while region-wide emission levels declined (Lejano and Hirose 2005). Further, under one of the rules, licensed car scrappers were allowed to purchase old, polluting vehicles and destroy them, and in return receive emission credits by the South Coast Air Quality Monitoring District (SCAQMD) that could be sold to oil refineries (Drury et al. 1999). The majority of the emission credits were purchased by four oil companies: Unocal, Chevron, Ultramar, and GATX to avoid the cost of installing pollution-reduction technologies. The trading program led to a situation where workers and local residents of these communities were unnecessarily exposed to benzene, a known human carcinogen, and other volatile organic compounds that were contained in the emissions and that these emissions could have been remediated by pollution reduction technologies that were already in widespread use in similar port operations along the West Coast (Drury et al. 1999).

Ensuring New Fuels Don't Increase Pollution in Low-Income and Minority Communities

The lesson learned in California from the experiment with MTBE—a fuel additive that reduced air pollution, but was quickly banned after research found that it polluted drinking water—has critical implications for how we can close the climate gap.

Similarly, ethanol—a biofuel proposed for broader use by California and federal policymakers to help combat climate change—could reduce our dependence on oil. However, biofuel refineries could harm the health of adjacent communities by exposing them to the chemical and microbial byproducts of the distillation processes necessary for fuel production (Madsen 2006).

Research also predicts that some ethanol fuels may increase ozone-related deaths, hospitalization, and asthma by 9 percent in Los Angeles and 4 percent nationwide if used to power vehicles (Jacobson 2007). Low-income and minority communities, which are disproportionately clustered near highways and goods transport corridors, would bear the majority of the burden.

Lastly, it should be noted that growing crops for fuel will likely raise prices of food crops (Tenenbaum 2008). This would be most damaging to low-income consumers and low-income agricultural laborers who are most vulnerable to job loss and hunger (Tenenbaum 2008).

Other Key Recommendations to Close the Climate Gap

More research is needed to look at the rates and impacts of climate change events that are projected to occur. Identifying possible mitigation and adaptation strategies that would reduce climate-related illnesses and deaths, particularly in the most vulnerable communities, should be a priority for the regulatory community as well as policymakers.

1. **Close the Health Impacts Gap Between People of Color and the Poor, and the Rest of the Population.**

- **Focus Planning and Intervention in Poor and Minority Neighborhoods.** Because burdens of heat-related illness are borne disproportionately by groups of older residents, children, and those of low socioeconomic status (Knowlton et al. 2009; English 2007; Basu and Ostro 2008), preparedness strategies should include messages and information about avoiding extreme heat exposure that are disseminated and targeted toward parents and caregivers of young children, and the elderly (Knowlton et al. 2009). Climate change interventions to address the built environment should prioritize vulnerable groups who live in neighborhoods with high risks of heat island effects, poor housing quality and a lack of access to transportation to escape extreme weather events. These proactive strategies could go a long way to reduce the disproportionate burden of heat-related health effects on the poor and communities of color.

- **Use New Mapping Technologies to Identify Vulnerable Neighborhoods.** Differential exposures to the health-damaging impacts of climate change, such as excessive heat and extreme weather events could be examined from a geographical equity perspective by using GIS maps overlaid with vulnerability models and current socioeconomic, racial/ethnicity, and cultural group distributions in California. Interaction of these data layers should be taken into account when developing climate change policy (Elliott et al. 2005), so as to reduce the likelihood that future policies would create disproportionate burdens on already vulnerable populations.

- **Research the Potential Benefits and Harms of New Fuels.** Policymakers must take steps to better assess the effects of exposure to new fuels (i.e., ethanol) as well as increased emissions of other pollutants during combustion (Jacobson 2007) and production on those already feeling the negative impact of the climate gap. More studies must also focus on the dangers of food shortages and food price increases associated with the production of ethanol and other biofuel crops (Tenenbaum 2008). Obtaining this information could illuminate whether biofuels are a viable solution or would simply widen the climate gap.

- **Measure the Success of Mitigation Strategies by Whether They Protect Everyone.** Runaway climate change, where positive feedback loops drive warming irrespective of human mitigation actions, could occur (NRC 2002; Gjerde et al. 1999; Pizer 2003). As we enact policies to reduce the chances that full scale global warming will occur, we must also develop downstream adaptation strategies such as infrastructure protection, efficient and effective air-cooling technologies, and better surveillance for emerging infectious diseases. If we don't pay close attention to the climate gap from the beginning, disparities between populations of differing socioeconomic status will likely increase.

- **Design Research That Identifies Opportunities for Targeting Greenhouse Gas Reductions to Reduce Toxic Air Emissions in Highly Polluted Neighborhoods.** In order to design proper policies and monitor the efficacy of climate policies, future research should: (1) explore how to characterize, quantify, and maximize reducing both climate and toxic pollution in existing or new "toxic hotspots"; (2) determine the geographic scale at which these evaluations can take place given the data available; and (3) identify the data necessary to improve future evaluations.

2. **Develop Policies that Close the Gap Between the Economic Disparities Faced by People of Color and the Poor, and the Rest of the Population.**

Because climate change and climate solutions are likely to negatively impact certain economic sectors more than others, policies must take into account how low-income families and people of color will be affected and what more can be done to help them adjust to major economic shifts. Some important policy directions include:

- Examine which greenhouse gas source sectors hold the most pollution reduction promise without economic disruption, both in terms of overall emission reductions and environmental health benefits (Prasad 2008);
- Anticipate and address inevitable job shifts and retraining needs to maximize opportunities for low-income communities and communities of color to successfully transition to and benefit from a new, clean energy economy;
- Ensure that revenue generated from climate policy will help high-poverty neighborhoods absorb the higher prices for energy and other basic necessities.

3. **Close the Conversation Gap.**

Because climate change will affect some populations more than others, it is important to capture the specific vulnerabilities of different neighborhoods. Local expertise, community wisdom, and other contextual information are important to supplement technical knowledge. Researchers hoping to generate climate change-impact knowledge that is sensitive to community-specific concerns should integrate community participation in their studies (Morello-Frosch et al. 2005; Minkler and Wallerstein 2003; Coburn J. 2009). To proactively address the climate gap, ensure the effectiveness of preparedness and adaptation strategies and alleviate environmental health inequalities, agency officials and policymakers must ensure that vulnerable communities play a prominent role in shaping future solutions to climate change in California (Elliott et al. 2005).

But it's more than just the regulatory agencies and affected communities. Policy differences between those who favor "cap and trade" vs. those who support carbon fees have led to tensions between advocates that share the goals of protecting the planet and protecting the poor. Concerns about whether climate policy will cost or create jobs have led to strains between those working to recover the economy and those working to save the planet. These tensions have led to a conversation gap.

One of the first steps to addressing the climate gap is addressing this conversation gap. Working together — across sectors and constituencies—and insuring that the effects of climate change and climate policy are not unequally felt by the poor and communities of color is exactly the recipe we need to cool the planet and create economic opportunities and health benefits for everyone.

CONCLUSIONS

This analysis of available data connects the dots between some facts we've known and others we haven't to reveal a hidden climate gap.

The climate gap means that climate change will more seriously affect the health of communities that are least likely to cope with, resist, and recover from the impacts of extreme weather events and potential increases in air pollution compared to the rest of the population (Knowlton et al. 2004). Further, low-income and minority communities could be more seriously harmed by the economic shocks associated with climate change both in price increases for basic necessities (i.e., water, energy, and food) and by threats of job loss due to economic and climatic shifts that affect industries such as agriculture and tourism (Stern 2006).

Policymakers have a clear choice: ignoring the climate gap could reinforce and amplify current as well as future socioeconomic and racial disparities. On the other hand, policymakers can proactively close the climate gap through strategies that address the regressive economic and health impacts of climate change, and that lift all boats by ensuring that everyone shares equally in the benefits of climate solutions, and no one is left bearing more than their fair share of the burdens.

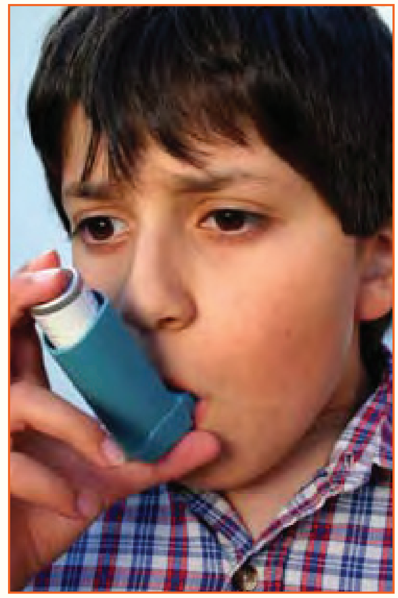
APPENDIX

California's Climate Policy: Moving in the Right Direction, but Room for Improvement on Reducing Climate and Toxic Pollution in the Dirtiest Neighborhoods

Two critically dangerous sources of air pollution that will be addressed through greenhouse gas reduction measures in California are nitrogen oxide (NOx), a precursor of ozone formation and particulate matter, which contributes to 3,500 premature deaths every year, along with a handful of illnesses (Bailey et al. 2008).

Thanks to California's climate policy, nitrogen oxide is expected to be reduced by 86,000 tons by 2020, more than three quarters of which will be achieved through regulatory requirements for cleaner cars and trucks (Bailey et al. 2008). Projected particulate matter and nitrogen oxide reductions together are estimated to prevent approximately 780 premature deaths, 11,000 fewer cases of asthma-related and other lower respiratory symptoms, 980 fewer cases of acute bronchitis, and 77,000 fewer work days lost in California (CARB 2008b). These health benefits are projected to be valued at $1.4 billion to $2.3 billion in 2020 (Bailey et al. 2008). Moreover, actual health and economic benefits of these climate change policies may be underestimated because many emission reduction measures and public health benefits such as reduced cancer risks have not been accounted for (Bailey et al. 2008).

Known carcinogens that may be reduced are benzene, formaldehyde, and toluene, predominantly produced directly and indirectly by mobile sources and by the refining and combustion of fossil fuels (EPA 2005). These air toxics are important to closing the climate gap, as several studies indicate that communities of color and the poor bear a disproportionate burden of health risks associated with air toxics exposures (CARB 2008c; Morello-Frosch and Jesdale 2006; Morello-Frosch et al. 2002; Morello-Frosch and Shenasa 2006).



California's Early Action Measures Could Go a Long Way to Closing the Climate Gap

The California Air Resources Board's plans also include Early Action Measures (EAMs) that could be enforceable on or before 2010 (HSC §38560.5, Health and Safety Code Section 38560–38565). These policies include regulations affecting landfills, motor vehicle fuels, refrigerant in cars, port operations, and many other sources in 2007, including nine Discrete Early Action measures for which the CARB will adopt regulations by the end of 2009 (CARB 2007; CARB 2008b). It is estimated that if all Early Action Measures are adopted together with the additional proposed measures, 52,000 tons of nitrogen oxide and particulate matter pollution would be removed from the air, which would lead to a further decrease in exposure to unhealthy local pollution. It would also prevent an additional $1.1 billion to $1.8 billion in health costs in the year 2020 alone (Bailey et al. 2008).

These measures could potentially benefit poor and minority neighborhoods that tend to host significant industrial and transportation emission sources. However, these projected benefits have only been quantified at the state level, and more work needs to be done by the Air Resources Board and other researchers to examine more closely how regional greenhouse gas reductions will impact the distribution of toxic air pollution reductions in neighborhoods struggling w ith the dirtiest air. This assessment will be essential to closing the climate gap in California.

Health Endpoint	Health Benefits of Existing Measures and 2007 SIP *mean*	Health Benefits of Recommendations in the Proposed Scoping Plan *mean*
Avoided Premature Death	3,700	400
Avoided Hospital Admissions for Respiratory Causes	770	84
Avoided Hospital Admissions for Cardiovascular Causes	1,400	150
Avoided Asthma and Lower Respiratory Symptoms	110,000	11,000
Avoided Acute Bronchitis	8,700	910
Avoided Work Loss Days	620,000	67,000
Avoided Minor Restricted Activity Days	3,600,000	380,000

Table 2. Estimates of California air quality-related health benefits in 2020 if AB 32 Implementation Measures are Implemented. (Source: CARB 2008c)

References

Ackerman, F., and E. Stanton. 2008. *The Cost of Climate Change: What We'll Pay if Global Warming Continues Unchecked*. NRDC: New York, New York.

ALA (American Lung Association). 2008. State of the Air: 2008. American Lung Association: New York.

American Community Survey. 2007. 2007 American Community Survey 1-Year Estimates. Washington, D.C.

Bailey, D., K. Knowlton, and M. Rotkin-Ellman. 2008. *Boosting the Benefits: Improving air quality and health by reducing global warming pollution in California*. Natural Resources Defense Council: New York, New York.

Basu, R., and B. D. Ostro. 2008. "A Multicounty Analysis Identifying the Populations Vulnerable to Mortality Associated with High Ambient Temperature in California." *Am J Epidemiol* 168(6): 632–637.

Basu, R., and J. M. Samet. 2002. "Relation between elevated ambient temperature and mortality: A review of the epidemiologic evidence." *Epidemiol Rev* 24(2): 190–202.

Bernard, S. M., J. M. Samet, A. Grambsch, K. L. Ebi, and I. Romieu. 2001. "The potential impacts of climate variability and change on air pollution-related health effects in the United States." *Environ Health Perspect* 109 Suppl 2: 199–209.

Blaikie, P., T. Cannon, I. Davis, and B. Wisner. 1994. *At Risk: Natural Hazards, People's Vulnerability, and Disasters*. Routledge, New York.

BLS (Bureau of Labor Statistics). 2002. Consumer expenditure survey. Washington D.C.

Bolin, R., and P. Bolton. 1986. *Race, religion, and ethnicity in disaster recovery, program on environment and behavior*. University of Colorado, Institute of Behavioral Science, Natural Hazards Research and Applications Information Center: Boulder, Colorado.

Boyce, J., and M. Riddle. 2007. *Cap and Dividend: How to Curb Global Warming While Protecting the Incomes of American Families*. Political Economy Research Institute.

Buffa, Andrea, Zabin, Carol, Brown, Cheryl and Graham-Squire, Dave. 2008. *California's Global Warming Solutions Act of 2006: A Background Paper for Labor Unions* (2008 University of California, Berkeley Center for Labor Research and Education. Available at: http://laborcenter.berkeley.edu/greenjobs/AB32_background_paper08.pdf

CARB (California Air Resources Board). 2006. Quantification of the Health Impacts and Economic Valuation of Air Pollution from Ports and Goods Movement in California. Appendix A in Emission Reduction Plan for Ports and Goods Movement (GMERP).

CARB. 2007. Expanded list of early action measures to reduce greenhouse gas emissions in California recommended for board consideration. California Air Resources Board. Sacramento, California.

CARB. 2008a. *Methodology for Estimating Premature Deaths Associated with Long-term Exposure to Fine Airborne Particulate Matter in California*. California Air Resources Board. Sacramento, California.

CARB. 2008b. *Climate change proposed scoping plan: A framework for change*. California Air Resources Board. Sacramento, California.

CARB. 2008c. *Diesel particulate matter health risk assessment for the West Oakland community: Preliminary summary of results*. California Environmental Protection Agency, Air Resources Board, Sacramento, California.

CASS. 2002. California agriculture statistical review. Sacramento, California. California Agriculture Statistics Service.

CBO (Congressional Budget Office). 2007a. *Trade-offs in allocating allowances for CO2 emissions*. Washington, D.C.

CBO. 2007b. Trade-offs in allocating allowances for CO2 emissions, in *A series of Issue Summaries*. Congressional Budget Office. Congressional Budget Office: Washington, D.C.

Cifuentes. L., V. H. Borja-Aburto, N. Gouveia, G. Thurston, and D. L. Davis. 2001. "Assessing the health benefits of urban air pollution reductions associated with climate change mitigation (2000–2020): Santiago, Sao Paulo, Mexico City, and New York City." *Environ Health Perspect* 109(Suppl 3): 419–425.

Confalonieri, U., and B. Menne. 2007. Human health. Climate Change 2007. *Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, O. F. C. M. L. Parry, J. P. Palutikof, P. J. van der Linden, and C. E. Hanson, eds. Cambridge, UK.: Cambridge University Press 391–431.

Cordova, R., M. Gelobter, A. Hoerner, J. R. Love, A. Miller, C. Saenger, and D. Zaidi. 2006. *Climate Change in California: Health, Economic and Equity Impacts*. Redefining Progress: Oakland, California.

CRAG (California Regional Assessment Group). 2002. *Preparing for a changing climate: The potential consequences of climate variability and change for California*. Washington, D.C.: U.S. Global Change Research Program.

Donoghue, E., M. Nelson, G. Rudis, R. I. Sabogal, J. T. Watson,and G. Huhn. 2003. "Heat-related deaths - Chicago, Illinois, 1996–2001, and United States, 1979–1999." *MMWR Morb Mortal Wkly Rep* 52: 610–613.

Corburn J. (2009) Cities, climate change and urban heat island mitigation: Localizing global environmental science. Urban Studies 47(2) In press.

Curriero, F. C., K. S. Heiner, J. M. Samet, S. L. Zeger, L. Strug, and J. A. Patz. 2002. "Temperature and mortality in 11 cities of the eastern United States." *Am J Epidemiol* 155(1): 80–87.

Drechsler, D., N. Motallebi, M. Kleema, D. Cayan, K. Hayhoe, L. S. Kalkstein, N. Miller, S. C. Sheridan, J. Jin, and R. A. VanCuren. 2006. *Public health-related impacts of climate change in California*. California Energy Commission.

Dutzik, T., R. Sargent, and F. Figdor. 2007. *Cleaner, cheaper, smarter: The case for auctioning pollution allowances in a global warming cap-and-trade program*. U.S. PIRG Education Fund.

Drury R, Belliveau M, Kuhn J, Bansal S. 1999. “Pollution trading and environmental injustice: Los Angeles’ failed experiment in air quality.” *Duke Environmental Law and Policy Forum* 9:231–289.

EDD (California Employment Development Department). 2004. Occupational Employment (2002) and Wage (2003) Data, Occupational Employment Statistics Survey Results. Sacramento, California.

EDD. 2004. “Occupational Employment (2002) and Wage (2003) Data, Occupational Employment Statistics Survey Results.” 2004, from www.calmis.cahwnet.gov/file/occup$/oeswages/Cal$oes2003.htm.

Elliott, M., C. Saenger, and A. Hoerner. 2005. *Latinos and climate change: A scoping report*. Redefining Progress: Oakland, California.

English, P., K. Fitzsimmons, S. Hoshiko, T. Kim, H. G. Margolis, T. E. McKone, M. Rotkin-Ellman, G. Solomon, R. Trent, and Z. Ross. 2007. *Public health impacts of climate change in California: Community vulnerability assessments and adaptation strategies*. Climate Change Public Health Impacts Assessment and Response Collaborative, California Department of Public Health Institute, Richmond, California.

EPA. 2005. *Toxics release inventory (TRI) basis of OSHA carcinogens*. United States Environmental Protection Agency, Washington, D.C.

Epstein, P., and C. Rodgers. 2004. *Inside the greenhouse: The impacts of CO2 and climate change on public health in the inner city*. Center for Health and the Global Environment: Boston, Massachusetts.

Hajat, S., B. Armstrong, M. Baccini, A. Biggeri, L. Bisanti, and A. Russo. 2006. “Impact of high temperature on mortality: Is there an added heat wave effect?” *Epidemiology* 17: 632–638.

Hayhoe, K., D. Cayan, C. B. Field, P. C. Frumhoff, E. P. Maurer, N. L. Miller, S. C. Moser, S. H. Schneider, K. N. Cahill, E. E. Cleland, L. Dale, R. Drapek, R. M. Hanemann, L. S. Kalkstein, J. Lenihan, C. K Lunch, R. P. Neilson, S. C. Sheridan, and J. H. Verville. 2004. “Emissions pathways, climate change, and impacts on California.” *Proc Natl Acad Sci U S A* 101(34): 12422–12427.

Fothergill, A., and L. Peek. 2004. “Poverty and disasters in the United States: A review of recent sociological findings.” *Natural Hazards Journal* 32(1): 89–110.

Frumkin, H., A. J. McMichael, and J. J. Hess. 2008a. “Climate change and the health of the public.” *Am J Prev Med* 35(5): 401–402.

Frumkin H., J. Hess, G. Luber, J. Malilay, and M. McGeehin. 2008b. “Climate change: The public health response.” *Am J Public Health* 98(3): 435–445.

Gage, K. L., T. R. Burkot, R. J. Eisen, and E. B. Hayes. 2008. “Climate and vectorborne diseases.” *Am J Prev Med* 35(5): 436–450.

Gjerde, J., S. Grepperud, and S. Kverndokk. 1999. “Optimal climate policy under the probability of a catastrophe.” *Resource and Energy Economics* 21: 289–317.

Goulder, L. 1995. “Environmental taxation and the double dividend: A reader's guide.” *International Tax and Public Finance* 2:157–183.

Greenberg, J. H., J. Bromberg, C. M. Reed, T. L. Gustafson, and R. A. Beauchamp. 1983. “The epidemiology of heat-related deaths, Texas—1950, 1970–79, and 1980.” *Am J Public Health* 73(7): 805–807.

Greenough, P. G., and T. D. Kirsch. 2005. “Hurricane Katrina. Public health response—assessing needs.” *N Engl J Med* 353(15): 1544–1546.

Hassett, K., A. Mathur, and G. Metcalf. 2008. *The incidence of a U.S. carbon tax: A lifetime and regional analysis*. Cambridge, Massachusetts: American Enterprise Institute for Public Policy Research.

Hepburn, C., M. Grubb, K. Neuhoff, F. Matthes, and M. Tse. 2006. “Auctioning of EU ETS phase II allowances: How and why?” *Climate Policy* 6(1): 137–160.

HSC §38560.5, Health and Safety Code Section 38560–38565: Sacramento, California.

IPCC (Intergovernmental Panel on Climate Change). 2007. *Working Group I Report: The Physical Science Basis.*

Jacobson, M. Z. 2007. “Effects of ethanol (E85) versus gasoline vehicles on cancer and mortality in the United States.” *Environ Sci Technol* 41(11): 4150–4157.

Jacobson, M. 2008. “On the causal link between carbon dioxide and air pollution mortality.” *Geophys Res. Let.* 35(L03809).

Juhwan Lee, Steven De Gryze, and Johan Six “Effect of Climate Change on Field Crop Production in the Central Valley of California.” Report from California Climate Change Center, March 2009, Draft Paper CEC-500-2009-041-D. Available at: http://www.energy.ca.gov/2009publications/CEC-500-2009--041-D.PDF

Kilbourne, E. 1997. Heat waves and hot environments. *In The Public Health Consequences of Disasters.* E. Noji, Editor. New York, New York: Oxford University Press.

Kinney, P. L., M. S. O'Neill, M. L. Bell, and J. Schwartz. 2008. “Approaches for estimating effects of climate change on heat-related deaths: Challenges and opportunities.” *Environmental Science & Policy* 11(87–96).

Knowlton, K., J. E. Rosenthal, C. Hogrefe, B. Lynn, S. Gaffin, R. Goldberg, C. Rosenzweig, K. Civerolo, J. Y. Ku, and P. L. Kinney. 2004. "Assessing ozone-related health impacts under a changing climate." *Environ Health Perspect* 112(15): 1557–1563.

Knowlton, K., M. Rotkin-Ellman, G. King, H. G. Margolis, D. Smith, G. Solomon, R. Trent, and P. English. 2009. The 2006 California Heat Wave: Impacts on Hospitalizations and Emergency Department Visits. *Environ Health Perspect* 117(1): 61–67.

Kovats, R. S., and S. Hajat. 2008. "Heat stress and public health: A critical review." *Annu Rev Public Health* 29: 41–55.

Kunzli, N., R. McConnell, D. Bates, T. Bastain, A. Hricko, F. Lurmann, E. Avol, F. Gilliland, and J. Peters. 2003. "Breathless in Los Angeles: The exhausting search for clean air." *Am J Public Health* 93(9): 1494–1499.

Lejano, R., and R. Hirose. 2005. "Testing the assumptions behind emissions trading in non-market goods: The RECLAIM program in Southern California." *Environmental Science & Policy* 8:367–377.

Madsen, A. M. 2006. "Exposure to airborne microbial components in autumn and spring during work at Danish biofuel plants." *Ann Occup Hyg* 50(8): 821–831.

Medina-Ramon, M., A. Zanobetti, D. P. Cavanagh, and J. Schwartz. 2006. "Extreme temperature and mortality: Assessing effect modification by personal characteristics and specific cause of death in a multi-city case only analysis." *Environ Health Perspect* 114:1331–1336.

Minkler, M., and N. Wallerstein. 2003. *Community-based Participatory Research for Health*. San Francisco, California: Jossey-Bass.

Luginbuhl RC, Jackson LL, Castillo DN, Loringer KA. 2008. Heat-related deaths among crop workers—United States, 1992–2006. MMWR Morb Mortal Wkly Rep 57:649–653.

Morello-Frosch, R. A., and B. Jesdale. 2006. "Separate and Unequal: Residential Segregation and Estimated Cancer Risks Associated with Ambient Air Toxics in U.S. Metropolitan Areas." *Environmental Health Perspectives* 114(3): 386–393.

Morello-Frosch, R., and B. Jesdale. 2008. Unpublished impervious surface and tree cover data. Data for this analysis was derived from: U.S. Geological Survey's National Land Cover Dataset 2001. www.mrlc.gov/nlcd.php, accessed on June 20, 2007; and ESRI's ArcMap census boundary files www.census.gov/geo/www/cob/bdy_files.html, accessed June 6, 2008.

Morello-Frosch, R., and R. Lopez. 2006. "The riskscape and the color line: Examining the role of segregation in environmental health disparities." *Environmental Research* 102: 181–196.

Morello-Frosch, R., and E. Shennasa. 2006. "The Environmental 'Riskscape' and Social Inequality: Implications for Explaining Maternal and Child Health Disparities." *Environmental Health Perspectives* 114(8): 1150–1153.

Morello-Frosch, R., M. Pastor Jr., C. Porras, and J. Sadd. 2002. "Environmental Justice and Regional Inequality in Southern California: Implications for Future Research." *Environmental Health Perspectives* 110(supplement 2): 149–154.

Morello-Frosch, R., M. Pastor, J. Sadd, C. Porras, and M. Prichard. 2005. Citizens, Science, and Data Judo: Leveraging Community-based Participatory Research to Build a Regional Collaborative for Environmental Justice in Southern California. In *Methods for Conducting Community-Based Participatory Research in Public Health*, B. Israel, et al., editors. University of Michigan, Jossey-Bass Press.

Naughton, M. P., A. Henderson, M. C. Mirabelli, R. Kaiser, J. L. Wilhelm, S. M. Kieszak, C. H. Rubin, and M. A. McGeehin. 2002. "Heat-related mortality during a 1999 heat wave in Chicago." *Am J Prev Med* 22(4): 221–227.

NRC (National Research Council). *Abrupt Climate Change: Inevitable Surprises*. Committee on Abrupt Climate Change. Washington, D.C.: National Academy Press.

Oke, T. 1973. "City size and the urban heat island." *Atmos. Environ.* 7:769–779.

O'Neill, C. 2004. "Mercury, risk and justice." *ELR News and Analysis* 34: 11070–11115.

O'Neill, M. S., P. L. Kinney, and A. J. Cohen. 2008. "Environmental equity in air quality management: Local and international implications for human health and climate change." *J Toxicol Environ Health* A 71(9-10): 570–577.

O'Neill, M. S., A. Zanobetti, and J. Schwartz. 2003. "Modifiers of the temperature and mortality association in seven US cities." *Am J Epidemiol* 157(12): 1074–1082.

O'Neill, M. S., A. Zanobetti, and J. Schwartz. 2005. "Disparities by race in heat-related mortality in four US cities: The role of air conditioning prevalence." *J Urban Health* 82(2): 191–197.

Ostro BD, Roth LA, Green RA, Basu R (2009) Estimating the Mortality Effect of the July 2006 Heat Wave. A Report from the Climate Change Center, Draft Paper. March 2009, CEC-500-2009-036-D. Available at: http://www.energy.ca.gov/2009publications/CEC-500-2009-036/CEC-500-2009-036-D.PDF

Patz, J. A., and S. H. Olson. 2006. "Climate change and health: Global to local influences on disease risk." *Ann Trop Med Parasitol* 100(5-6): 535–549.

Poumadere, M., C. Mays, S. Le Mer, and R. Blong. 2005. "The 2003 heat wave in France: Dangerous climate change here and now." *Risk Anal* 25(6): 1483–1494.

Phelan, J. C., B. G. Link, A. Diez-Roux, I. Kawachi, and B. Levin. 2004. "Fundamental causes' of social inequalities in mortality: A test of the theory." *J Health Soc Behav* 45(3): 265–285.

Pittock, B., D. Wratt, R. Basher, B. Bates, M. Finlayson, H. Gitay, A. Woodward, A. Arthington, P. Beets, B. Biggs, et al. 2001. *Climate Change 2001: Impacts, Adaptation, and Vulnerability*. Cambridge, U.K.: Cambridge University Press.

Pizer, W. 2003. Climate change catastrophes. Resources for the Future Discussion Paper.

Prasad, S. 2008. Environmental Justice: Draft CEC PIER-EA Discussion Paper. California Energy Commission, Public Interest Energy Research: Sacramento, California.
Redefining Progress. 2006. *Climate Change in California: Health, Economic and Equity Impacts.*

Reiter, P. 2001. "Climate change and mosquito-borne disease." *Environ Health Perspect* 109(Suppl 1): 141–161.

Rogot, E., P. D. Sorlie, and E. Backlund. 1992. "Air-conditioning and mortality in hot weather." *Am J Epidemiol* 136(1): 106–116.

Schulz, A. J., D. R. Williams, B. A. Israel, and L. B. Lempert. 2002. "Racial and spatial relations as fundamental determinants of health in Detroit." *The Milbank Quarterly* 80(4): 677–707.

Shonkoff S, Morello-Frosch R, Pastor M, Sadd J (2009) Environmental Health and Equity Impacts from Climate Change and Mitigation Policies in California: A Review of the Literature. Publication # CEC-500-2009-038-D Available at: http://www.climatechange.ca.gov/publications/cat/index.html

Semenza, J. C., C. H. Rubin, K. H. Falter, J. D. Selanikio, W. D. Flanders, H. L. Howe, and J. L. Wilhelm. 1996. "Heat-related deaths during the July 1995 heat wave in Chicago." *N Engl J Med* 335(2): 84–90.

Stern, N. 2006. *Stern Review on the Economics of Climate Change*. London.

Swiss Re. 2006. *Natural catastrophes and man-made disasters 2005: High earthquake casualties, new dimension in windstorm losses*.

Tenenbaum, D. 2008. "Food vs. fuel: Diversion of crops could cause more hunger." *Environ Health Perspect* 116(6): A254–A257.

Thomalla, F., and T. Downing, E. Spanger-Siegfried, G. Han, and J. Rockström. 2006. "Reducing hazard vulnerability: Towards a common approach between disaster risk reduction and climate adaptation." *Disasters* 30(1): 39–48.

Tierney, K. 1988. "The Whittier Narrows, California earthquake of October 1, 1987 – Social aspects." *Earthquake Spectra* 4(1): 11–23.

UNWTO (United Nations World Tourism Organization). 2007. Climate Change and Tourism: Proceedings of the 1st International Conference on Climate Change and Tourism, Djerba, Tunisia, 9–11 April 2003.

USCB (U.S. Census Bureau). 2004. Current Housing Reports, American Housing Survey for the Los Angeles-Long Beach Metropolitan Area: 2003.

USCB. 2005. California — County. Percent of People Below Poverty Level in the Past 12 Months (For Whom Poverty Status is Determined). Washington, D.C.: United States Census Bureau.

Vandentorren, S., F. Suzan, S. Medina, M. Pascal, A. Maulpoix, J. C. Cohen, and M. Ledrans. 2004. "Mortality in 13 French cities during the August 2003 heat wave." *Am J Public Health* 94(9): 1518–1520.

Walls, M., and J. Hanson. 1996. Distributional Impacts of an Environmental Tax Shift: The Case of Motor Vehicle Emissions Taxes. Resources for the Future: Washington, D.C.

Whitman, S., G. Good, E. R. Donoghue, N. Benbow, W. Shou, and S. Mou. 1997. "Mortality in Chicago attributed to the July 1995 heat wave." *Am J Public Health* 87(9): 1515–1518.

Williams, D. R., and C. A. Collins. 2001. "Racial residential segregation: A fundamental cause of racial disparities in health."

*Public Health Report*s 116: 404–416.

The Climate Gap Report

EXHIBIT 2

Arnold Schwarzenegger
Governor

CLIMATE CHANGE, EXTREME HEAT, AND ELECTRICITY DEMAND IN CALIFORNIA

PIER PROJECT REPORT

Prepared For:
California Energy Commission
Public Interest Energy Research Program

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Texas Tech University
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Preface

The Public Interest Energy Research (PIER) Program supports public interest energy research and development that will help improve the quality of life in California by bringing environmentally safe, affordable, and reliable energy services and products to the marketplace.

The PIER Program, managed by the California Energy Commission (Energy Commission), conducts public interest research, development, and demonstration (RD&D) projects to benefit California's electricity and natural gas ratepayers. The PIER Program strives to conduct the most promising public interest energy research by partnering with RD&D entities, including individuals, businesses, utilities, and public or private research institutions.

PIER funding efforts are focused on the following RD&D program areas:

- Buildings End-Use Energy Efficiency
- Energy-Related Environmental Research
- Energy Systems Integration
- Environmentally Preferred Advanced Generation
- Industrial/Agricultural/Water End-Use Energy Efficiency
- Renewable Energy Technologies
- Transportation

In 2003, the California Energy Commission's Public Interest Energy Research (PIER) Program established the **California Climate Change Center** to document climate change research relevant to the states. This Center is a virtual organization with core research activities at Scripps Institution of Oceanography and the University of California, Berkeley, complemented by efforts at other research institutions. Priority research areas defined in PIER's five-year Climate Change Research Plan are: monitoring, analysis, and modeling of climate; analysis of options to reduce greenhouse gas emissions; assessment of physical impacts and of adaptation strategies; and analysis of the economic consequences of both climate change impacts and the efforts designed to reduce emissions.

The California Climate Change Center Report Series details ongoing Center-sponsored research. As interim project results, the information contained in these reports may change; authors should be contacted for the most recent project results. By providing ready access to this timely research, the Center seeks to inform the public and expand dissemination of climate change information, thereby leveraging collaborative efforts and increasing the benefits of this research to California's citizens, environment, and economy.

Climate Change, Extreme Heat, and Energy Demand in California is the final report for the Assessing Potential Impacts of Climate Change in California project (contract number 500-99-013, work authorization number 119) conducted by Lawrence Berkeley National Laboratory, Texas Tech University, and the University of California, Berkeley.

For more information on the PIER Program, please visit the Energy Commission's website www.energy.ca.gov/pier/ or contract the Energy Commission at (916) 654-5164.

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Abstract

This study analyzed the relationship among climate change, extreme heat, and electricity demand in California through the use of atmosphere-ocean general circulation models. These model-based projections of temperature over the coming century were forced by three scenarios from the *Intergovernmental Panel on Climate Change Special Report on Emissions Scenarios*. These analyses indicate that extreme heat events in California will increase rapidly, exceeding the rate of increase in mean temperature. *Extreme heat* is defined here by the 90 percent exceedance probability (T90) of the warmest summer days under the current climate. The number of extreme heat days in Los Angeles, where T90 is currently 95°F, may increase from the present-day value of 12 days per year up to 96 days per year by 2100, implying current heat wave conditions may last for the entire summer. Projected increases in extreme heat under the higher A1fi scenario by 2070–2099 tend to be 20–30 percent higher than those projected under the lower B1 scenario. These findings, combined with observed relationships between high temperature and electricity demand for air-conditioning, suggest potential shortfalls in transmission and supply during more frequent future T90 peak electricity demand periods. Electricity response to recent extreme heat events suggests that peak electricity demand will further challenge planned supply capacities when population and income growth are taken into account.

Keywords: California, climate change, extreme heat, electricity demand, heat wave

Executive Summary

Introduction

California is one of the world's largest economies and a world leader in energy efficiency and demand-side management practices. Statewide, electricity demand per capita has remained nearly flat over the last few decades, partly due to energy efficiency incentives. However, California's aggregate energy demand is growing rapidly, spurred by rapid population growth, especially in the warm Central Valley, and an overall increase in air conditioner use.

Over the twenty-first century, the frequency of extreme heat events for major cities in heavily air-conditioned California is projected to increase rapidly and, with it, peak electricity demand for air conditioning. In 2004, for example, 30 percent of California peak electricity demand was attributable to residential and commercial air conditioning use alone. The upward trend in aggregate peak demand in California is expected to approach or exceed 67 gigawatts (GW) in 2016, which is a 1.35 percent per year increase since 2000. The anticipated population growth underlying these forecasts over the same period is 1.30 percent, indicating that demand growth is expected to very slightly outpace population growth. During summertime extreme heat days in California, the use of air conditioning and other cooling appliances increases electricity load near-linearly with higher temperatures.

Purpose

Electricity in California is a resource already under stress. Over the coming century, projected increases in both mean and extreme temperatures are projected to challenge California's electricity supply, particularly during times of peak demand. This assessed the likely magnitude of expected changes, given present-day population and technology.

Project Objective

This study's objective was to quantify the impacts of extreme heat days on peak electricity demand through the use of atmosphere-ocean general circulation models. These model-based projections of temperature over the coming century were forced by three scenarios from the *Intergovernmental Panel on Climate Change Special Report on Emissions Scenarios:* the higher emission scenario (A1fi, fossil intensive, with rapid technological and economic growth); mid-high emission scenario (A2, a heterogeneous world, with regionally oriented development and slower growth), and lower emission scenario (B1, a convergent world that transitions rapidly to an information-based, rather than material-based, economy). To this end, the researchers first calculated the historical 1961–1990 maximum temperature exceedance threshold for the 10 percent warmest June through September (JJAS) days—the defining threshold referred to as *T90*. The T90 values represent an important metric in California energy capacity analyses and are often described as the 1-in-10 JJAS high temperature days. In addition to the T90 values, the researchers also calculated average JJAS cooling degree days (CDD). Cooling degree day values are a common metric used to estimate the energy requirements for air conditioning, and they are calculated using the equation CDD = (Ta - Tac)*days, where *Ta* is the daily mean near-surface air temperature, *Tac* = 65°F (18°C) is an average daily-mean temperature threshold for human thermal comfort, and *days* is the number of days with temperatures exceeding Tac.

Project Outcomes

Increases in temperature extremes and variance are projected to exceed the rate of increase in mean temperature due to climate change over the coming century. Furthermore, the degree of change expected depends critically on the emissions pathway followed over that time; that is, the technological, social, and political decisions made over that time frame will affect emissions and their effect on the climate.

Overall, projected increases in extreme heat under the higher A1fi emission scenario by 2070–2099 tend to be 20–30 percent higher than those projected under the lower B1 emission scenario. Increases range from approximately double the historical number of days for inland California cities (such as Sacramento and Fresno) and up to four times present-day levels for previously temperate coastal cities (such as Los Angeles and San Diego), implying that current-day "heat wave" conditions may dominate summer months—and patterns of electricity demand—in the future. When the projected extreme heat and observed relationships between high temperature and electricity demand for California were mapped onto current electricity availability, maintaining technology and population constant for demand-side calculations, researchers found a potential for electricity deficits as high as 17 percent during T90 peak electricity demand periods.

Conclusions

All indicators point to increases in summer electricity demand in California, even when confounding factors such as increased population and market saturation of air conditioning are disregarded. Through calculation of projected increases in extreme heat and electricity demand, this research quantified the difference in potential impacts resulting from lower and higher emissions scenarios. Model uncertainties notwithstanding, extreme heat and associated human health risks and electricity demands under the B1 lower emissions scenario are significantly lower than those projected to occur under the higher A2 and A1fi scenarios. Calculations of electricity demand under a range of human comfort levels also highlight the potential for adaptation to play a major role, reducing projected increases in electricity demand by roughly one third for inland cities, and by as much as 95 percent for cooler coastal cities.

Recommendations

Alternative technologies such as solar photovoltaic electricity generation represent an important future technology for this region, with electricity production being proportional to solar radiation and thus closely matching summer peak electricity demand. Technologies such as these have the potential to reduce the cost associated with increased demand for cooling under a warmer climate without increasing emissions of greenhouse gases that are causing the problem in the first place.

Benefits to California

The influence of climate change on extreme heat and electricity demand in California and other similar air-conditioned regions is likely to challenge current-day electricity providers, spur conservation and adaptation measures, and emphasize the potential for emissions mitigation efforts such as those already adopted by the State of California to reduce projected impacts through following a lower emissions pathway worldwide.

1.0 Introduction

Since 1980, U.S. electricity demand has increased by more than 75%, with the largest increase in residential and commercial sectors for space heating and cooling. As the southwestern United States becomes more populated and extreme heat days become more frequent, electricity demand will continue to rise. A 2005 Government Accountability Office report (GAO 2005) on meeting energy demand in the twenty-first century states that the United States accounts for 5% of the world's population, yet consumes 25% of the annual energy used worldwide. The GAO report concludes that due to consumer choices of high consumption, all major fuel sources face environmental, economic, or other constraints or trade-offs in meeting projected demand. Clear and consistent policy is therefore needed to guide energy markets, suppliers, and consumers.

The nation's energy infrastructure, its refinery capacity, and electricity line transmission system have not adequately kept up with peak demand, and electricity supply shortfalls have resulted. Electricity generation and transmission deregulation have compounded these problems, as remote transmission and energy gaming have pushed electricity flow up to and beyond the capacity limit, often resulting in electricity supply failure. This has already occurred during extreme summer heat events over the last several years, most notably in the summer of 2003, when a system failure resulted in the largest blackout in U.S. history, leaving as many as 50 million people without power for several days.

In addition to increasing electricity demand, significant increases in the frequency, intensity, and duration of summertime extreme heat days are also projected due to climate change (Houghton et al. 2001; Hayhoe et al. 2004; Tebaldi et al. 2006; Miller and Hayhoe 2006; Alley et al. 2007). Extreme heat days are defined here as the 10% warmest days of the summer, calculated as 1961–1990 warmest days exceeding the 90% probability of the summertime daily maximum temperatures (T90) for a given location or region. The correlation between daily mean near-surface air temperature (Ta) and peak electricity demand during such T90 heat extremes suggests the potential for significant temperature-driven increases in future electricity demand for air conditioning (Belzer et al. 1996; Amato et al. 2005; Mendelsohn and Neumann 1999; Rosenthal and Gruenspecht 1995; Henley and Peirson 1998; Cartalis et al. 2001; Valor et al. 2001). Although this would be expected in the heavily air-conditioned South, such increases may also occur in northern cities. For example, Colombo et al. (1999) analyzed the frequency of extreme heat and electricity demand for nine Canadian cities using the current climate and a warmer climate based on a doubling in atmospheric greenhouse gas (GHG) emissions. Their study suggests that a 3°C increase in the daily maximum temperature would lead to a 7% increase in the standard deviation of current peak energy demand during the summer.

California is one of the world's largest economies and a world leader in energy efficiency and demand-side management practices. Statewide, electricity demand per capita has remained essentially flat, partially due to energy efficiency incentives. However, California's aggregate energy demand is growing rapidly, spurred by the rapid expansion of population (over 36 million) especially in the warm Central Valley region, and an overall increase in the use of air conditioners. The upward trend in aggregate peak demand in California is expected to approach or exceed 67 gigawatts (GW) in 2016, which is a 1.35% per year increase since 2000

(CEC 2005). The anticipated population growth underlying these forecasts over the same period is 1.30% (CEC 2005), indicating that demand growth is expected to very slightly outpace population growth. During warm summer T90 days in California, the use of air conditioning and other cooling appliances increases electricity load near-linearly with higher temperatures (CEC 2004; Bartholomew et al. 2002). In 2004, 30% of California peak electricity demand was due to residential and commercial air conditioning use alone (CEC 2004).

Extreme heat days during recent summers have triggered energy alerts with brownouts and blackouts. Electricity transmission lines and related infrastructure, along with the restructured energy market, place limits on current expansion of the flow of electricity supply during peak demand periods and are not expected to be rectified in the near-term (CEC 2004). During the recent July 2006 heat wave, the warmest year to date since California weather records began in 1895 (NOAA 2006), California minimum temperatures were 8°F–15°F (4.4°C–8.3°C) above average. Los Angeles experienced 20 consecutive days at or above 100°F (38°C), and Sacramento experienced 11 consecutive days at or above 110°F (43°C). During this heat wave, there was an all-time single day record electricity demand of 50.3 GW and several regions within California were without power from hours to days due to infrastructure failures (e.g., transformers in Northern California were unable to cool properly and caught fire).

One indicator of increased "peakiness" of the electric system is the load factor, which measures the relationship between annual peak demand in GW and consumption in GW hours. If peak demand grows more quickly than the aggregate consumption, then the load factor decreases, highlighting the likelihood of the types of conditions leading to brownouts or even blackouts. CEC (2005) shows that load factors adjusted for weather have decreased in recent years in California, which is primarily blamed on the increased use of air conditioners.

California's electricity supply reliability problems during periods when demand exceeds the available generating and/or transmitting capacity has already resulted in industries moving to regions with a more dependable supply of electricity. In the future, this issue is likely to continue to plague California, the southwestern United States, and expanding regions where electricity shortfalls occur.

World demand for energy is approximately equivalent to a continuous power consumption of 13 trillion watts (i.e., 13 TW). With aggressive conservation and energy efficiency, an expected global population of 9 billion accompanied by rapid technology growth is projected to more than double energy demand to 30 TW by 2050 and to more than triple to 46 TW by 2099 (GAO 2005). The same Government Accounting Office report (GAO 2005) on meeting energy demand in the twenty-first century concludes that due to the consumer choices of high consumption, all major fuel sources face environmental, economic, or other constraints or trade-offs in meeting projected demand. Energy shortfalls are already occurring in China and other emerging economies, where the economic expansion has led to a surge in the adoption of household appliances, including air conditioners. If our economies continue on a high-energy consumption trajectory into the future, projected temperature increases over the coming century may further strain energy providers, resulting in electricity shortages and negative health and economic impacts.

Section 2 describes the details of this study's approach to determining historical and projected extreme heat frequency, intensity, and duration, cooling degrees days, and electricity demand. This is followed by a discussion of the results, an evaluation of a potential adaptation strategy, and conclusions.

2.0 Approach

To quantify the impacts of extreme heat days on peak electricity demand, the historical 1961–1990 maximum temperature exceedance threshold for the 10% warmest June through September (JJAS) days (averaging approximately 12 days per year over the historical period) is calculated and referred here as *T90.* The number of projected future JJAS days with maximum temperatures at or above the historical T90 values are then calculated. T90 values are an important metric used in California energy capacity analyses and are often described as the 1-in-10 JJAS high temperature days. In addition to the T90 values, JJAS cooling degree days (CDD) are also calculated, defined by the National Climatic Data Center (Owenby et al. 2005) as CDD = (Ta - Tac)*days, where *Ta* is the daily mean near-surface air temperature, *Tac* = 65°F (18°C) is an average daily-mean temperature threshold for human thermal comfort, and *days* is the number of days with temperatures exceeding Tac. Intensity is simply the difference between Ta and Tac, but it can be further broken down into daytime (maximum) and nighttime (minimum) temperature intensities. Humidity also plays a role in the human thermal comfort threshold; however, California is very dry during the summer, and therefore humidity is not a significant factor for this region.

This study's analysis of changes in extreme heat implicitly accounted for technology and population change through atmosphere-ocean general circulation model (AOGCM) projections forced by the Intergovernmental Panel on Climate Change (IPCC) Special Report on Emission Scenarios (SRES) (Nakicenovic et al. 2000). The SRES scenarios include a range of population increases and accompanying technological and societal changes. However, in the calculation of California's regional energy demand, technology and population were held constant at today's levels in order to quantify the range of possible outcomes as a perturbation about the historical demand. This perturbation approach has been used in previous impact assessment studies (e.g., USGCRP 2000). It provides a constrained estimate of potential outcomes that can be extrapolated using a range of projected changes in population and technology applied to demand. Here, the possibility of such extrapolated scenarios are briefly explored, although technological advancement is difficult, if not impossible, to project beyond about a 10-year timeline, because of the large uncertainties pertaining to the rate of discovery, evaluation, and social adaptation of new technologies.

Similar to previous assessments of temperature and extreme heat increases for California (e.g., Hayhoe et al. 2004; Cayan et al. 2006), three AOGCMs were used: the U.S. Department of Energy/National Center for Atmospheric Research (DOE/NCAR) Parallel Climate Model (PCM) (Washington et al. 2000); the National Oceanic and Atmospheric Administration/ Geophysical Fluid Dynamics Laboratory (NOAA/GFDL) CM2.1 (Delworth et al. 2006); and United Kingdom Meteorological Office (UKMO) HadCM3 (Pope et al. 2000) model.

As illustrated by Figure 1, use of three AOGCMs captures the greater part of the scientific uncertainty inherent in future projections of temperature increases in response to human emissions. The PCM model lies at the lower end, whereas GFDL and HadCM3 fall at the mid to higher end of the full IPCC range of 2°C to 4.5°C for a doubling of atmospheric CO_2 concentrations (Alley et al. 2007).

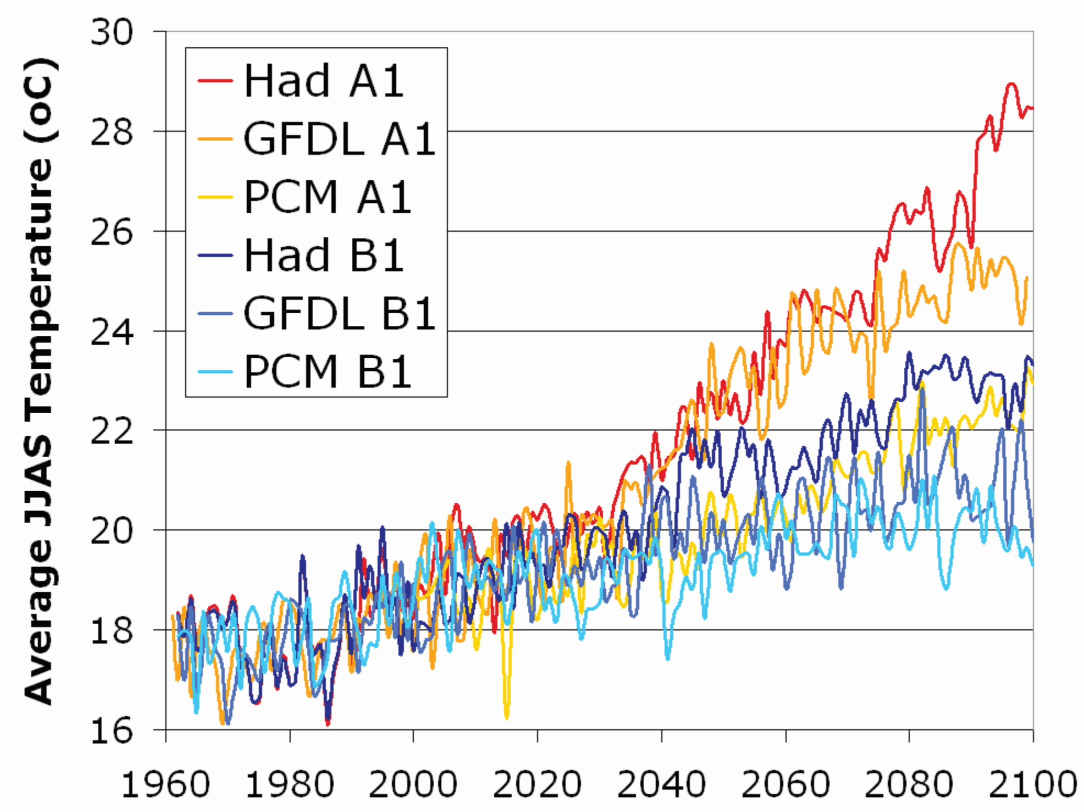

Figure 1. Projected average summer (JJAS) temperature increases for California under the SRES higher (A1FI), mid-high (A2), and lower (B1) emissions scenarios, as simulated by the HadCM3, GFDL CM2.1, and PCM models. Temperature changes are larger under the higher emission scenarios as compared to the lower, and for the higher sensitivity models (HadCM3 and GFDL CM2.1) as compared to the lower sensitivity model (PCM).

As also illustrated in Figure 1, even greater uncertainty is introduced by assumptions regarding future emissions from human activities. For that reason, the three AOGCMs are forced by three different emission scenarios for the period 2000 to 2099: the IPCC SRES higher (A1fi; fossil intensive, with rapid technological and economic growth), mid-high (A2; a heterogeneous world, with regionally oriented development and slower growth), and lower (B1; a convergent world that transitions rapidly to an information-based, rather than material-based, economy) scenarios. These IPCC SRES scenarios represent the range of non-intervention emissions futures, with projected 2100 atmospheric CO_2 concentrations reaching approximately 550 parts per million (ppm) to almost 1000 ppm.

For each of the nine model/scenario combinations used here (GFDL A1fi simulations were not available at the time of the analysis), projected California-wide temperature increases were first calculated directly from the AOGCM output (Figure 1). This coarse-resolution approach tends to cause a slight cool bias, due to the proportion of grid cells near ocean waters and mountainous regions. For that reason, AOGCM-based maximum and minimum daily temperatures were then statistically downscaled to the individual city level using historical model simulations and the long-term observational weather station records. Downscaled daily temperature time-series were generated for five urban centers within California; San Francisco, Los Angeles, Sacramento, Fresno, and San Bernardino/Riverside.

Statistical downscaling was accomplished using multiple linear regression equations based on the nearest long-term daily weather station observations for each city. Statistical downscaling procedures have the advantage of being computationally efficient, but as they rely on historical relationships between large-scale climate fields and local variables, partial stationarity over time must be assumed. Statistical downscaling through regression is a common approach that has been well-documented in the literature (Wilby et al. 1998; Huth et al. 2002; Wilby et al. 2002; Wilby and Dawson 2004), with the method used here being described in Dettinger et al. (2004).

Specifically, observed temperatures for 1976 to 1990 were used to train a set of linear third-order regression equations that transform the large-scale temperature predictors to a local-scale predictand, while preserving the distribution of the observed mean and variance. The resulting model was then verified on the 1961–1975 period with the downscaled time-series having a near-exact fit to observations. Future projections were then averaged for three time periods (2005–2034, 2035–2064, and 2070–2099) to produce climatological near-term, mid-term, and long-term projections of increased temperatures for California on which to base estimates of future shifts in the timing and magnitude of electricity demand.

3.0 Results

To determine the likely impacts of climate change under higher and lower emissions scenarios, researchers calculated projected increases in average daily temperature, the number of future days that would exceed the historical T90 threshold, and the average JJAS CDD values. These projections were then used as the basis for determining changes in statewide and urban demand for electricity for cooling under assumptions of present-day population and technology. Lastly, the impacts of upper and lower-bound population growth and technology advances in California were extrapolated to estimate the likely future range of peak electricity demand and also evaluate the potential to mitigate the impact of temperature on electricity shortages through adaptation.

3.1. Projected Increases in T90 Events

During the historical period (1961–1990), by definition T90 events occurred an average of just over 12 times per year, 12 being equal to 10% of the total number of days in the months of June through September. Using the T90 threshold defined by the historical 90th percentile temperature threshold (see Table 1 for historical T90 threshold temperatures for each city), the number of days projected to exceed this threshold in the future were then evaluated, both at the state level and for the five urban centers examined here.

As average temperatures rise, the historical T90 threshold will be exceeded more frequently. Moreover, T90 events are expected to be more intense (i.e., hotter), last longer, and occur earlier in the season relative to the 1961–1990 reference period.

For California as a whole, the total number of T90 days is projected to *double* relative to a historical mean of 12 days per summer, to an average of 23–24 days per summer as early as 2005–2034. By mid-century (2035–2064), this becomes 27–39 days (B1), 29–47 days (A2), and 32–54 days (A1fi). By the end of the century (2070–2099), the statewide number of JJAS T90 days are projected to increase an average of four times (B1), 5.5 times (A2), and 6.5 times (A1fi) relative to the historical average (Table 1 and Figure 2).

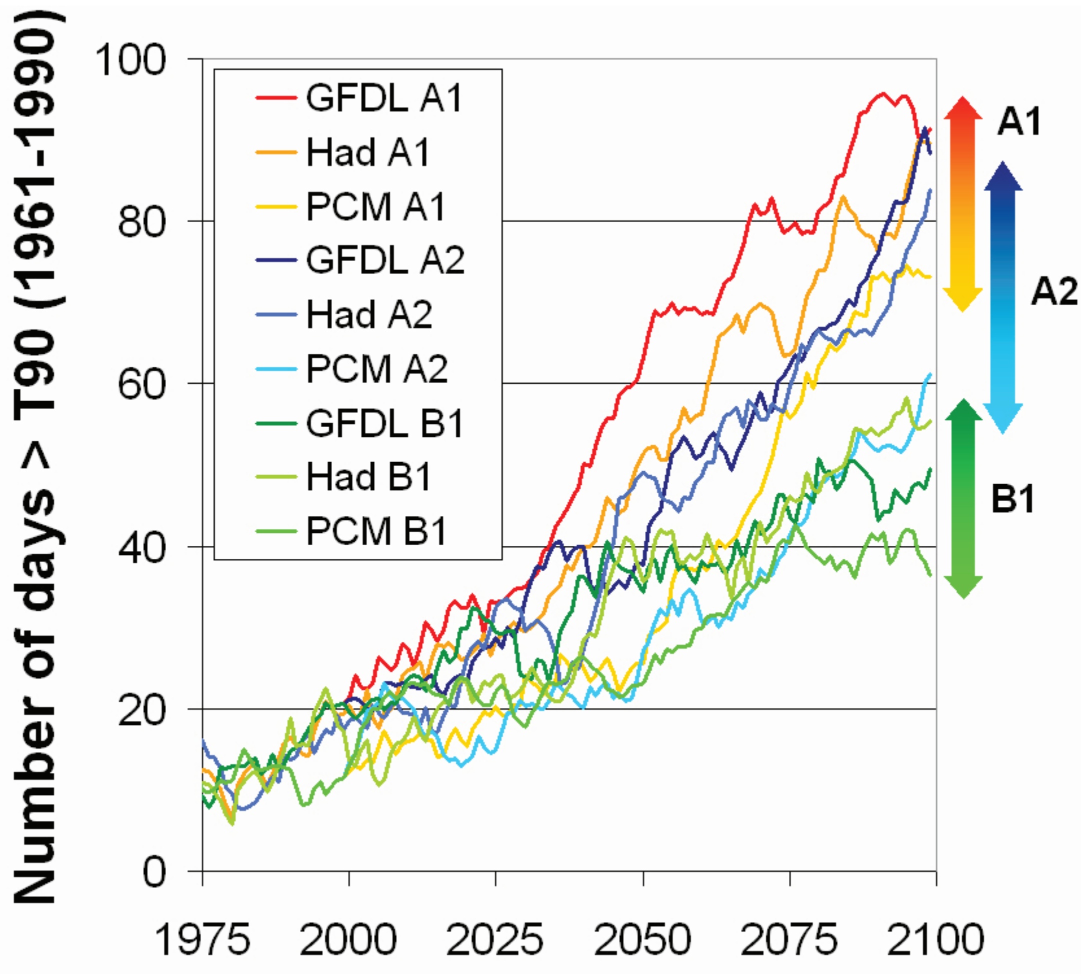

Figure 2. California-wide projected average number of JJAS T90 days per year from 1975 to 2100. Year-to-year variations have been smoothed using a 10-year running mean to show long-term trends. Projected values are shown for the HadCM3, GFDL CM2.1, and PCM models. Shaded arrows indicate the end-of-century range for simulations corresponding to the SRES A1fi (higher, red/orange), A2 (mid-high, blue), and B1 (lower, green) emission scenarios.

As shown in Table 1, T90 threshold values for the urban locations vary from a low of 27°C for San Francisco up to 40°C for Fresno. Using city-specific T90 thresholds, similar increases in the number of JJAS T90 days were projected for the five urban locations (Table 1). By 2005–2034, in most cities the number of days doubles relative to the historic reference period. By the end of the century, there are projected to be 3.5 to 4 times more T90 days under B1, 5.5 to 6 times more days under A2, and 6 to 7 times more days under the higher A1fi scenario.

As for the statewide projections, increases for individual urban areas are proportionally larger under the higher emissions scenarios (A1fi and A2), relative to the lower B1. Furthermore, coastal cities such as Los Angeles and San Francisco are projected to see changes of more than 90 T90 days by the end-of-century under the A1fi and A2 scenarios, as compared with slightly lower projections of 70 to 80 T90 days per year for inland areas.

Table 1. T90 threshold values (in degrees Celsius, determined such that an average of 12 days per year exceed the T90 threshold during the period 1961–1990), and projected increased number of days exceeding the 1961–1990 T90 threshold for near-term (2005–2034), mid-century (2035–2064), and end-of-century (2070–2099) periods. Values shown are the range given by HadCM3, GFDL CM2.1, and PCM model simulations for the SRES A1fi (higher), A2 (mid-high), and B1 (lower) emissions scenarios.

	T90 threshold (°C)	Scenario	No. of days exceeding T90 threshold		
	1961–1990		2005–2034	2035–2064	2070–2099
Statewide	35	A1fi	19–34	32-66	69-88
		A2	18–30	29-47	53-76
		B1	21–26	27–39	39–52
San Francisco	27	A1fi	20	32–46	70–94
		A2	13–28	20–48	40–91
		B1	17–23	23–35	37–49
Los Angeles	33	A1fi	24	34–50	63–93
		A2	16–24	23–48	39–98
		B1	19-24	27–36	38–45
Sacramento	38	A1fi	20	33–46	70–78
		A2	15–36	25–49	47–89
		B1	17–23	26–42	40–52
San Bernardino	40	A1fi	21–23	31–46	63–78
		A2	13–27	20–46	36–87
		B1	20–27	26–36	36–45
Fresno	40	A1fi	19–21	33–45	69–75
		A2	15–35	25–51	46–93
		B1	16–27	26–42	40–52

3.2. Projected Increases in CDD Values

Statewide, annual CDD values for a 18°C (65°F) mean temperature threshold average 400°C-days to 500°C-days per year for the period 1961–1990. For California as a whole, average CDD values are projected to increase to 600°C-days–1000°C-days by mid-century. By end-of-century, the difference between emissions scenarios becomes clear, with CDD values for California ranging from 650°C-days–1000°C-days under the lower B1 scenario, and up to 800°C-days–1250°C-days and 1000°C-days–1500°C-days under the higher A2 and A1fi scenarios, respectively. These increases are double (B1) to triple (A2, A1fi) the historical values.

Perhaps even more relevant to electricity supply is the average CDD value during a T90 event, when the electric power demand peaks. California currently has a CDD value of approximately 20°C-days per day during summer heat episodes. For each degree above the base comfort per day (°C-days), an additional amount of energy will be required for cooling.

By mid-century, daily CDD values for T90 days are projected to increase from their present-day value of 20°C-days up to approximately 100°C-days. By the end of the century, daily CDD values during T90 events exceed 150°C-days under most scenarios (Figure 3). Together, the impact of projected increases in T90 day frequencies and duration (with more such events occurring closer together or even consecutively) act to enhance daily average CDD values as well as JJAS totals, likely increasing peak electricity demand.

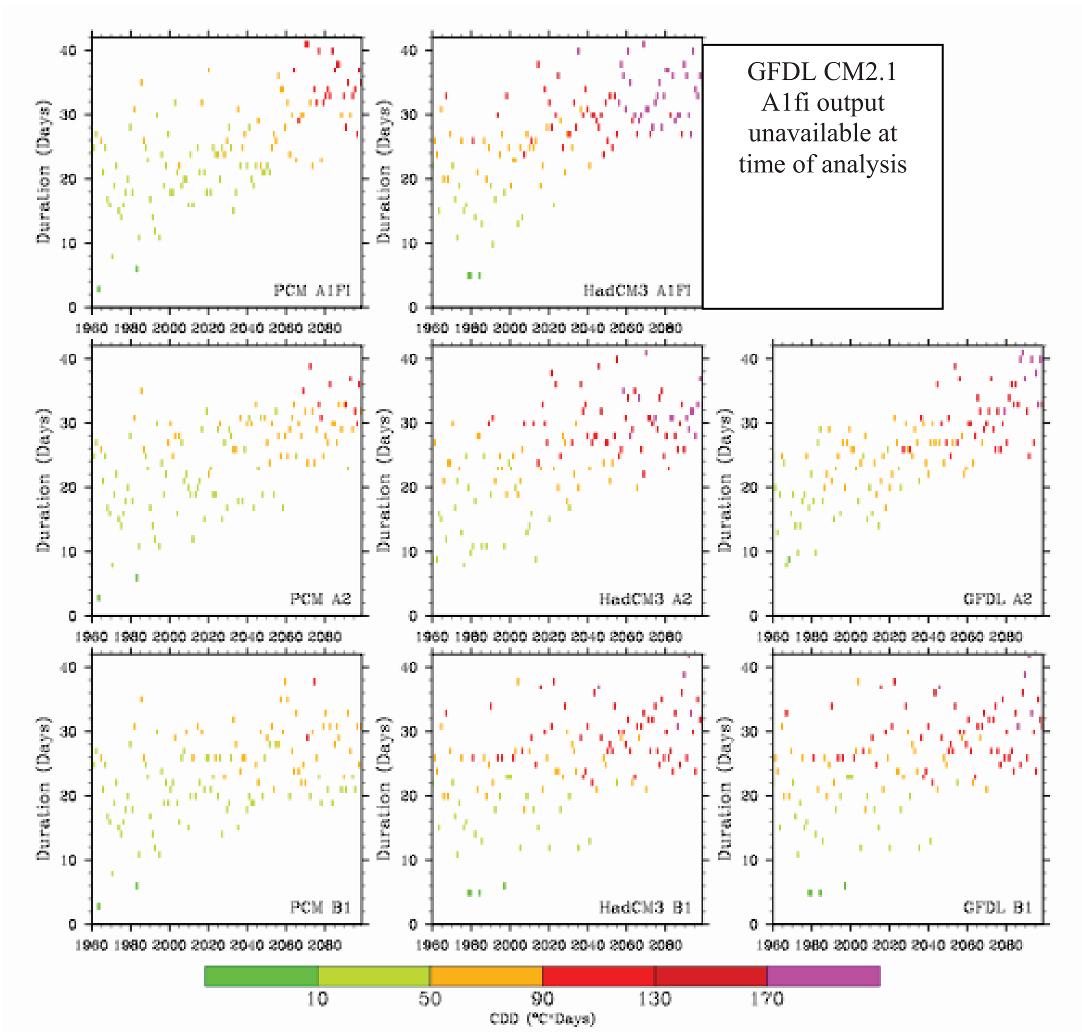

Figure 3. California-wide duration and intensity for JJAS T90 events from 1960 to 2100 as simulated by the HadCM3, GFDL and PCM models for the SRES A1fi (higher), A2 (mid-high), and B1 (lower) emission scenarios, as labeled. Note that GFDL A1fi simulations were not available at the time of calculation.

At the urban scale, similar increases in CDD values are seen for the five cities examined here (Table 2). Resolving individual urban centers also shows that there are significant inland and coastal differences in the T90 values and the corresponding CDD values, with projected increases being greatest in the southern and inland locations. Additional projected CDD increases for cities further north and south (Crescent City and El Centro, not shown) confirm this north-south gradient of increasing T90 and CDD values.

Also in contrast to the T90 analysis, interscenario differences are more evident before the mid-century, with projected increases for 2035–2064 ranging from 50°C-days per year up to 80°C-days per year under B1 and up to 150°C-days per year under A1fi for the more northerly San Francisco. As the CDD values increase towards the end of the century, even greater increases are seen under the higher A1fi and A2 emission scenarios relative to the lower B1 emission scenario (Table 2). By the end of the century, the projected increase in CDD values under the A2 and A1fi scenarios range from 150°C-days per year in the north, up to 750°C-days per year in the south, and are 1.2 to 2.3 times greater than that projected under B1.

Table 2. Historical (1961-1990) simulated and projected future change in annual Cooling Degree Days (CDD) relative to the historical average for five California cities, listed from low to high present-day CDD values. Values shown for the SRES A1fi (higher), A2 (mid-high), and B1 (lower) emission scenarios for the range simulated by downscaled projections from the HadCM3, GFDL2.1, and PCM models.

	1961-1990	2035-2065			2070-2099		
	(absolute value)	A1fi	A2	B1	A1fi	A2	B1
San Francisco	60	+ 90-150	+ 90-100	+ 60-90	+ 260-340	+ 140-220	+ 110-150
Los Angeles	570	+ 190-340	+ 210-310	+ 150-200	+ 410-590	+ 260-550	+ 230-310
Sacramento	690	+ 310-400	+ 270-360	+ 220-280	+ 630-720	+ 310-630	+ 330-410
San Bernardino/Riverside	800	+ 250-430	+ 200-410	+ 190-270	+ 520-750	+ 240-750	+ 290-390
Fresno	900	+ 320-410	+ 200-370	+ 220-310	+ 640-730	+ 250-670	+ 340-410

3.3. Projected Increase in Electricity Demand

Peak electricity demand and temperatures in California are strongly correlated. For temperatures above 28°C (82°F), California peak electricity demand exhibits a linear increase at a rate of 700 MW/°F (DOE 2004; CEC 2002). In 2004, the 1-in-10 (T90) California JJAS peak electricity demand outlook was 57 GW, indicating a remaining reserve margin of only 5.5% and a Stage I electricity emergency. At electricity demand levels above 57 GW, spot markets are used. For statewide mean daily temperatures above 86°F (30°C), electricity demand exceeds 60 GW, and capacity is less than 5%, resulting in Stage II electricity emergency response programs being put into effect. When only 3% of the reserve margin is available, a Stage III emergency alert is proclaimed, accompanied by rolling blackouts.

Using the above temperature-demand relationship, statewide JJAS peak electricity demand increases under all projections of future climate change, due to the increased frequency of days warmer than 28°C (82°F). Residential peak electricity demand at mid-century is projected to increase by 2.8%–10.0% under the A1fi and A2 scenarios and by 3.4%–7.7% under the B1 scenario. By the end-of-century, this demand will increase by 6.2%–19.2% under the A1fi and

A2 scenarios, and by 4.0%–11.2% under the B1 scenario. Much of this increased peak demand is projected to occur simultaneously across the state, as extreme heat events are of a regional rather than local nature. This raises concerns regarding the reliability and structural stability of the energy grid to supply the needs of all sectors, including industrial, residential, and emergency services.

This demand analysis holds the Gross Daily Product (GDP) and aggregate population constant at today's level, to illustrate the effect of the increased frequency of extreme heat days on peak electricity demand. Based on this approach, the increases in aggregate demand come from temperature-induced increases in the per capita rate of electricity consumption. The CEC (2005) forecasts reflect a growth of aggregate peak electricity demand essentially matching population growth. This implies that improvements in "electricity efficiency" of the economy have to exactly offset the increased demand.

Of course, it is not only the increased frequency of extreme heat days that drives up peak demand. Economic growth of California's economy measured by increasing the gross state product is another main determinant of electricity demand. Although historically per capita energy consumption has been flat, due to aggressive energy efficiency programs, technological advances will have to offset increases from both of these factors to grow electricity supply at the same rate as population growth.

4.0 Discussion

Projected increases in extreme temperatures characterized by a T90 threshold, cooling degree days, and direct estimates of electricity demand all suggest that electricity demand in California is likely to continue to rise over this century. Although California's installed electricity capacity will also continue to grow over time, its current rates of growth suggest frequent summer electricity shortages may occur as early as 2020. This scenario is particularly more likely for southern California, where the electricity operating reserve has already dropped below the 5% reserve margin during multiple hot days in recent years. By the end of this century, all model/scenario combinations indicate an increase in region-wide extreme temperature conditions of a severity associated with electricity shortages under the current configuration of the electric power system and patterns of demand.

Furthermore, population estimates suggest a large influx along major transportation corridors in the California Central Valley, a region that is already very hot during JJAS, requiring air conditioner use. If a doubling and a quadrupling of the population within the Central Valley were imposed during this century, then the demand side would also increase proportionally and supply would consequently need to be doubled or quadrupled as well. As mentioned earlier, technological advancement is highly unpredictable; however, there is always the possibility of breakthroughs.

The natural conclusion arising from projections such as these is that electricity production must be significantly increased. However, in future years, meeting California's demand for electricity —including peak power—will most likely require a combination of new supplies, improved transmission and distribution facilities, and further enhancement of the demand-side policies and programs that are already in place. In particular, adaptation to future change through widespread adoption of conservation and passive cooling strategies may have the potential to reduce the projected increase in future electricity demand significantly. By raising the average temperature threshold at which air conditioning is commonly turned on through adaptation strategies such as the use of fans and flow-though ventilation, less electricity would be required for cooling under a given temperature regime. This is not unheard-of in California; during the 2000–2001 energy crises, Californians responded to an imposed electricity efficiency and demand program that resulted in a reduction of approximately 6000 MW, representing 10% of the peak demand (CEC 2004). During the summer of 2000, there were 29 days where electricity demand exceeded 40,000 MW. Although the summer of 2001 was as hot as 2000, there was a substantial reduction in demand, with only six such days occurring. This reduction was due to a combination of price increases and voluntary reduction of electricity use.

Some measure of the adaptive potential for reducing projected increases in CDD and the subsequent rise in residential and commercial electricity demand can be obtained through comparing projected increases in CDD values calculated based on the standard 65°F (18°C) threshold with CDD values calculated using a higher threshold of 75°F (24°C). Raising the CDD threshold by 10°F through more efficient cooling with fans and ventilation would greatly reduce the projected increase in CDD values and related electricity demand, particularly for coastal cities (Figure 4). This simplified assumption suggests potential savings through adaptation. For

San Francisco, raising the CDD threshold to 75°F would result in end-of-century CDD increases of less than 15°C-day per year, effectively eliminating any increases in projected demand under both the A1fi/A2 and B1 scenarios. Los Angeles shows potential reductions of 40%–55% in projected CDD increases relative to the 65°F threshold, while inland cities (San Bernardino, Sacramento, Fresno) indicate an adaptive capacity ranging from 10%–40%.

Considering that significantly higher CDD values and related electricity demand result from higher (as compared with lower) emission scenarios, and that most affordable near-term options for increasing electricity supply via fossil fuels also involve simultaneous increases in GHG emissions, these estimates of adaptation potential have important implications for decision making at the city and state level.

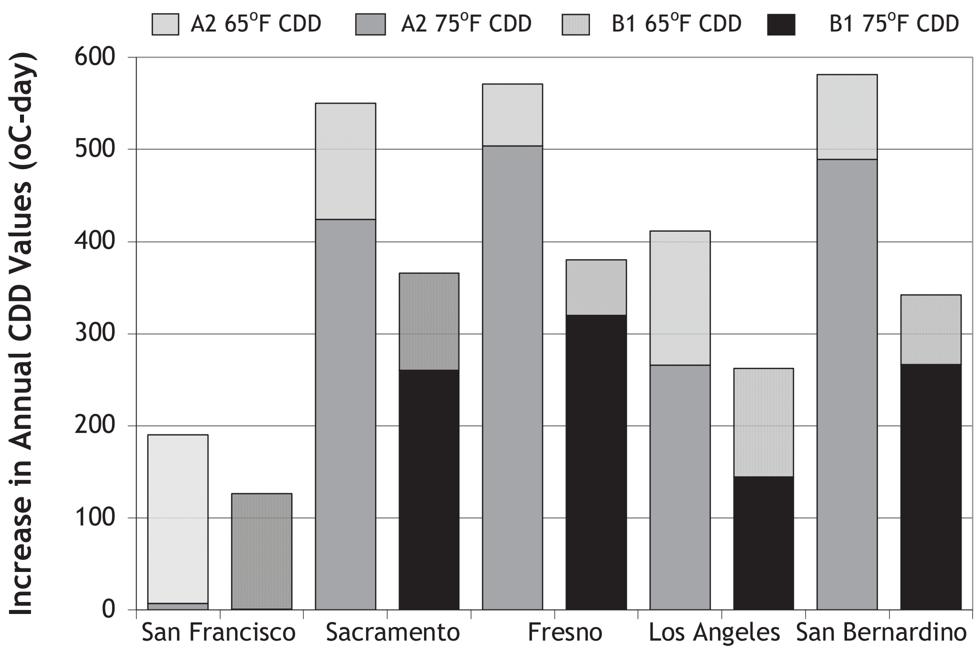

Figure 4. Projected increase in annual CDD for a 65°F (solid) vs. a 75°F (lined) average temperature threshold for 2070–2099, relative to 1961–1990. Results shown are the averaged projections from the HadCM3, GFDL2.1, and PCM models for the SRES A2 (mid-high, orange) and B1 (lower, yellow) emission scenarios for five California cities. Comparison of the projected change based on a higher vs. a lower threshold value for CDD calculation illustrates the adaptation potential for mitigating projected future energy demand, which appears to be greater for coastal cities (San Francisco, Los Angeles) and less for inland areas (Sacramento, Fresno, San Bernardino).

5.0 Summary and Conclusions

All indicators point to increases in summer electricity demand in California, even when confounding factors such as increased population and market saturation of air conditioning are disregarded. Through calculation of projected increases in extreme heat and electricity demand, the difference in potential impacts resulting from lower and higher emissions scenarios can be quantified. Model uncertainties notwithstanding, extreme heat and associated human health risks and electricity demands under the B1 lower emissions scenario are significantly lower than those projected to occur under the A2 and A1fi higher scenarios. Calculations of electricity demand under a range of human comfort levels also highlight the potential for adaptation to play a major role, reducing projected increases in electricity demand by roughly one third for inland cities, and by as much as 95% for cooler coastal cities.

Alternative technologies such as solar photovoltaic electricity generation represent an important future technology for this region, with electricity production being proportional to solar radiation and thus closely matching summer peak electricity demand (Borenstein 2005). Technologies such as these have the potential to reduce the cost associated with increased demand for cooling under a warmer climate without increasing emissions of GHGs that are causing the problem in the first place.

In conclusion, the influence of climate change on extreme heat and electricity demand in California and other similar air-conditioned regions is likely to challenge current-day providers, spur conservation and adaptation measures, and raise questions regarding the potential for mitigation to reduce projected increases through following a lower emissions pathway worldwide.

6.0 References

Alley, R. et al. 2007. *Climate Change 2007: The Physical Science Basis: Summary for Policymakers.* Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, 21pp. Available online at: www.ipcc.ch/SPM2feb07.pdf.

Amato, A., M. Ruth, P. Kirshen, and J. Horwitz. 2005. "Regional energy demand responses to climate change: Methodology and application to the Commonwealth of Massachusetts." *Climatic Change* 71: 175–201.

Batholomew, E. S., R. Van Buskirk, and C. Marnay. 2002. *Conservation in California during the summer of 2001.* LBNL-51477, 22 pp.

Belzer, D., M. Scott, and R. Sands. 1996. "Climate Change Impacts on U.S. Commercial Building Consumption: An Analysis Using Sample Survey Data." *Energy Sources* 18: 2.

Borenstein, S. 2005. Valuing the Time-Varying Electricity Production of Solar Photovoltaic Cells. University of California Energy Institute Working Paper 142 (CSEM WP-142).

California Energy Commission (CEC). 2002. *2002–2012 Electricity Outlook Report.* P700-01-004F, 174 pp.

California Energy Commission (CEC). 2004. *Integrated Energy Policy Report.* California Energy Commission Report 100-04-006CM, 80 pp.

California Energy Commission (CEC). 2005. *Summer 2005 Electricity Supply and Demand Outlook.* California Energy Commission Report CEC-700-2005-006-SD.

Cartalis, C., A. Synodinou, M. Proedrou, A. Tsangrassoulis, and M. Santamouris. 2001. "Modifications in energy demand in urban areas as a result of climate changes: An assessment for the southeast Mediterranean region." *Energy Conv and Mgmt.* 42: 1647–1656.

Cayan, D., A. L. Luers, M. Hanemann, G. Franco, and B. Croes. 2006. *Possible scenarios of climate change in California: Summary and recommendations.* CEC-2005-186-SD.

Colombo, A. F., D. Etkin, and B. W. Karney. 1999. "Climatic variability and the frequency of extreme temperature events for nine sites across Canada." *J. Climate* 12: 2490–2502.

Delworth, T. L., A. J. Broccoli, A. Rosati, R. J. Stouffer, et al. 2006. "GFDL's CM2 global coupled climate models – Part 1 – Formulation and simulation characteristics." *J. Climate* 19: 643–674.

Dettinger, M. D., D. R. Cayan, M. K. Meyer, and A. E. Jeton. 2004. "Simulated hydrologic responses to climatic change variations and change in the Merced, Carson, and American River Basin, California 1900–2099." *Climatic Change* 62: 283–317.

Department of Energy (DOE). 2004. Technical Support Document: Energy efficiency program for commercial and industrial equipment: Commercial unitary air conditioners and heat pumps.

Government Accountability Office (GAO). 2005. *Meeting energy demand in the 21st century.* GAO-05-414T, 34 pp. www.gao.gov.

Hayhoe, K., D. Cayan, C. B. Field, P. C. Frumhoff , E. P. Maurer, N. L. Miller, S. C. Moser, S. H. Schneider, K. Nicholas Cahill, E. E. Cleland, L. Dale, R. Drapek, R. M. Hanemann, L. S. Kalkstein, J. Lenihan, C. K. Lunch, R. P. Neilson, S. C. Sheridan, and J. H. Verville. 2004. "Emissions pathways, climate change, and impacts on California." *Proc. Natl. Acad. Sci.* 101: 12422–12427.

Henley, A., and J. Peirson. 1998. "Residential energy demand and the interaction of price and temperature: British experimental evidence." *Energy Economics* 20: 157–171.

Huth, R. 1999. "Statistical downscaling in central Europe: Evaluation of methods and potential predictors." *Climate Res.* 13: 91–101.

Mendelsohn, R., and J. Neumann. 1999. *The Impact of Climate Change on the United States Economy.* Cambridge University Press, Cambridge, UK.

Miller, N. L., and K. Hayhoe. 2006. Emissions scenario-based analysis of projected extreme heat and energy costs in California, Forum on Risks and Impacts on Society, 86th Annual AMS Meeting, 29 January–2 February 2006, Atlanta, Georgia.

Nakicenovic´, N., J. Alcamo, G. Davis, B. de Vries, J. Fenhann, S. Gaffin, K. Gregory, A. Grubler, T. Y. Jung, T. Kram, et al. 2000. *Intergovernmental Panel on Climate Change Special Report on Emissions Scenarios.* Cambridge University Press, Cambridge, U.K.

NOAA. 2006. July 2006 Statewide Temperature Ranks, National Climate Data Center, NESDIS www.noaanews.gov/stories2006/s2677.htm.

Owenby, J., R. Heim, M. Burgin, and D. Ezell. 2005. Climatology of the U.S. No. 81 - Supplement # 3, Maps of Annual 1961–1990 Normal Temperature, Precipitation and Degree Days, Online Document Library, www.ncdc.noaa.gov/oa/documentlibrary/clim81supp3/clim81.html.

Pope, V. D., M. Gallani, P. Rowntree, and R. Stratton. 2000. "The impact of new physical parametrizations in the Hadley Centre climate model: HadAM3." *Climate Dynamics* 16: 123–146.

Rosenthal, D., and H. Gruenspecht. 1995. "Effects of global warming on energy use for space heating and cooling in the United States." *Energy Journal* 16: 2: 77–96.

Tebaldi, C., K. Hayhoe, J. Arblaster, and J. Meehl. 2006. "Going to the extremes: An intercomparison of model-simulated historical and future changes in extreme events." *Climatic Change* 10.1007/s10584-006-9051-4.

USGCRP. 2000. *Climate change impacts on the United States: The potential consequences of climate variability and change.* Editors: Melilo, J. M., A. C. Jacentos, T. R. Karl, and the National Assessment Synthesis Team. 2000: U.S. Global Research Program, U.S. Climate Change Research Program, Washington, D.C.

Valor, E., V. Meneu, and V. Caselles. 2001. "Daily air temperature and electricity load in Spain." *J. Appl. Met.* 40: 1413–1421.

Wilby, R. L., and C. W. Dawson. 2004. *Using the Statistical DownScaling Model (SDSM) Version 3.1 – A decision support tool for the assessment of regional climate change impacts. User's Manual.* Climate Change Unit, Environment Agency of England and Wales, 67 pp.

Wilby, R. L., C. W. Dawson, and E. M. Barrow. 2002. "SDSM - a decision support tool for the assessment of regional climate change impacts." *Environmental Modelling and Software* 17(2): 145–157.

Wilby, R. L., T. M. L. Wigley, D. Conway, P. D. Jones, B. C. Hewitson, J. Main, and D. S. Wilks. 1998. "Statistical downscaling of general circulation output: A comparison of methods." *Water Resources Res.* 34: 2995–3008.

Washington, W. M., J. W. Weatherly, G. A Meehl, A. J. Semtner, T. W. Bettge, A. P. Craig, W. G. Strand, J. Arblaster, V. B. Wayland, R. James, and Y. Zhang. 2000. "Parallel climate model (PCM) control and 1% per year CO_2 simulations with a 2/3 degree ocean model and 27 km dynamical sea ice model." *Climate Dynamics* 16: 755–774.

EXHIBIT 3

Pie in The Sky?

The Battle for Atmospheric Scarcity Rent

Peter Barnes and Marc Breslow

February 2001

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Program on Development, Peacebuilding, and the Environment
Political Economy Research Institute (PERI)
University of Massachusetts Amherst

Introduction

There's a trillion dollar pot of gold in the sky, and it's called *atmospheric scarcity rent.* Few talk about it, but a historic battle is looming to see who gets this treasure. The outcome could shape the 21st century in surprising ways.

What on earth—or above it—is atmospheric scarcity rent? It's what owners charge for things in high demand because they are scarce. The *Mona Lisa,* for example, has a high scarcity rent because it is much sought after, and there is only one original. In general, the less plentiful things are relative to demand—whether buildable land, Mark McGwire home run balls, or New York taxi medallions—the higher the scarcity rent. Scarcity rent is not to be confused with the rent you pay your landlord. Only part of that price—the part that reflects the value of land—represents scarcity rent. The rest reflects the value of the building itself, the services your landlord provides, and his cost of money, among other things.

Atmospheric scarcity rent is a new phenomenon that reflects the sky's limited capacity to provide critical services to humans. For example, the air carries electromagnetic waves that are indispensable to broadcasters and telecommunications companies. And there are only so many usable frequencies that don't interfere with each other. When Congress in 1997 gave broadcasters a large chunk of the electromagnetic spectrum to use for digital broadcasting, at no charge, opponents like Senator John McCain called it a $70 billion giveaway (Common Cause 1997).

The kind of scarcity rent that concerns us in this chapter has to do with the sky's limited capacity to absorb carbon dioxide. Our demand for sky-borne carbon storage is the flip side of our demand for fossil fuels. The more fuel we burn, the more carbon dioxide the sky has to absorb. Up to now, we've paid handsomely for oil dug from the ground, but we've paid nothing for air to hold combusted wastes. That disparity is about to disappear.

Science has shown that Chicken Little had it almost right. The sky isn't falling, but it is *filling*. It can safely handle only so much acid-brewing sulfur, ozone-eating chlorine, and heat-trapping carbon dioxide, and we are now reaching those limits if we haven't already surpassed them. Governments have finally begun to recognize the problem of global warming, and in 1997, 50 nations signed the Kyoto Protocol, an agreement to cut carbon emissions by the year 2012. Now the question is, how will we ensure that the cuts happen? How will we fix the flaw in markets that has so far blinded us to the sky's limits?

The fix is to create markets for sky use, just as there are markets for land and water use. Normally, markets recognize scarcity via property laws, which allow an owner to charge others for using his or her things. If Waste Management, Inc. owned the atmosphere, they'd charge us whatever the market would bear for dumping our wastes into their sink. But to date, there haven't been any property laws for the sky, and so the air has been subject to what Garrett Hardin called the tragedy of the commons.[1]

The Commons

Hardin envisioned an open pasture where herdsmen bring their cattle to graze. As long as there is plenty of land and not too many animals, each herdsman can take full advantage of the commons. But as the population increases, the land meets the limit of its capacity. Regardless, each herdsman, seeking to maximize his own gain, adds another animal to his herd. Eventually the herdsmen ruin the land and the source of their own sustenance. Hardin applied the same parable to environmental sinks:

> *In a reverse way, the tragedy of the commons reappears in problems of pollution. Here it is not a question of taking something out of the commons, but of putting something in …The rational man finds that his share of the cost of the wastes he discharges into the commons is less than the cost of purifying his wastes before releasing them. Since this is true for everyone, we are locked into a system of "fouling our own nest"…* (Hardin 1968)

One way to prevent such nest-fouling is to set limits on overall pollution, and then issue permits allowing polluters to emit their share. To promote freedom and efficiency, companies can trade emission permits amongst each other. Firms that find it easy to cut emissions can sell some of their permits to firms that find it hard, and we end up with the same total reduction at the least cost.

Such a "cap and trade" system was first put into place nationwide by the Clean Air Act of 1990 in an effort to cut emissions of sulfur, a cause of acid rain. The law has been highly successful, persuading many policy makers to embrace a similar system to reduce domestic carbon emissions. Therein lie both danger and opportunity.

The danger is that we could follow the model of the Clean Air Act too closely. That law included a grandfather clause for historical polluters; the government simply gave away permits to these companies rather than charging for them. If we did the same for carbon permits, we would slide into the biggest giveaway of public assets since the railroad land grants of the 19th century—a giveaway of our no longer spacious skies. In such a scenario, all future users of fossil fuels would pay atmospheric scarcity rent to a small number of corporate "skylords."

The opportunity lies in the possibility to capture the atmospheric scarcity rent on behalf of all citizens equally. In this scenario, we would auction off permits to fossil fuel companies, at whatever price the market would bear. The revenue thus generated would flow into a trust whose beneficiaries would be all citizens, current and future. This "sky trust" would pay equal dividends to all.

The beauty of this plan is that it would help to protect the environment and at the same time promote equality. Conceptually, it's a rent recycling machine based on the principle: *from* all according to their use of the commons, *to* all according their equal ownership of that commons. As a bonus, the system would have a progressive impact on income distribution in the United States, helping to narrow the huge gap between rich and poor. A check of, say, $1,500 a year would boost low incomes by a much larger percentage than high ones. Fuel prices would rise, but for people of modest means, the benefits would outweigh the costs. Below we demonstrate in detail why that's true.

The Sky Trust

In 1998, the Corporation for Enterprise Development proposed the creation of a sky trust for the United States (Barnes 1988). One of the present authors, Peter Barnes, was the architect of that proposal. In 1999, four economists at Resources for the Future put forth a similar plan. Under both proposals, companies bringing fossil fuels into the U.S. economy would be required to purchase emission permits for the carbon content of their fuels. An effort is now underway to enact these proposals into law.

As a result, a dialogue has begun about who will collect atmospheric scarcity rent now and forever. The potential money at stake is substantial, much greater than it was in the case of sulfur. After all, sulfur is just an impurity in coal, not the essence of coal itself. Carbon, on the other hand, is the irreducible pith of all fossil fuels, the fire inside our cars and furnaces, the toaster of our bread, the elixir of our modern economy. We Americans blow about 1.5 *billion* tons of it into our sky every year—about 6 tons per man, woman and child. At a price of, say, $100 a ton, that's $150 billion worth of scarcity rent annually. By contrast, the potential for scarcity rent generated by the cap on sulfur emissions is estimated at less than $2 billion a year. [2]

Moreover, the utilities that received free sulfur emission permits in 1990 were state-regulated entities at the time, and it was argued that any windfall they received would be passed through to rate payers. The case with the fossil fuel companies is different. These emitters are almost all unregulated, and free permits would send the benefits directly to shareholders. To the extent that shareholding in energy corporations is skewed in favor of higher-income households, the result would be a regressive redistribution of income.[3] By contrast, the sky trust would have a progressive impact on income distribution, as we document below. More than that, it would fundamentally alter the way we look at open-access natural assets.

Who Has Control?

The question of who should own the economic value of the sky carries deep philosophic and religious overtones. Practically speaking, there are three possible owners: private corporations, the federal government, and citizens through a trust.

Free granting of common assets to corporations has a long, if somewhat tainted, history in America, from the enormous land grants of the 19th century to the recent gift of the electromagnetic spectrum to broadcasters. The standard argument used to justify public largesse to private firms is that they deliver a public value in exchange. They build railroads, extract valuable minerals, or transmit sharper television images. The citizenry thus gets something back for its generosity, making the deals at least arguably fair.

Whether gifts of this sort really have been good deals for the public is, of course, debatable--are sharper TV pictures worth a $70 billion subsidy? But regardless of the merits of past grants, the potential gift of carbon absorption capacity is in a class by itself. The public would get nothing in return, except possibly cooperation from energy companies in meeting an emissions cap. Such *realpolitik* is in fact the only serious argument advanced for making such a grant today.

The case for government ownership of carbon absorption capacity is certainly stronger than the case for corporate ownership. The federal government is presumed to represent the public interest, but the presumption is debatable. If we look at the historical record, it is not at all clear that the government has really managed public assets to the public benefit. Quite to the contrary, the government has all too often disposed of land, minerals, timber, and water at far below market value.

Even if the federal government were to receive market value for carbon absorption capacity, we have to ask what it would do with the money. The odds that the proceeds would be distributed equitably are not high. After all, the state has its favored constituents, and they tend not to be poor.[4] In the end, the argument for federal ownership rests mostly on habit ("we've always done things this way") and lack of imagination ("there's no other way to do it"). But the sky trust model shows that there *is* another way to do it. Indeed, a citizen trust along precisely these lines has been in place for some years in the state of Alaska.

The Permanent Fund

Under the Alaska Constitution, the natural resources of the state belong to its people. After oil began flowing from Prudhoe Bay in large quantities, Alaskans realized that they were sitting on a bonanza, and it would not last forever. In 1976, they amended the state constitution to create a system for saving some of their oil wealth for the future. From then on, 25 percent of the state's oil revenue has been placed in an entity called the Permanent Fund.

The principal of the Permanent Fund is managed as a trust for all current and future Alaska residents. The money is kept separately from the state treasury. It is invested in a diversified portfolio of stocks, bonds, and real estate, and the legislature cannot touch it. The annual income of the fund is divided into two roughly equal pots. About half is used for schools, highways, and other public capital investments, and the rest is paid in equal dividends to all Alaskans. In 1999, the individual dividend was $1,770.[5]

A sky trust, like the Alaska Permanent Fund, would be based on the premise that citizen ownership, if properly structured, is preferable to government ownership. After all, the sky is a gift from our common Creator. It was not given to a government, and certainly not to private corporations. We, the meek, are its inheritors and stewards. If it turns out that this gift is worth real money, well, that money belongs to us and to our heirs. While federal ownership of the sky would strengthen the apparatus of the state, citizen ownership would strengthen families and children. If we believe that families and children are the bedrock of our society and our future, we should design our institutions and allocate our resources accordingly.

The sky is the ultimate commons—we all inhale oxygen from it, exhale carbon dioxide into it, and use it daily in other less obvious ways. On the theory that use implies ownership, or simply that commoners own the commons, the sky should be our common property.

A confusion has arisen in America between the commons and the state. They are often considered the same, when in fact they are not. Historically, the English commons were owned by the commoners who used them. State property—the king's property—was something else. When the commons were enclosed, the land went not to the state or king but to the local gentry, a poor-to-rich redistribution within what would now be called the private sector. The commoners' prior ownership interest was sometimes acknowledged with small cash payments.

Our intent, of course, is not to revive an outdated agricultural system, but to adapt a venerable civic institution to 21st century realities. From a purely technical perspective, this is not difficult. Americans are the most ingenious creators of financial instruments the world has known. If we can invent 30-year mortgages, stock index mutual funds, and pork belly futures, we can surely design ways to structure common ownership of common assets. Compared to much of what's already out there, a sky trust would be a straightforward and highly transparent financial instrument. Administratively, it's a no-brainer: revenue flows in from permit auctions, and dividends flow out via annual checks or electronic funds transfers. As a percentage of the cash flow, administrative costs would be extremely low.

A sky trust would be the old commons in new clothes, a pasture transmogrified into an investment account. It would expand the political right of one person, one *vote*, to an economic right of one person, one *share* (of the commons, that is). In so doing, it would create a new class of property owners whose membership, with a nod to Thomas Jefferson, includes every American. It would make every future baby a trust-fund baby.

Narrowing the Income Gap

The sky trust would promote not only equality of ownership but also equality of income. The first benefit is fairly evident, but the second is less obvious. On the one hand, the payout from the trust would clearly have a progressive impact: all citizens would receive the same annual dividend, boosting the incomes of the poor by a larger percentage than the incomes of the rich. On the other hand, charging for emission rights would have a regressive impact: energy companies would see a rise in the cost of doing business, and they would try to pass on that cost to consumers by raising fuel prices. Businesses that use fuel in production would try to pass on their costs, too. Higher fuel prices would probably take a bigger bite, in percentage terms, from low incomes than high ones. So there are two opposing forces at work. Which is stronger?

In the end, the progressive effect of equal payouts outweighs the regressive effect of higher energy costs. Low-income households would see a net gain in income, and upper-income households would see a slight loss. (See Table 1.) To arrive at that conclusion, we had to answer a number of questions. First, what would fuel producers have to pay for carbon emission rights? Second, how much of that cost would be passed on to consumers in the form of higher prices? Third, how would these higher prices affect spending among different income groups? And finally, when you subtract the extra expense from the dividend that each person would receive, what would be the net gain or loss? Total payments into the sky trust would equal total payouts, so in aggregate it is a wash. But some would receive more than they pay, and others would pay more than they receive. Our calculations suggest that the biggest winners would be households in the lowest 10 percent of the income spectrum. The biggest losers would be households in the top 10 percent—but they can afford it.

The Price of Carbon

First we consider the price that energy companies would pay for carbon emission permits. Numerous studies by government agencies, university scholars, and private econometric firms have tried to forecast the carbon price that would be needed to meet the Kyoto target: reducing emissions in 2010 to 93% of their 1990 level. Their estimates vary widely, partly because they use different econometric methods, and partly because they are dealing with many unknowns and have to make assumptions. Some of the uncertainties are political, some economic. At the political end, we don't know how quickly the cap on emissions would be phased in. If it were instituted abruptly, households and firms would have little time to respond to higher prices by cutting energy use or switching to less polluting fuels. We also don't know how much international permit-trading would be allowed. Some proposals would allow extensive international trading among firms, while others would limit trading to certain countries or allow only domestic trades. (See box, "To Trade Or Not to Trade.") In general, the greater the trading, the lower the carbon price, although this varies among countries (Weyant and Hill 1999, p. xxx).

Most studies assume that, once a cap is set, the carbon price would be driven entirely by the market. Resources for the Future, however, has proposed limiting the initial carbon price to as little as $25 per ton, allowing the price to rise by seven percent a year (in real terms) over the next five years, arguing that the low initial price would help to avoid a shock to the economy. The RFF plan would also set aside some of the permit revenue in the first 10 years to assist workers and communities hurt by the shift to a low-carbon economy. Under this plan, the sky trust would collect less scarcity rent at the outset, although the worker-assistance plan would not significantly alter the impact on income distribution.

To Trade or Not to Trade

The idea of trading emission rights among nations is controversial. Advocates argue that it would foster flexibility and efficiency. Some countries would find it relatively easy and inexpensive to cut emissions, while others would find it hard. Countries that find it easy could sell some of their emissions rights to those that find it hard, and we would end up with the same total reduction in emissions at the least cost.

Opponents, on the other hand, see a danger in trading between rich and poor countries. Rich countries might simply pay poorer ones for the right to keep polluting as much as ever. Poorer countries perhaps would not be able to afford higher fuel prices, putting a brake on their development. The more trading, the less improvement we would likely see in energy efficiency by the United States, Europe, and Japan.

Because of the great disparity between industrialized and developing regions, the 1997 Kyoto Protocol exempted developing countries from its targets for reductions in carbon dioxide emissions. Nonetheless, a similar dynamic between rich and poor could occur even among the industrialized nations, between the wealthiest countries on the one hand and the former Soviet Union and Eastern Europe on the other. Emissions in the latter regions have dropped greatly due to disastrous economic declines. As a result, in 2010 these regions are expected to have large quantities of excess permits available for sale, often termed “hot air” in the current literature.

The Pacific Northwest National Laboratory, operated by the Battelle Institute for the U.S. Department of Energy, projects a U.S. carbon price of $168 per ton with no trading, $73 with trading limited to the developed countries, and $26 with global trading, in 1992 dollars (MacCracken *et al.* 1999, 57). In the case of limited trading, the model predicts that the United States would buy rights from Eastern Europe and the Soviet Union to emit 248 million tons of carbon, or about one-seventh of total U.S. emissions.

So much for politics. As for economic unknowns, one question is how consumers would respond to higher energy prices. If they were strongly resistant to cutting fuel consumption, then prices for emission permits would be bid up greatly. If, on the other hand, demand were quite elastic, and consumers responded to higher fossil fuel prices by cutting back sharply in consumption, then permit prices would not rise as much and the scarcity rent would be lower.

Consumers could reduce their use of fossil fuels in at least three ways. They could do less of certain activities—cut back on driving, for instance. Or they could do the same things more efficiently—perhaps trade in that sport utility vehicle for a small Saturn sedan. Another option is to switch to a less polluting fuel—heat their homes with natural gas instead of oil, for example. Since petroleum has about four-fifths the carbon content of coal per BTU of energy, and natural gas has three-fifths, switching from coal can cut emissions without reducing total energy use.

Taking all of these possibilities into account, numerous researchers have attempted to forecast the carbon price needed to curb consumption enough to meet the Kyoto target. Studies have been done by the U.S. Energy Information Administration (EIA 1998 and 1999), DRI/McGraw Hill (Probyn and Goetz 1996), Pacific Northwest National

Laboratory (MacCracken *et al.* 1999), and the National Institute for Environmental Studies at Kyoto University in Japan (Kurosawa *et al.* 1999). Eleven such studies were collected in a special 1999 issue of *The Energy Journal*. The estimates for a carbon price range from about $20 to more than $400 a ton (Weyant and Hill, p. xxxi).

To assess the impact of the sky trust on income distribution, we examined three of the scenarios presented in *The Energy Journal.* One study projects a relatively high carbon price of $296 a ton, the second a moderate price of $191 a ton, and the third a low price of $83 a ton (all here converted to 1999 dollars). Our base case, the middle scenario of $191 per ton, comes from the Pacific Northwest National Laboratory, operated by the Battelle Institute for the U.S. Department of Energy (MacCracken *et al.* 1999, 48). This model assumes no international trading of emission permits. For calculations based on the other two scenarios, see the Appendix.

Cost and Benefit to Households

We assume that as energy companies incur higher costs, they will pass these on to consumers in the form of higher prices for oil, gas, and coal. In addition, firms that use fossil fuels to produce goods and services would incur higher expenses and will raise prices as well. Using our base case, we estimate that households would spend an additional $1,158 to $4,119 annually (in 1999 dollars), depending on their income level, with the poorest households spending the least, and the richest households the most.

To estimate these expenses, we drew from an analysis by Gilbert Metcalf of Tufts University (1998), which uses data from the 1994 Consumer Expenditure Survey. Metcalf did not look at carbon emissions permits per se. Rather, he looked at environmental taxes, a close proxy. Metcalf estimated the effects of a package of environmental taxes on households at varying income levels, dividing all households into deciles, or tenths, of the population. We used only the carbon tax portion of Metcalf's package to estimate the distribution of costs among deciles. Then, because Metcalf's carbon tax is smaller than the carbon price projected to meet the Kyoto targets, we scaled up his results to match our estimate of total revenue from scarcity rent.

As noted earlier, the sky trust would collect revenues from auctioning of carbon emission permits and then distribute the proceeds to households across the United States, with each individual receiving the same annual payout from the trust. Because households in the higher income deciles are on average larger (when the deciles are ordered by income per household), the dividends per household are greater as one moves up the income distribution, ranging from $1,512 at the bottom to $2,740 at the top. High-income households consume far more than low-income households, however, so their expenses for the higher fossil fuel prices would rise more, too. The combined result of higher carbon costs and sky trust dividends is a net gain to households at the bottom of the income spectrum and a net loss to households at the top. On average, households in the bottom decile would gain $354 per year, while households at the top would lose $1,378. Across the income distribution, the bottom six deciles and the eighth decile would gain. The seventh decile would face a small loss of $170, while the ninth decile would lose

$228 per household. Table 1 and Figure 1 present these results. In percentage terms, households at the low end would enjoy significant gains relative to income, ranging from 5.1 percent for the first decile to 1.1 percent for the third. The top decile would see the largest loss, with income declining by 0.9 percent.[6]

Table 1
Costs and Benefits to Households (Families) Across the Income Spectrum
Based on a carbon price of $191 per ton (1999 dollars)

Income Decile	Mean Household Income ($)	Costs From Higher Prices ($)	Benefits From Sky Trust ($)	Net Effect ($)	Net Effect As % of Income
1	6,884	1,158	1,512	+354	+5.1%
2	13,127	1,418	1,777	+359	+2.7%
3	20,453	1,800	2,034	+234	+1.1%
4	28,107	2,085	2,358	+272	+1.0%
5	35,900	2,089	2,393	+304	+0.8%
6	44,406	2,303	2,429	+126	+0.3%
7	53,613	2,719	2,549	-170	-0.3%
8	66,179	2,800	2,902	+102	+0.2%
9	87,480	3,144	2,916	-228	-0.3%
10	161,801	4,119	2,740	-1,378	-0.9%

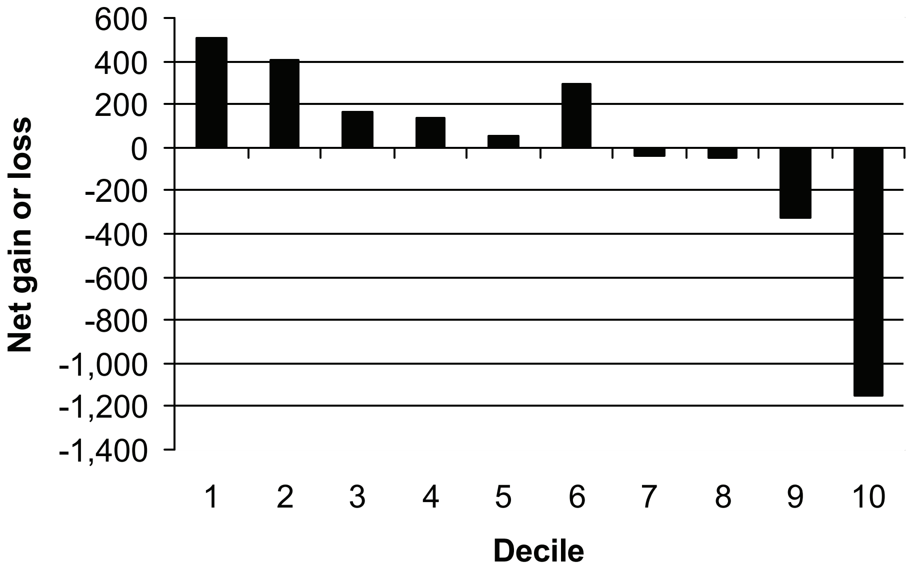
Note: income figures are pre-tax, but include transfers such as Social Security payments.

The exact carbon price is difficult to predict, but even if it were substantially higher or lower than $191 we still can be fairly certain of a progressive impact on income distribution (see Appendix). That's because our conclusions rest on well-known patterns of consumption and household size. It is clear, then, that a system based on the principle "*from* all according to their use of the atmosphere, *to* all according to their equal ownership" would help to reduce the disparity between rich and poor in the United States.

A New Model for a New Millennium

The sky trust would be a historic breakthrough, a gift to the 21st century as great as social insurance was to the 20th. Social insurance is an ingenious system for sharing risk, protecting people from loss of income due to age, disability, or temporary unemployment. The sky trust is a next step. Insurance provides a safety net; the sky trust provides a ladder. Insurance is costly and is unlikely to expand much further; the sky trust has plenty of room to grow.

Figure 1: Net Gain or Loss ($) per Household, by Decile



The sky trust would establish a new organizing principle. Social insurance draws from all according to their income and gives to all according to their longevity, disability, or economic need. The sky trust would draw from all according to their use, and give to all according to their equal ownership. It's hard to argue with that formula. One of the oldest principles of markets is that people should pay for what they use. The sky trust simply extends that principle to assets which, foolishly, had previously been priced at zero. Similarly, it is a basic tenet of capitalism that dividends should flow to property owners; the only novel notion here is that of *equal and universal* ownership.

How else could ownership of the sky be divided? One can argue that human-made assets should be unequally distributed in order to encourage individual effort. But who can argue that sky ownership should be unequally divided? After all, no person lifted a finger to create it. The atmosphere is a purely inherited asset, not from anyone's parents but from the common creation.

If a sky trust is created early in the 21st century, we can envision similar common ownership trusts emerging later in the century as other scarcities arise. Fresh water and habitats for biodiversity, for example, are other common assets whose scarcity will soon confront us. And new technologies, such as the Internet and genetic engineering, may unveil yet unknown scarcities, just as wireless radio did in the last century.

A sky trust, in sum, would marry two systems to meet two important goals. The cap and trade system would serve to limit use of a perishable commons so as to sustain it, while the trust would serve to preserve common ownership. This solution would thereby remedy not only Hardin's *ecological* tragedy of the commons, but also an oft-forgotten *economic* tragedy: loss of the commons by the commoners—a loss that typically occurs just when a commons becomes commercially valuable. The sky trust is equitable as well as ecological, efficient as well as effective. Moreover, it relies on property rights and market pricing, while it avoids taxes and government bureaucracy. Is there any better way for a market economy to stay dynamic, while it adjusts to scarcities created by its own success?

APPENDIX

This appendix looks more closely at the financial impact of the sky trust on households across the income spectrum. First, we show the impact on income distribution under three scenarios with varying carbon prices. Next, we compare the sky trust to the alternative possibility of redistributing benefits through the tax system. Finally, we note some caveats in our assessment of the costs and benefits of the sky trust.

The Three Scenarios

Our three scenarios project carbons prices of $83 per ton, $191 per ton, and $296 per ton. These prices translate into total scarcity rents in 2010 of $104 billion, $239 billion, and $368 billion, respectively. We find that regardless of the carbon price, the sky trust would have a progressive impact on income distribution.

The low and middle estimates come from the Second Generation Model (SGM) devised by the Pacific Northwest National Laboratory. The middle figure is based on the assumption that there would be only domestic trading of emission permits. The low figure assumes trading would be allowed among the relatively wealthy industrial countries that agreed to comply with the Kyoto Protocol (the so-called Annex I countries). The high figure comes from the MERGE3 model, devised by a research group from Stanford University and the Electric Power Research Institute (Manne and Richels 1999). In each case, we estimated the following:

- The carbon price generated by a 2010 emission cap at seven percent below 1990 levels, in compliance with the Kyoto Protocol.
- The decline in demand for each fossil fuel, both in the short run and the long run, as fuel prices rise in response to emission costs.
- The additional amount each household would spend on fuels and on goods and services made with fuels.
- The dividend distributed to each person through the sky trust.

Table 2 shows how the total scarcity rent rises with the equilibrium carbon price; Table 3 shows how the sky trust's costs and benefits would be distributed to households across

Table 2: Projected Carbon Prices and Revenues, Year 2010 (1999 dollars)

	High	Middle	Low
Carbon price ($ per ton)	$296	$191	$83
Total emissions (millions of tons)	1,243	1,249	1,249
Total revenue (billions)	$367,657	$238,710	$103,725
Avg. revenue per household	$3,639	$2,363	$1,027
Revenue per person	$1,409	$915	$397

the income spectrum. As the price of carbon varies, so does the impact on household income, but the pattern in all cases is the same: poorer households see a net benefit, and richer households see a net loss. Thus, regardless of the carbon price, the sky trust would help to narrow the income gap in the United States.

Table 3: Three Scenarios of Costs and Benefits Per Household in 2010 (1999 dollars)

	Cost			Benefit			Net effect		
Income decile	**High**	**Middle**	**Low**	**High**	**Middle**	**Low**	**High**	**Middle**	**Low**
1	1,792	1,158	503	2,340	1,512	657	+547	+354	+154
2	2,194	1,418	616	2,750	1,777	772	+556	+359	+156
3	2,786	1,800	782	3,149	2,034	884	+362	+234	+102
4	3,227	2,085	906	3,649	2,358	1,024	+421	+272	+118
5	3,234	2,089	908	3,704	2,393	1,040	+471	+304	+132
6	3,564	2,303	1,001	3,760	2,429	1,056	+196	+126	+55
7	4,208	2,719	1,182	3,945	2,549	1,108	-263	-170	-74
8	4,334	2,800	1,217	4,491	2,902	1,261	+157	+102	+44
9	4,865	3,144	1,366	4,512	2,916	1,267	-353	-228	-99
10	6,374	4,119	1,790	4,241	2,740	1,191	-2,133	-1,378	-599

The Sky Trust Versus a Tax Package

The sky trust can be compared with various plans for taxing carbon and then recycling by reducing other federal or state taxes. Depending on how the tax recycling is done, the net effect on different segments of Americans could vary greatly. We find, however, that it is much easier to achieve a progressive effect through the "one person, one share" sky trust than through the tax system.

For either the sky trust or a tax package, the net financial effect on households is the sum of two opposite flows:

- expense from higher prices for fossil fuels and for products made with fossil fuels.
- sky trust dividends or tax benefits.

With the sky trust, as indicated earlier, the six lower income deciles show net gains, while three of the four upper deciles show net losses. With tax shifting, the net effect would of course depend on the particular mix of taxes and tax cuts, and it is possible that the government would spend part or all of the tax revenue rather than rebating it fully through tax cuts. Numerous analysts have estimated the net results of various tax packages (Hamond 1999; Johnstone 1998; Krupnick 1993; Poterba 1991). Metcalf (1999) has done one of the most recent analyses.

Metcalf combines a carbon tax, an air pollution tax, and a motor fuels excise tax, totaling 10 percent of federal revenue in 1994, or $126 billion. He uses input-output data to trace the impacts of these taxes used in various industries, and assumes that the costs of higher fuel prices are passed on entirely to consumers. Then he uses data from the Consumer Expenditure Survey to identify consumption patterns for each income decile (tenth) of U.S. households. Using those patterns, Metcalf projects the distributional impacts of his pollution taxes, and finds that the taxes would cost $569 a year for the poorest decile and rise to $2,260 for the richest decile (Metcalf 1999, 51).

Metcalf then constructs a package of corresponding tax reductions to match the environmental tax increases. He proposes a reduction in Social Security payroll taxes, an increased tax credit per exemption taken in the federal personal income tax, and an overall cut in the federal income tax rate (Metcalf 1999, 15). We have taken Metcalf's reductions and scaled them up to match the total revenue flow projected in our base case, which projects total scarcity rent of $238 billion. At this level, the gains to households from the tax cuts range from $642 at the bottom to $4,209 at the top. Matching these gains to mean income by decile (see Table 1), the tax cuts alone turn out to be quite progressive, ranging from 9.3 percent of income for the first decile to 2.6 percent of income for the top decile.

While the tax cuts in Metcalf's package are progressive, they are not progressive *enough* to overcome the regressive effect of higher fuel prices. For the first decile, higher fuel prices cause household expenses to rise by 16.8 percent of median income. The burden is much lighter on higher-income groups, dropping to a 2.5 percent increase in expenses for the highest income decile. Consequently, the net result of the total tax package is regressive: the lowest-income decile loses $516 a year per household; the second through fourth deciles lose smaller amounts; and the fifth through tenth deciles come out ahead (Metcalf 1999, 51).

In other words, from the point of view of income distribution, Metcalf's tax shift is the mirror image of the sky trust (see Table 4). Even though the tax cuts he projects have a progressive impact, they cannot overcome the harmful effects of higher consumer prices, and so the net result is regressive. The reason is not hard to fathom. While the distribution of *costs* in both scenarios is similar, the distribution of *benefits* varies markedly, and is more strongly progressive in the "one person, one share" sky trust. Because spending on fuel costs, both directly and indirectly is a much higher fraction of income at lower income levels, it takes the highly egalitarian effect of the sky trust to yield net benefits for lower income groups.[7]

Caveats

Household size

Our analysis reveals that average household size rises with income, from 1.65 persons per household for the poorest decile to 3.18 for the ninth decile and 2.99 for the tenth (richest) decile. The reasons for this are not entirely clear, but it appears that many households in the lowest deciles, when ranked by income per household, have only one earner and relatively few children. Hence if sky trust dividends are distributed on a per person basis (as in our calculations), higher-income households enjoy more benefits relative to low-income ones than if dividends were paid out on a per household basis.

Table 4: Net Effect on Income Per Household (increase or decrease in annual pre-tax income) (1999 dollars)			
Income Decile	Sky trust	Metcalf tax package	Difference
1	+354	-516	+870
2	+359	-397	+756
3	+234	-266	+500
4	+272	-217	+490
5	+304	+100	+204
6	+126	+331	-205
7	-170	+72	-242
8	+102	+248	-146
9	-228	+543	-771
10	-1,378	+90	-1,469

This suggests an area for future research. Ranking households (or families) into deciles by the income per household may not be the most appropriate method of rating their incomes. Larger households have higher living costs than do smaller ones, so a ranking which accounts for those differences such as income per person, would yield a more accurate reflection of where households really fall in their ability to meet their living costs. Such a revised ranking of households—based on income per person rather than total incomer per household—would be likely to narrow the differences in the average family size across deciles; if so, the estimated net effect of the sky trust would be even more strongly progressive.[8]

Annual vs. lifetime income

We have drawn our conclusions about distributional impacts using data on annual income. Many economists believe, however, that households base their spending decisions on expectations about their long-run, or lifetime, income. A young family may buy a house or invest in higher education, for example, with the expectation that household income will rise over time. Therefore, economists sometimes use current expenditures as a proxy for lifetime income, and analyze distributional questions on this basis. Recalculations on this basis would yield somewhat different results, but would be unlikely to alter our basic conclusion that the sky trust's net impact on income distribution would be highly progressive.

Endnotes

[1] As James Boyce observes (Boyce 2001), this is more accurately termed the "tragedy of open access."

[2] Based on 9 million tons of sulfur allowances and allowance prices in the range of $200/ton during 1999. See http://www.epa.gov/acidrain/ats/prices.html.

[3] According to a recent study by Edward N. Wolff, the financial wealth of the top one percent of households exceeds the combined wealth of the bottom 95 percent (Wolff 1998, p. 37).

[4] The authors differ somewhat on this point. Breslow is more optimistic than Barnes that the government might favor the less affluent. Barnes hopes Breslow is right, but is ready to use non-state institutions (such as the commons) when appropriate. "Don't put all your eggs—or dreams—in one basket," he believes. Of course, federal legislation is needed to assign property rights to a sky trust. But winning a one-time battle to set up a sky trust is one thing; winning repeated battles over taxing and spending is quite another.

[5] See the Alaska Permanent Fund web site at http://www.apfc.org.

[6] The percentage for the richest 10% of households is likely to be an overestimate, however, because federal statistics do not report the incomes of the top decile above a few hundred thousand dollars per household, thus understating average income in the decile.

[7] A recent analysis of the distributional effects of carbon-allowance trading policies by the Congressional Budget Office (2000) compared four alternatives: (1) an initial giveaway of carbon allowances coupled with a cut in corporate income taxes; (2) an initial giveaway coupled with an equal lump-sum rebate to all households; (3) an auction of allowances coupled with a cut in corporate income taxes; and (4) an auction coupled with an equal lump-sum payment to all households. The last scenario is closest to the sky trust proposal (although we propose equal payments *per person*, rather than per household).

[8] Recall that higher income household receive greater payments by virtue of their larger household size. A reduction in size differences across deciles would reduce these payout differences.

References

Barnes, Peter. 1998. *Annual Report.* San Francisco: Corporation for Enterprise Development. Available at http://www.skytrust.cfed.

Barnes, Peter. 1999. "The Pollution Dividend." *The American Prospect* 44: 61-67. May/June. Available at http://www.prospect.org/archives/44/44barnes.html.

Boyce, James K. 2001. "From Natural Resources to Natural Assets." In *Natural Assets: Democratizing Community Ownership,* edited by James K. Boyce and Barry G. Shelley. New York: Russell Sage Foundation Press.

Common Cause. 1997. "Channeling Influence: The Broadcast Lobby & The $70 Billion Free Ride." April. Available at http://www.commoncause.org/publications/040297_rpt.htm.

Espey, Molly. 1998. "Gasoline Demand Revisited: An International Meta-analysis of Elasticities." *Energy Economics* 20: 273-295.

Hamond, Jeff, Hardy Merriman, and Gary Wolff. 1999. "Equity and Distributional Issues in the Design of Environmental Tax Reform." San Francisco: Redefining Progress. Uunpublished paper.

Hardin, Garrett. 1968. "The Tragedy of the Commons." *Science* 162(1968):1243-1248. Available at http://dieoff.org/page95.htm.

H. John Heinz Center for Science, Economics and the Environment. 1998. *Designs for Domestic Carbon Emissions Trading*. Available at http://www.heinzctr.org/programs/gcfinal.pdf.

Johnstone, Nick and Janaki Alavalapati. 1998. "The Distributional Effects of Environmental Tax Reform." Discussion Paper 98-01. London: International Institute for Environment and Development.

Kopp, Raymond, Richard Morgenstern, William Pizer and Michael Toman. 1999. "A Proposal for Credible Early Action in U.S. Climate Policy." Policy paper. Washington, D.C.: Resources for the Future. Available at http://www.weathervane.rff.org/features/feature060.html.

Krupnick, Alan J., Margaret A. Walls, and H. Carter Hood. 1993. "The Distributional and Environmental Implications of an Increase in the Federal Gasoline Tax." ENR 93-24. Washington, D.C.: Resources for the Future.

Kurosawa, Atsushi, Hiroshi Yagita, Zhou Weisheng, Koji Tokimatsu, and Yukio Yanagisawa. 1999. "Analysis of Carbon Emission Stabilization Targets and Adaptation by Integrated Assessment Model." *The Energy Journal*. "Special Issue: The Costs of the Kyoto Protocol: A Multi-Model Evaluation:" 157-176.

MacCracken, Christopher N., James A. Edmonds, Son H. Kim and Ronald D. Sands. 1999. "The Economics of the Kyoto Protocol." *The Energy Journal*. "Special Issue: The Costs of the Kyoto Protocol: A Multi-Model Evaluation:" 25-71.

Manne, Alan S., and Richard Richels. 1999. "The Kyoto Protocol: A Cost-Effective Strategy for Meeting Environmental Objectives?," *The Energy Journal.* "Special Issue: The Costs of the Kyoto Protocol: A Multi-Model Evaluation:" 1-24.

Metcalf, Gilbert E. 1999. "A Distributional Analysis of An Environmental Tax Shift," *National Tax Journal* 52(4):655-681.

Poterba, James M. 1991. "Is the Gasoline Tax Regressive?" In *Tax Policy and the Economy*, edited by David Bradford. Cambridge, Mass.: MIT Press.

Probyn, Christopher and Will Goetz. 1996. *Macroeconomic Impacts of Greenhouse Gas Control Policies.* Paper presented to the The Climate Change Analysis Workshop. DRI/McGraw Hill (June 6, 1996).

Sabelhaus, J. 1996. *Consumer Expenditure Survey: Family-Level Extracts, 1980:1-1994:1*. Washington, DC: Congressional Budget Office, mimeo.

U.S. Bureau of Labor Statistics. *Consumer Expenditure Survey.* http://www.bls.gov.

U.S. Census Bureau. 1988. *Current Population Survey, Annual Demographic Survey*. March Supplement. Cross tabulation from web site: ferret.bls.census.gov, 12/10/99. Also household income data extracted 4/23/2000, and medians per decile calculated by authors.

U.S. Department of Commerce, Economics and Statistics Administration, Bureau of the Census. 1998. *Statistical Abstract of the United States 1998*.

U.S. Energy Information Administration. 1998. *Impacts of the Kyoto Protocol on U.S. Energy Markets and Economic Activity.* SR/OIAF/98-03. Available at http://www.eia.doe.gov/oiaf/kyoto/kyotorpt.html.

U.S. Energy Information Administration. 1999. *Analysis of the Impacts of an Early Start for Compliance with the Kyoto Protocol*. SR/OIAF/99-02. Available at http://www.eia.doe.gov/oiaf/kyoto3/kyoto3rpt.html.

Weyant, John P. and Jennifer N. Hill. 1999. "Introduction and Overview." *The Energy Journal.* "Special Issue: The Costs of the Kyoto Protocol: A Multi-Model Evaluation:" viii – xliv.

Wolff, Edward N. 1998. “Recent Trends in Wealth Ownership.” Paper presented at New York University, Conference on Benefits and Mechanisms for Spreading Asset Ownership in the United States. New York (December 10-12).

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Peter Barnes is a writer and entrepreneur who has started and guided several socially responsible companies. Barnes's first business, The Solar Center, pioneered in providing solar-heated water to apartment buildings in the San Francisco Bay Area. He co-founded Working Assets Money Fund, one of the first socially screened investment funds, in 1983. Recognizing that people spend more money than they save, he created the Working Assets Visa Card in 1985. Working Assets Long Distance followed three years later. Barnes is a founding member of the Social Venture Network and Businesses for Social Responsibility.

Before entering business, Barnes was a writer and journalist for several publications, including *Newsweek* and *The New Republic*. He is the author of *Pawns: The Plight of the Citizen-Soldier* (Knopf, 1972) and *The People's Land: A Primer on Land Reform in the U.S.* (Rodale, 1974). He also serves on the boards of Greenpeace International, the Noise Polution Clearinghouse, TV-Free America, and the Mesa Refuge, a writers' retreat in Point Reyes Station, California. At present Barnes leads the Common Assets Project at the Corporation for Enterprise Development, which seeks to create an equity stake for citizens in common assets such as the sky.

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The Natural Assets Project

The Natural Assets Project, based at the Political Economy Research Institute of the University of Massachusetts, Amherst, is a collaborative initiative launched with support from the Ford Foundation. The project aims to promote critical analysis and discussion of the potential for building natural assets – individual and social wealth based on natural resources and ecosystem services – to advance the goals of poverty reduction, environmental protection, and environmental justice.

EXHIBIT 4

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Cap and Dividend: How to Curb Global Warming While Protecting the Incomes Of American Families

James K. Boyce & Matthew Riddle

November 2007

POLITICAL ECONOMY RESEARCH INSTITUTE

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CAP AND DIVIDEND:

HOW TO CURB GLOBAL WARMING WHILE PROTECTING THE INCOMES OF AMERICAN FAMILIES

James K. Boyce & Matthew Riddle

Political Economy Research Institute
University of Massachusetts, Amherst

November 2007

ABSTRACT

This essay examines the distributional effects of a "cap-and-dividend" policy for reducing carbon emission in the United States: a policy that auctions carbon permits and rebates the revenue to the public on an equal per capita basis. The aim of the policy is to reduce U.S. emissions of carbon dioxide, the main pollutant causing global warming, while at the same time protecting the real incomes of middle-income and lower-income American families. The number of permits is set by a statutory cap on carbon emissions that gradually diminishes over time. The sale of carbon permits will generate very large revenues, posing the critical question of who will get the money. The introduction of carbon permits – or, for that matter, any policy to curb emissions – will raise prices of fossil fuels, and have a regressive impact on income distribution, since fuel expenditures represent a larger fraction of income for lower-income households than for upper-income households. The net effect of carbon emission-reduction policies depends on who gets the money that households pay in higher prices. We find that a cap-and-dividend policy would have a strongly progressive net effect. Moreover, the majority of U.S. households would be net winners in purely monetary terms: that is, their real incomes, after paying higher fuel prices and receiving their dividends, would rise. From the standpoints of both distributional equity and political feasibility, a cap-and-dividend policy is therefore an attractive way to curb carbon emissions.

Key words: Global warming; fossil fuels; climate change; carbon permits; cap-and-dividend; cap-and-auction; cap-and-trade.

JEL codes: H22, H23, Q48, Q52, Q54, Q58

EXECUTIVE SUMMARY

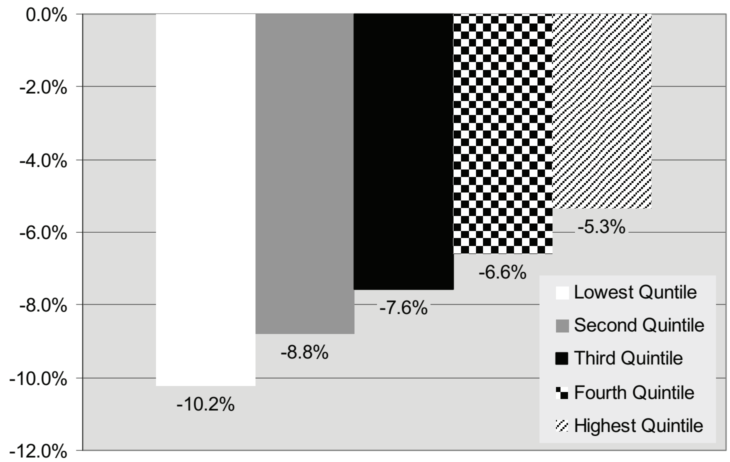
Policies to curb emissions of carbon dioxide – the main cause of global warming – will inevitably raise the prices of fossil fuels: coal, oil, and natural gas. The resulting price increases will reduce the real incomes of American families, striking hardest at those who can afford it least: lower-income households for whom fuel costs represent a higher fraction of their expenditures. The political feasibility of U.S. efforts to curb carbon emissions may hinge on whether policies are designed to protect middle-class and poor families from these adverse income effects.

A "cap-and-dividend" policy offers a simple and practical way to do this. The policy would auction carbon permits – rather than giving them free-of-charge to historic polluters – and then return all or most of the revenue to American families on an equal per person basis. Families who consume lower-than-average amounts of fossil fuels come out ahead, receiving more in dividends than they pay in higher prices. Those who consume more-than-average amounts pay more.

The policy has three basic steps:

- *First,* U.S. carbon emissions are capped at a level that gradually declines over time. One widely discussed target is to reduce emissions 80% below their current level by the year 2050.
- *Second,* based on the cap in a given year, permits are auctioned to firms that bring fossil carbon into the economy (whether through domestic extraction or imports). The supply of permits in a given year is fixed by the cap; their price depends on the demand for them.
- *Third*, revenue from the sale of permits is deposited into a trust fund and paid out equally to every woman, man, and child in the country. In addition, some fraction of the revenue initially may be earmarked for other uses, such as transitional adjustment assistance.

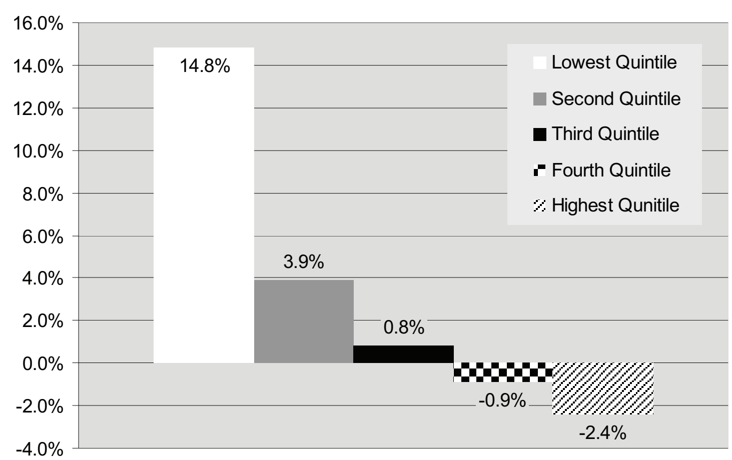
FIGURE A: IMPACT ON FAMILY INCOMES OF A $200/TON CARBON CHARGE



Source: Calculated from Table 7.

This paper calculates the net effects of a cap-and-dividend policy on income distribution in the United States. We estimate that a permit price of $200 per ton of carbon would reduce U.S. emissions by approximately seven percent. The resulting increases in the prices of fossil fuels, and in the prices of goods and services produced with them, would raise the cost of living of the median American family by $1,570 per year. The price increases would represent a larger percentage of family income in poor households than in more affluent households (see Figure A).

FIGURE B: NET IMPACT ON FAMILY INCOMES OF A CAP-AND-DIVIDEND POLICY



Source: Calculated from Table 9.

The revenue from the sale of carbon permits would amount to roughly $200 billion per year. If this revenue is recycled to the public equally, the majority of households receive more in dividends than they pay as a result of higher fossil fuel prices. The net impact ranges from a 14.8% income gain for the poorest 20% of families (and a 24% gain for the poorest 10%) to a 2.4% loss for richest 20% (see Figure B).

Initially earmarking a modest fraction of the carbon revenues for other uses, such as transitional adjustment assistance, could further enhance the appeal of the cap-and-dividend policy. Up to 10% of the carbon revenues can be dedicated to other uses while maintaining positive net benefits for roughly 50% of households. Withholding carbon revenues beyond this threshold would push the net beneficiary share of the population below half.

A cap-and-dividend policy will assert the principle of common ownership of nature's wealth: the right to benefit from our share of the Earth's capacity to absorb carbon emissions is allocated equally to all Americans. It will protect the real incomes of the majority of Americans while curbing global warming and hastening the U.S. economy's transition towards the energy sources of the future. From the standpoints of both distributional equity and political feasibility, a cap-and-dividend policy is therefore an attractive way to curb carbon emissions.

I. INTRODUCTION

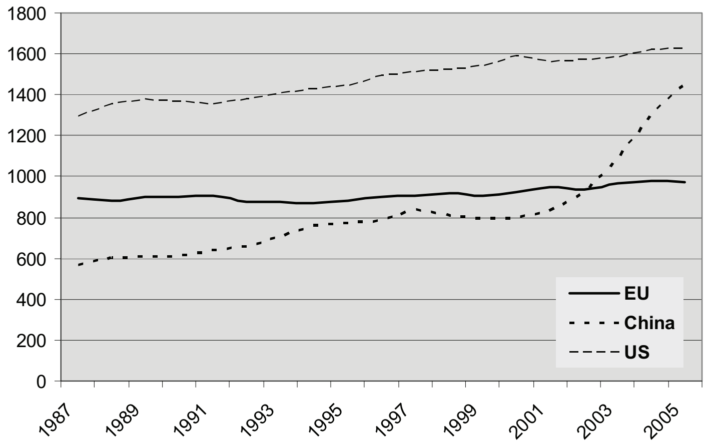
The time is coming when the United States government will enact policies to curb emissions of carbon dioxide and other greenhouse gases, joining the efforts of other nations to confront the historic challenge of global warming. When this happens, a key question – from the standpoints of both fairness and political feasibility – will be how to protect the incomes of American families.

The Clinton administration signed the 1997 Kyoto Protocol, which envisioned a 7% cut in U.S. carbon emissions from their 1990 level by the year 2012. But the Senate refused to ratify the agreement, and when the government of George W. Bush came to power it announced it had "no interest" in the accord.

Political winds in the country are now shifting. At the Group of Eight summit meeting in Germany in June 2007, the Bush administration agreed to re-enter international climate negotiations and to "seriously consider" a European plan to cut greenhouse gas emissions in half by 2050. A legislative proposal unveiled in August 2007 by U.S. Senators Joseph Lieberman and John Warner goes further, calling for a 70% reduction by 2050. It now seems possible, even likely, that the U.S. will adopt a serious emissions-reduction policy early in the post-Bush administration.

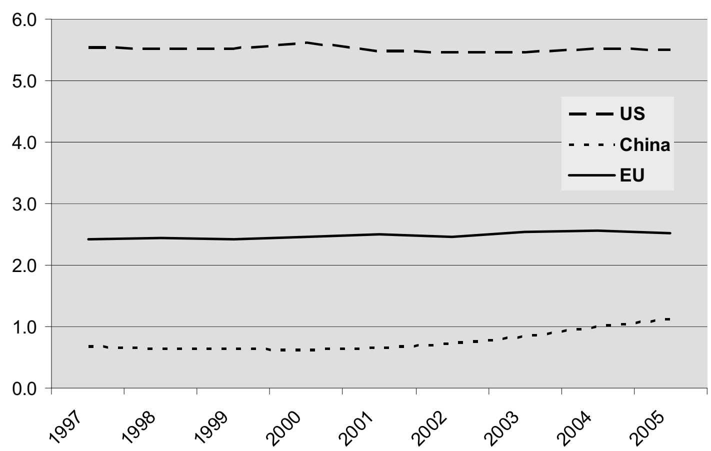
Any policy to curb carbon emissions will raise prices of fossil fuels – coal, oil, and natural gas – and the prices of other goods and services in proportion to the use of fossil fuels in supplying them. These price increases will reduce the real incomes of Americans in general, and low-income and middle-class American households in particular. But for every dollar paid by consumers in higher prices, someone else receives a dollar in additional income. Recycling this money to the public would protect real incomes of the majority of Americans. This paper examines how this can be done by a cap-and-dividend policy that distributes carbon revenues equally to all.

FIGURE 1A: CARBON EMISSIONS OF THE U.S, CHINA, AND EU-15, 1987-2005[1]
(MILLION METRIC TONS)



Source: U.S. Energy Information Administration (2007, Table H.1).

FIGURE 1B: CARBON EMISSIONS PER CAPITA OF THE U.S, CHINA, AND EU-15, 1987-2005
(MILLION METRIC TONS)



Source: U.S. Energy Information Administration (2007, Table H.1).

II. THE CARBON ECONOMY

The United States is the world's top emitter of carbon dioxide (CO_2), the most important greenhouse gas. The burning of fossil fuels in the U.S. released 1.6 billion metric tons (mt) of carbon (5.9 billion mt of CO_2) in 2005. This is 12% more than China, the second-largest emitter, and 65% more than the EU-15 (see Figure 1a).

TABLE 1: CARBON DIOXIDE EMISSIONS BY FUEL SOURCE AND SECTOR, 2004
(MILLIONS OF METRIC TONS OF CO_2)

Fuel Source	Petroleum	Coal	Natural Gas	Other[a]	total	% via electricit
Residential	141.6	695.4	372.8	4.1	1213.9	69.4
Transportation	1902.7	3.8	32.7	0.0	1939.2	0.2
Industrial[b]	465.4	747.4	519.9	3.3	1736.0	38.1
Commercial	88.2	669.0	272.9	3.9	1034.1	77.4
Total	2597.9	2115.6	1198.3	11.3	5923.2	39
(%)	43.9	35.7	20.2	0.2	100	

a. "Other" includes emissions from electricity generation from municipal solid waste and geothermal energy.
b. Industrial emissions from coal include net coke imports.
Source: Calculated from U.S. Energy Information Administration's Historical Data Series. For details, see endnote 2.

In per capita terms, U.S. emissions are five times higher than China's and more than double those of the EU-15 (see Figure 1b).

The composition of U.S. carbon dioxide emissions across fuels and sectors is shown in Table 1. Petroleum accounts for roughly 44% of emissions, coal for 36%, and natural gas for 20%. Electricity generation using these fuels accounts for 39% of the total, with coal-fired plants accounting for more than four-fifths of this amount. Transportation accounts for roughly one-third of total emissions, industry for a further 29%, residential energy use for 20%, and commercial energy use for 18%.

The "carbon footprint" of individual American households – the amount of carbon emissions generated in supplying the goods and services they consume – varies depending on their total expenditure and its composition. Table 2 shows how expenditure patterns varied across households in 2003, ranging from the poorest tenth of the population, whose annual per capita expenditure was under $2,000, to the richest tenth, whose per capita expenditure was close to $30,000.[3]

The carbon content of various categories of consumption items can be calculated from input-output accounts. These provide detailed data on the inputs used by each industry, making it possible to trace the price effects of a change in fossil fuel prices from industry to prices. For this purpose we rely on calculations by Metcalf (1999), updating his measure to reflect 2003 prices.[4] The results are presented in

TABLE 2: CONSUMPTION PATTERNS BY EXPENDITURE DECILE, 2003

Per capita expenditure decile	Per capita expenditure ($)	Average per capita expenditures by consumption category ($)							
		Food	Industrial goods	Services	Electricity	Household fuels	Car fuels	Air transport	Other transport
1	1927	659	225	729	128	52	124	3	8
2	3521	1118	426	1418	227	83	226	11	13
3	4736	1361	638	2001	278	113	304	23	18
4	5991	1621	904	2559	341	144	375	28	19
5	7380	1813	1188	3351	349	164	444	45	27
6	8847	2051	1795	3849	380	186	489	67	30
7	10711	2297	2219	4901	415	211	537	83	46
8	13228	2559	3343	5880	459	214	614	105	54
9	17178	3081	4821	7489	519	273	735	177	83
10	29943	4292	10908	12363	642	334	888	367	149
Total	10346	2085	2647	4454	374	177	474	91	45

Source: Authors' calculations from Consumer Expenditure Survey.

Table 3. As one would expect, the most carbon-intensive categories of consumption are electricity, household fuels (primarily heating oil and natural gas) and car fuels, each of which generates more than two metric tons of carbon per $1000 expenditure. The least carbon-intensive category is services, for which the corresponding figure is 80 kilograms.

TABLE 3: CARBON EMISSIONS PER DOLLAR EXPENDITURE BY CONSUMPTION CATEGORY

Consumption category	**tC per $1000** (2003 dollars)
Food	0.15
Industrial goods	0.14
Services	0.08
Electricity	2.82
Household fuels	2.64
Car fuels	2.08
Air transport	0.56
Other transport	0.30

Source: Calculated from Metcalf (1999); see text for details.

Combining the information in Tables 2 and 3, we can examine the average carbon emissions from U.S. household consumption across the range of per capita expenditure. The results are presented in Table 4. The consumption of the average American, with per capita expenditure of about $10,000, generates approximately 3.7 metric tons of carbon emissions.[5] Direct energy use in the form of car fuels, residential electricity, and household fuels (mainly heating oil and natural gas) accounts for roughly three-fifths of these emissions. Indirect use, via carbon emissions generated in producing other goods and services consumed by the household, account for the remaining two-fifths.

As one might expect, households with higher expenditure generally have bigger carbon footprints. As shown in the final column of Table 4, carbon emissions per person in the richest decile (tenth) of the population are more than double the national average, and more than eight times higher than the lowest decile.

Carbon emissions *per dollar* decline, however, as household expenditure rises. In the top decile, one dollar of expenditure on average generates 0.27 kilograms (kg) of carbon emissions; in the lowest decile the corresponding figure is 0.50 kg. The reason lies in their consumption patterns, as can be seen in Table 3: the poor spend a larger fraction of their household budget on electricity and fuels, while more affluent households spend a larger fraction on services and industrial goods. It so happens that necessities, which account for a larger share of the expenditure of the poor, are more-carbon-intensive than luxuries, which account for a larger share of the expenditure of the well-

TABLE 4: CARBON EMISSIONS BY EXPENDITURE DECILE (METRIC TONS OF CARBON PER YEAR)

Per capita expenditure decile	Per capita expenditure ($)	Average per capita carbon emissions by expenditure category								Total carbon emissions per capita
		Food	Industrial goods	Services	Electricity	Household fuels	Car fuels	Air transport	Other transport	
1	1927	0.10	0.03	0.05	0.36	0.15	0.26	0.002	0.002	0.96
2	3521	0.18	0.06	0.10	0.64	0.23	0.47	0.006	0.004	1.69
3	4736	0.21	0.09	0.15	0.79	0.32	0.63	0.013	0.005	2.21
4	5991	0.25	0.13	0.21	0.96	0.39	0.78	0.016	0.006	2.74
5	7380	0.27	0.17	0.27	0.99	0.46	0.92	0.025	0.008	3.11
6	8847	0.30	0.27	0.32	1.07	0.51	1.02	0.037	0.009	3.53
7	10711	0.34	0.33	0.41	1.17	0.58	1.12	0.047	0.014	4.01
8	13228	0.37	0.50	0.50	1.30	0.59	1.28	0.059	0.016	4.60
9	17178	0.44	0.72	0.64	1.47	0.75	1.53	0.099	0.025	5.66
10	29943	0.59	1.63	1.08	1.81	0.91	1.85	0.206	0.044	8.13
Total	10346	0.31	0.39	0.37	1.06	0.49	0.98	0.051	0.013	3.67

Source: Authors' calculations using data in Tables 2 and 3.

to-do. As a result, carbon emissions rise with household expenditure at a diminishing rate (see Figure 2). As discussed in the next section, this concave relationship has important implications for the distributional effects of public policies to reduce carbon emissions.

III. THE CASE FOR A CAP-AND-DIVIDEND POLICY

The most reliable way to reduce carbon emissions is to establish a "cap," a limit on the total amount of fossil-fuel carbon that enters the U.S. economy in a given year. The cap can gradually be lowered over time to meet targets for emissions reductions in future years. Based on the cap, a fixed number of annual permits are issued to suppliers of fossil fuels, including both domestic producers and importers. Whether these permits are sold or given away, they represent a claim on a scarce resource – the U.S. share of the biosphere's capacity to absorb and recycle carbon – and as such they have economic value.

The net effect of emission-reduction policies on household incomes depends on:

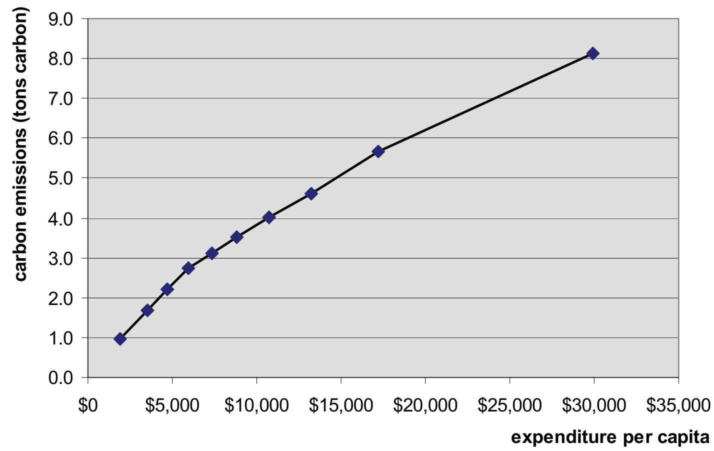
(i) how the household is impacted by higher prices for fossil fuels, and

(ii) how the economic value represented by carbon permits is distributed.

If the permits are given away, a key issue is who gets them. If they are sold, a key issue is who gets the money.

If the permits are given free-of-charge to energy companies – based, for example, on their historic levels of sales of fossil fuels – the result is a windfall gain to these firms, or more precisely, to their shareholders.[6] If the permits are auctioned to the highest bidder and the proceeds are retained by the government, the revenue is similar to that from a tax, and the money can be used to increase government spending and/or cut other taxes. In this paper we analyze a third option, in which the permits are auctioned and the revenue is rebated to the public on an equal

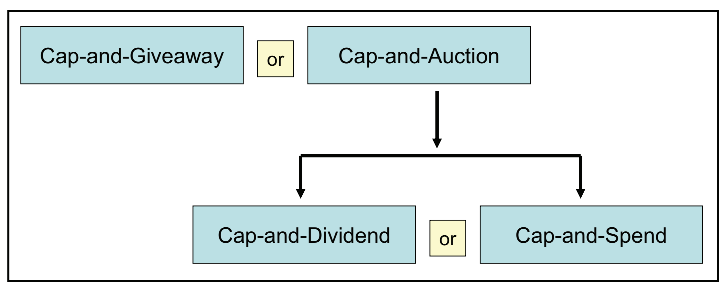
FIGURE 2: CARBON EMISSIONS AND HOUSEHOLD EXPENDITURE, 2003



Source: See Table 4.

per capita basis, a policy sometimes termed a "sky trust" (Barnes 2001).[7] We refer to these three policy options as "cap-and-giveaway," "cap-and-spend," and "cap-and-dividend," respectively (see Figure 3).

FIGURE 3: THREE POLICY OPTIONS FOR CARBON PERMIT ALLOCATION



From open access to common wealth

The enactment of policies to curb carbon emissions is tantamount to the creation of property rights to the sky, or more precisely, to the carbon-absorptive capacity of the biosphere. In the absence of such policies, this is an "open access" resource, in principle freely available to all but in practice disproportionately available to those with the wealth and power to claim it: those who burn the most fossil fuel.[8] Government regulations, carbon taxes, and carbon permits all assert the right to regulate access to this resource, effectively converting it into a form of property.

The question then becomes, who are the rightful owners of this property? If we believe that the gifts of creation are held by all of us in common, rather than being the property of private owners or the government, then the answer is clear: it belongs equally to every woman, man, and child in the country.

A cap-and-dividend policy would transform the U.S. share of the Earth's carbon-absorptive capacity from an open-access resource into the common wealth of all Americans. As a way to curb U.S. carbon emissions, this policy has four attractive features:

- *First,* the cap-and-dividend policy puts into practice the principle of common ownership of nature's wealth: rights to benefit from the carbon-absorptive capacities of the biosphere are allocated equally to all.
- *Second*, the cap-and-dividend policy protects the real incomes of the majority of the population in the face of higher prices for fossil fuels, surmounting a major political impediment to the adoption of policies to curb global warming.
- *Third*, the cap-and-dividend policy results in a progressive redistribution of income, the scale of which depends on the level of the carbon charges and how the carbon intensity of household expenditure varies with income.
- *Fourth,* unlike carbon taxes or a cap-and-spend policy, the cap-and-dividend policy's favorable distributional outcome does not hinge on the willingness and ability of the government to do "the right thing" – however this may be defined – with present and future carbon revenues.[9]

How would a cap-and-dividend policy work?

The cap-and-dividend policy would deposit the revenues from auction sales of carbon permits into a trust fund, an autonomous institution apart from the government budget, akin to the Social Security Trust Fund. These revenues would then be rebated to individuals on an equal per person basis.

Carbon revenues would be most easily collected "upstream," at the mine heads, oil refineries, natural gas pipelines, and ports where fossil fuels enter the U.S. economy. Nationwide there would be roughly 2000 such collection points (Kopp et al. 1999; CBO 2001). The costs of collecting the revenue would represent a very small fraction of the amount collected; the administrative costs of petroleum taxes and excise duties currently range from 0.12 to 0.25% of revenue (Smulders and Vollebergh, 2001, p. 116).[10]

A fixed number of carbon permits would be auctioned (monthly, quarterly, or annually), with the number determined by the national carbon cap at any given point in time. Permit holders would be entitled to bring fossil carbon into the economy within a specified time (say, one year from the date of purchase of the permit). A secondary market in permits could emerge – permit holders who decide not to use their carbon allotment could sell it to others – but with frequent auctions and limited permit life spans, this market would likely be small relative to the total number of permits.

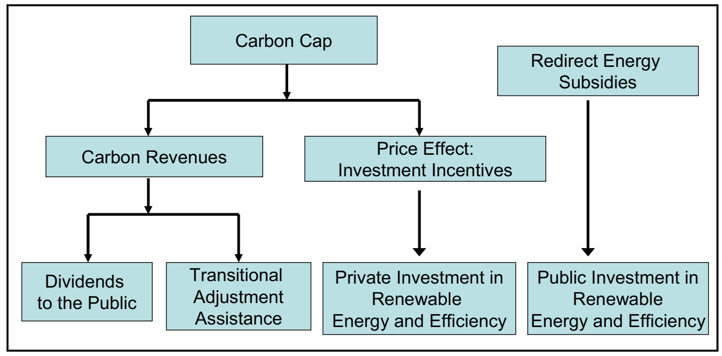
The number of permits issued would diminish over time, as the cap on carbon emissions is gradually tightened. Issuing a fixed number of permits rather than setting a fixed carbon charge (a "carbon tax") would guarantee that the nation's emission-reduction objectives are achieved. The price of the permits would depend on demand and supply. When the economy is booming, for example, higher demand for permits will lead to a higher price than when the economy is sluggish. Similarly, if higher fossil fuel prices and other policies spark rapid improvements in energy efficiency and development of renewable energy sources, the carbon permit price will be lower than if these occur more slowly. In contrast, setting a fixed price instead of a fixed number of permits would allow the quantity of carbon emissions to vary depending on these and other factors. Given the uncertainties as to the extent of emission reductions, the price-setting approach also could be more vulnerable to erroneous forecasts or political manipulations that undermine emission-reduction goals.

Revenues from the sale of carbon permits would be paid out equally to every man, woman, and child in the country. One way to distribute these dividends would be to issue "Sky Trust cards" that could be used at automatic teller machines (ATMs) to withdraw cash. If permit auctions are held quarterly, the balances in every individual's account would be topped up quarterly, too. As with bank accounts, individuals could check their balances online, as well as at the ATM. The administrative costs of issuing Sky Trust cards would be no greater than the current cost of issuing Social Security cards; in fact, after the initial distribution to existing holders of Social Security cards, the two operations could be combined.

In the case of children, an alternative way to distribute carbon revenues would be to accumulate their dividends in individual development accounts (IDAs) until they reach the age of eighteen. They could withdraw funds as they enter adulthood, perhaps with rules or incentives to encourage investment in further education or purchases of homes or businesses.

The introduction of carbon permits would alter relative prices throughout the economy. Fossil fuels, and goods and services whose supply relies heavily on them, would become more expensive, strengthening incentives to invest in energy efficiency and non-fossil energy sources. The energy investment playing field, which is currently tilted in favor of fossil fuels by the implicit subsidy resulting from free use of the Earth's finite capacity to recycle emissions, would become more level. The playing field could be further leveled by ending the explicit government subsidies currently given to fossil-fuel industries in the form of tax breaks and royalty-free access to public lands. Redirection of subsidies to public investment in energy

FIGURE 4: CAP-AND-DIVIDEND POLICY



efficiency and renewable energy would complement the stimulus to private investment arising from the realignment of relative prices.

The redirection of private investment is crucial for any strategy to curb global warming. The Intergovernmental Panel on Climate Change (2007, p. 13), which foresees future energy investments totaling more than $20 *trillion* worldwide between now and 2030, observes that limiting global carbon emissions to 2005 levels by 2030 "would require a large shift in the pattern of investment, although the net additional investment required ranges from negligible to 5-10%."

As documented below, a cap-and-dividend policy would protect the real incomes of the majority of American families in the face of rising fossil fuel prices. But households and communities that currently depend on employment in fossil fuel-intensive industries, such as coal mining, would nevertheless see income losses. To protect these vulnerable sectors, a fraction of the revenue from the sale of carbon permits could be earmarked initially for transitional adjustment assistance. For example, Barnes (2001) proposes a transition fund that initially would recycle 25% of the revenue and gradually be phased out over a ten-year period.

Figure 4 summarizes the basic features of a cap-and-dividend policy: cap carbon emissions; auction permits to bring fossil carbon into the economy; distribute revenues from permit sales to the public, with a fraction initially earmarked for transitional adjustment assistance; realign incentives for private investment; and redirect government subsidies to public investments in energy efficiency and renewable energy.

In the next section, we analyze how a cap-and-dividend policy would affect the distribution of income in the United States. Before doing so, we briefly review prior studies on the distributional impacts of higher fossil fuel prices and carbon revenue recycling.

Distributional impact of higher fossil fuel prices

Carbon emission-reduction policies – whether in the form of regulations, carbon taxes, or caps and permits – will raise the price of fossil fuels, at least in the foreseeable future. The increased price is the flip side of reduced use. The higher cost of coal, oil, and natural gas in turn alters relative prices of goods and services throughout the economy in proportion to the carbon embodied in their production and distribution. In the end, the price increases are passed along to consumers (although producers may absorb part of the cost via lower profit margins, a possibility to which we return below).

The result of higher prices, in terms of absolute dollars, is that those who consume more fossil fuels directly in the form of energy, and indirectly in the form of other goods and services whose supply uses fossil fuels, pay more. Since the rich generally consume more of most things than the poor, they pay more (although how much any specific household pays depends on its consumption decisions). Relative to total expenditure, however, the poor pay more as noted above. This means that carbon emission-reduction policies have a regressive impact on income distribution – unless coupled with revenue-recycling policies that protect the real incomes of the poor and middle classes.

Based on the data in Table 4, for example, we can calculate that a $200/ton price for carbon would translate into a $215 rise in the cost of living for the average person in poorest decile, equivalent to more than 10 per cent of annual expenditure. The cost of living in richest decile would rise by $1,475 per person, but this would be equivalent to less than 5 per cent of annual expenditure.

Previous studies have reached similar conclusions. The U.S. Congressional Budget Office (CBO), in an analysis of the distributional impacts of carbon permits, estimated that the price effects would reduce real incomes in the lowest quintile of the income distribution by 3.3%, almost twice the 1.7% reduction in the highest quintile (CBO 2000, p. 21). In a follow-on study, Dinan and Rogers (2002, p. 212) report an even sharper disparity: reductions of 6.6% and 1.7% for the poorest and richest quintiles, respectively. In estimates based on a higher carbon price, Barnes and Breslow (2003, p. 144) report the cost for the lowest decile to be equivalent to 16.8% of income, whereas the cost for the top decile is equivalent to 2.5% of income.

Studies in other industrialized countries generally support the conclusion that carbon charges are regressive – taking a bigger slice in percentage terms from low-income households than from high-income households – or, at best, distributionally neutral or mixed. An analysis by Symons et al. (1994) found that a carbon tax in the United Kingdom would be "severely regressive." In Canada, Hamilton and Cameron (1994) concluded that a carbon tax would be "moderately regressive." Cornwell and Creedy (1996) likewise found that a carbon tax in Australia would be regressive. Symons et al. (2000) reported regressive effects in Germany, France, and Spain, a mixed effect in the UK, and a neutral effect in Italy. Klinge Jacobsen et al. (2003) and Wier et al. (2005) found that Denmark's existing carbon taxes are regressive, and Brännlund and Nordström (2004) reported that increases in carbon taxes in Sweden would be regressive.[11] Summarizing studies from a number of OECD countries, Cramton and Kerr (1999, p. 261) conclude: "The weak regressivity of carbon regulation appears to hold across countries and modeling techniques."[12]

Carbon revenue recycling

When consumers pay higher prices for goods and services, in proportion to the fossil carbon embodied in them, a great deal of money changes hands. The net effect of carbon charges depends crucially on where this money goes.

Recognizing that carbon charges could generate annual revenues of "tens or hundreds of billions of dollars," the U.S. Congressional Budget Office (2000) compared two methods of allocating carbon emission allowances: selling them through an auction, or giving them away free-of-charge to the energy companies that produce and import fossil fuels. The CBO also compared two methods of revenue recycling: reducing corporate taxes or rebating an identical lump-sum amount to each household. The only policy mix found to have a progressive distributional effect was the "sky trust" combination of permit sales and lump-sum redistribution of the revenues.[13] In this case, the regressive effect of fossil-fuel price increases was outweighed by the progressive effect of equal payments to each household. With a carbon charge of $100/ton, the CBO estimated that after-tax incomes in the lowest quintile of the income distribution would rise by 1.8%, while those of the top quintile would decrease by 0.9%. In an extension of the CBO analysis, Dinan and Rogers (2002) reported somewhat stronger redistributive impacts: a 3.5% rise in incomes for the lowest quintile, coupled with a 1.6% decline for the top quintile.[14]

Both of these studies assumed that carbon charges create "deadweight losses" by reducing fossil fuel consumption (and also, in the Dinan and Rogers study, by lowering real returns to labor and capital and thereby reducing factor supplies). For example, when consumers curtail fuel consumption in response to higher prices, they experience welfare losses in the form of "the discomfort associated with keeping their house cooler in the winter or the loss in satisfaction that would result from canceling a vacation because of high gasoline prices" (CBO 2003, p. 3). The studies add these losses to the monetary costs borne by consumers in the form of higher prices for the fossil fuels that they continue to consume.

Neither study accounted, however, for the welfare *gains* that would result from reduced use of fossil fuels. These include benefits from the mitigation of climate change and "co-benefits" from reduced emissions of other pollutants, including airborne particulates and sulfur dioxide, that are released by burning fossil fuels.[15] Yet the rationale for policies to reduce carbon emissions is precisely that the welfare gains to society exceed the welfare losses. A comprehensive analysis of the welfare impacts of carbon emission-reduction policies would allocate these gains across households, too. In the absence of such an accounting, the incorporation of "deadweight losses" from carbon caps gives a misleading picture of net effects: it counts the cost of reducing carbon emissions without counting the benefits.

The effect of this one-sided treatment of welfare effects is that the total costs of carbon charges (from higher prices plus "deadweight losses") exceed the total amount of revenue to be recycled (from higher prices alone). This understates the cap-and-dividend policy's positive impact on incomes of low-income households, and overstates its negative impact on those of high-income households.

In this paper, we adopt the simpler – and, in our view, more appropriate – procedure of estimating the monetary impacts of carbon charges and revenue recycling alone, without attempting to incorporate other welfare effects. Barnes and Breslow (2003) followed this procedure in a third analysis of the distributional impact of a cap-and-dividend policy.[16] They find that the bottom decile would receive a net benefit equal to 5.1% of income, while the top decile would bear a net loss of 0.9%. Roughly 70% of the population sees net gains, getting more back in dividends than they pay in higher fuel prices. Insofar as public policy is guided by majority rule, this augurs well for the political feasibility of a cap-and-dividend policy for curbing carbon emissions.

IV. DISTRIBUTIONAL IMPACTS OF A CAP-AND-DIVIDEND POLICY

In this section we provide new estimates of the impacts of a cap-and-dividend policy on the distribution of income in the United States, taking into account both the impact of higher prices on consumers and the recycling of carbon revenue via equal per capita dividends.

Apart from using more recent data for these calculations, our analysis differs from prior studies in several respects. We stratify households on the basis of expenditure rather than income, on the grounds that expenditure is a better proxy for lifetime income. Since households differ in size, we use expenditure per person rather than expenditure per household, on the grounds that this is a better measure of relative income. In addition to our baseline estimate of the net impact of a cap-and-dividend policy, the next section examines how the results change when some fraction of the carbon revenue is allocated initially to other uses, such as transitional adjustment assistance. In the appendix, we also show how the results are affected if we assume that some fraction of the cost of carbon permits is absorbed by producers via lower profit margins, instead of being entirely "passed through" to consumers.

What price for carbon?

The amount of money that will be generated by the sale of carbon permits depends on both the quantity of permits sold and their price. The quantity is set by the carbon emission cap. The price depends on the price elasticities of demand for fossil fuels, which translate changes in quantity into changes in prices.

No one can be certain as to the precise magnitude of these elasticities, particularly in the long-run when induced technological changes are taken into account. The Intergovernmental Panel on Climate Change (2007, p. 19), for example, reports that carbon prices of $20-295 per ton ($5-80 per ton of CO_2) in the year 2030 would be consistent with a trajectory for eventual stabilization of atmospheric concentrations in the year 2100. This wide price range illustrates why setting a cap on the quantity of permits and letting market forces determine their price is preferable to setting a price on permits (or levying a carbon tax) and letting market forces determine the quantity of emissions. If our central aim is to meet a timetable for emissions reductions, fixing the quantity guarantees that we will hit the target. Fixing the price does not.

While we do not know the precise magnitude of the price elasticity of demand for fossil fuels, we do know that it is inelastic, particularly in the short run; that is, the percentage change in price exceeds the associated percentage change in quantity demanded. With a price elasticity of -0.2, for example, a 2% reduction in quantity requires a 10% increase in price. This means that the lower the quantity of emissions permitted under the cap (and the higher the price of the permits), the greater the total amount of revenue.

We base the calculations that follow on a permit price of $200 per ton of carbon (tC). This is near the middle of the range of carbon price scenarios used in the literature reviewed by Barnes and Breslow (2003, pp. 142-3). It is also close to the initial price of $180/tC ($50/tCO_2) that a recent study by the MIT Joint Program on the Science and Policy of Global Change reckons is needed to achieve an 80% reduction in emissions by the year 2050, with the price gradually rising to $730/tC by that year (Paltsev et al., 2007). While the price we use for our calculations affects the magnitudes of costs and benefits, it does not affect their distributional pattern across households: if the permit price were higher, then the costs, dividends, and net benefits would rise; if the price were lower, they would be smaller.[17]

Table 5 shows how a $200/tC charge would change energy prices, assuming the cost to be entirely passed through into the price to end-users. Price increases for gasoline, heating oil, and natural gas are in the 20-30% range. The price of coal rises much more steeply due to its

TABLE 5: IMPACTS OF $200/TON CARBON CHARGE ON FOSSIL FUEL PRICES

Fuel	Price (2006) a	Carbon charge	Price increase
Gasoline	$2.53/gallon	$0.53/gallon	21%
Heating oil	$2.42/gallon	$0.71/gallon	29%
Natural gas (residential)	$13.76/1000 cu. ft.	$3.26/1000 cu. ft.	24%
Coal (delivered to electric utilities)	$31.22/short ton	$116/short ton	371%
Electricity	9.45 cents/kwh	3.68 cents/kwh	39%

Note: a. Coal and electricity prices refer to the year 2005.
Sources: Price data from U.S. Energy Information Administration (EIA). For each individual fuel reference, see endnote 17.

relatively low price and high carbon content, and electricity prices rise by nearly 40%.

To calculate how these price increases impact households, we use the data on consumption patterns and the carbon content of goods and services reported in Tables 2 to 4. To incorporate the response of consumers to changes in relative prices, we use estimates drawn from other studies of the price elasticities of demand for the various consumption categories.[18] These are reported in Table 6.

TABLE 6: PRICE ELASTICITIES OF DEMAND

Consumption category	Price elasticity of demand
Food	0.6
Industrial goods	1.3
Services	1
Electricity	0.2
Natural gas	0.2
Heating oil	0.27
Car fuels	0.26
Air transport	0.25
Other transport	0.25

Note: Short-run own price elasticities of demand.

We estimate that a $200 per ton carbon charge would reduce U.S. emissions by approximately 7%. Put differently, if a cap on annual carbon emissions is set at 7% below current levels, and the corresponding number of carbon permits is auctioned to fossil fuel suppliers, we estimate that the market price for these permits will be approximately $200/tC. At this price, the total amount of revenue generated by permit sales is $198 billion per year.[19]

Baseline scenario

In Table 7, we present the distributional impacts of a cap-and-dividend policy, with the entire cost of carbon permits passed through to consumers and the entire revenue from the sale of permits recycled to the public in the form of equal per capita dividends. The amount per person that households pay in higher prices is reported in the "charge" column. This amount rises with per capita household expenditure, from $215/person/year in the poorest decile to $1,475/person/year in the richest decile.
The dividend is the same across all households: $678 per person. For the bottom six deciles, this exceeds the amount paid in higher prices; for the top four deciles the charge exceeds the dividend. In other words, roughly 60% of Americans come out ahead in sheer monetary terms from the cap-and-dividend policy, while 40% pay more in higher prices than they get back in their share of the dividends. The poorer the household, the larger the net benefit; the richer the household, the larger the net cost. The policy increases net incomes in the poorest decile by 24.0%, while net incomes in the richest decile decline by 2.7%.

These estimates are decile averages. But for any individual household, the net impact of the cap-and-dividend policy depends on its consumption pattern and how much it responds to changing relative prices by shifting from more carbon-intensive to less carbon-intensive consumption. Any household that curtails its direct and indirect consumption of fossil fuels to a level below the national average comes out ahead, receiving more money in dividends than it pays in higher prices, regardless of its expen-

TABLE 7: DISTRIBUTIONAL IMPACT OF A CAP-AND-DIVIDEND POLICY
(BASED ON A CARBON CHARGE OF $200/TC, WITH 100% RECYCLING TO INDIVIDUALS)

Per capita expenditure decile	Per capita expenditure ($)	Average household size	Per capita incidence ($)			As percentage of expenditures		
			Charge	Dividend	Net benefit	Charge	Dividend	Net benefit
1	1927	3.4	215	678	463	11.2%	35.2%	24.0%
2	3521	3.3	338	678	341	9.6%	19.3%	9.7%
3	4736	3.2	424	678	254	9.0%	14.3%	5.4%
4	5991	2.7	514	678	164	8.6%	11.3%	2.7%
5	7380	2.6	576	678	102	7.8%	9.2%	1.4%
6	8847	2.5	649	678	30	7.3%	7.7%	0.3%
7	10711	2.3	732	678	-53	6.8%	6.3%	-0.5%
8	13228	2.1	837	678	-158	6.3%	5.1%	-1.2%
9	17178	2.0	1024	678	-346	6.0%	3.9%	-2.0%
10	29943	1.8	1475	678	-797	4.9%	2.3%	-2.7%

Source: Authors' calculations (see text for details).

diture decile. The policy rewards "good behavior" – reductions in carbon emissions – across the income spectrum.

Cap-and-dividend versus cap-and-giveaway

The cap-and-dividend distributional outcome differs radically from what would happen under a cap-and-giveaway policy in which carbon permits are distributed free-of-charge to fossil-fuel firms. Both policies would increase the prices of fossil fuels, and of other goods and services in proportion to the use of fossil fuels in their supply, but instead of capturing the "rent" from permit sales and rebating it to the public on an equal per person basis, the cap-and-giveaway policy would generate windfall profits for fossil-fuel firms. These profits would flow to shareholders in the form of higher dividends and capital gains, benefiting households in proportion to their ownership of corporate stock. In the words of a U.S. Congressional Budget Office report (2007. p. 2), a giveaway strategy "would transfer income from energy consumers – among whom lower-income households would bear disproportionately large burdens – to shareholders of energy companies, who are disproportionately higher-income households."[20]

Data on the distribution of stock ownership by income decile are presented in Table 8.[21] Stock ownership is concentrated in upper-income households, with the top tenth owning nearly 65% of the total, and the top two-tenths owning 77%. Using these figures, we can approximate the distributional effects of a cap-and-giveaway policy.[22]

Table 9 summarizes distributional outcomes under these two policy scenarios. In contrast to cap-and-dividend, the cap-and-giveaway policy results in a regressive redistribution of income and imposes net costs on the majority of American households: the bottom nine deciles pay more as a result of higher fuel prices than they receive in stock dividends and capital gains. The contrast between the distributional outcomes of the two policies is depicted graphically in Figure 5, with the deciles combined into quintiles for simplicity.

TABLE 8: DISTRIBUTION OF STOCK OWNERSHIP

Per capita income decile	Stock ownership	Share of total stock
1	7437	0.8%
2	4564	0.5%
3	8697	0.9%
4	16069	1.7%
5	23066	2.4%
6	40296	4.2%
7	54571	5.7%
8	67427	7.0%
9	116542	12.1%
10	626335	64.9%

Source: Calculated from 2004 Survey of Consumer Finances.

TABLE 9: CAP-AND-GIVEAWAY VERSUS CAP-AND-DIVIDEND

Per capita expenditure decile	Per capita expenditure ($)	Household size	Cap-and-Giveaway: Net benefits per capita ($)	Cap-and-Giveaway: As % of total expenditures	Cap-and-Dividend: Net benefits per capita ($)	Cap-and-Dividend: As % of total expenditures
1	1927	3.4	-91	-4.7%	463	24.0%
2	3521	3.3	-244	-6.9%	341	9.7%
3	4736	3.2	-309	-6.5%	254	5.4%
4	5991	2.7	-355	-5.9%	164	2.7%
5	7380	2.6	-377	-5.1%	102	1.4%
6	8847	2.5	-342	-3.9%	30	0.3%
7	10711	2.3	-336	-3.1%	-53	-0.5%
8	13228	2.1	-360	-2.7%	-158	-1.2%
9	17178	2.0	-231	-1.3%	-346	-2.0%
10	29943	1.8	2645	8.8%	-797	-2.7%

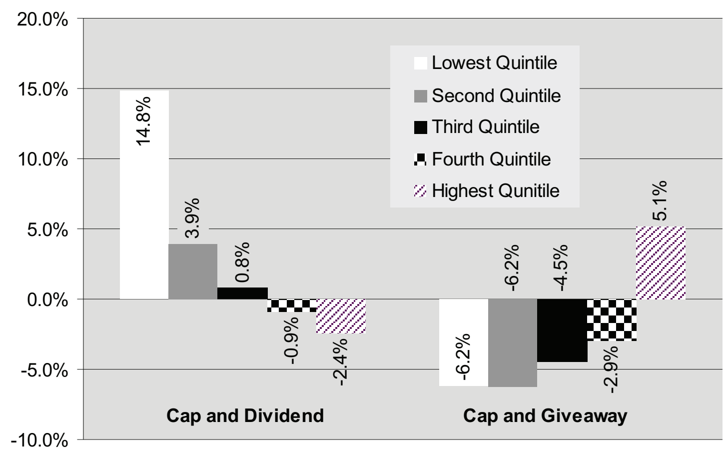
Based on a carbon charge of $200 per tC.
Source: Authors' calculations (see text for details).

In the absence of revenue recycling, the price increases arising from a carbon cap that yields a $200/tC permit price would raise the cost of living of the median American family by about $1,570 per year.[23] It is unlikely that the public would welcome such belt-tightening, particularly if they see the money going from their pockets into windfall profits for energy companies. Whether the public would be much happier if the money instead went to the government, as would occur with a cap-and-spend policy (or a carbon tax) is an open question. In contrast to these other policies, cap-and-dividend protects the real incomes of middle-class and low-income households. The political implications of these differences among policy outcomes should be evident.

Five caveats

Like all models of the distributional impacts of public policies, the estimates presented in Table 7 rest on a number of simplifying assumptions. We want to note five caveats in particular: (i) the assumption that the cost of carbon permits is passed through fully to consumers, rather than part of the cost being absorbed by producers via lower profit margins; (ii) the assumption of constant price elasticities of demand across expenditure deciles; (iii) the omission of welfare effects from our calculations; (iv) the omission of fossil fuel uses not tied to household consumption;

FIGURE 5: CAP-AND-DIVIDEND VERSUS CAP-AND-GIVEAWAY



Source: Calculated from Table 9..

and (v) the omission of sectoral employment impacts.

"Pass-through" to consumers. Studies of environmental policies – whether in the form of regulations, pollution taxes, or marketable pollution permits – typically assume that the costs these policies impose on firms are fully passed through to consumers in the form of higher prices. We have followed this conventional practice. It is plausible, however, that some fraction of the costs of carbon permits will be absorbed by producers via reduced profits – a possibility that may help to explain why producers often oppose environmental protection policies.

One reason why some firms might not shift the entire cost of carbon charges forward to consumers is that they are competing with other firms that are not equally impacted by the charges. Production costs of firms using less carbon-intensive technologies will rise less than those of firms in the same industry that use more carbon-intensive technologies.[24] To defend their market shares, the latter may trim profit margins rather than increasing prices to consumers enough to cover the full cost of their carbon permits. The ability of firms to absorb permit costs would be enhanced if they have been earning above-normal profits (for example, due to oligopolistic market power).

Households would bear the cost of any profit squeeze in proportion to their ownership of corporate stock. As noted above, this is highly unequal. Less-than-100% pass-through therefore would reduce the regressivity of carbon charges and enhance the progressivity of a cap-and-dividend policy. In the Appendix, we report calculations on distributional outcomes based on varying assumptions as to the actual extent of pass-through.

Constant price elasticities. In our calculations we assume that all households respond identically to price changes; that is, the price elasticity of demand does not vary across the expenditure spectrum. But there are plausible reasons to think that price elasticities may vary with income. For example, lower-income households may tend to respond more strongly to higher prices than upper-income households: with less money, they have a stronger incentive to economize.[25] In one of the few empirical studies of this question, West and Williams (2004) find that the lower-income households are more responsive to changes in the price of gasoline: in the poorest quintile they estimate the price elasticity of demand to be -0.73 (in other words, a 10% price rise leads to a 7.3% decline in demand), whereas in the richest quintile the price elasticity is only -0.18. If this pattern could be generalized, it would imply that our estimates overstate the impact of carbon charges on lower-expenditure households and hence understate the progressivity of a cap-and-dividend policy.[26]

Welfare effects. Our calculations refer only to the real-income effects of carbon charges and revenue recycling. As noted above, we do not attempt to take into account the positive and negative welfare effects arising from reduced use of fossil fuels. But it bears repeating that the underlying rationale for policies to curb carbon emissions is that the benefits of doing so outweigh the costs. In an analysis of welfare effects that excludes benefits from reduced global warming, De Canio (2007) concludes that the distribution of carbon revenues has much stronger effects on household incomes than the macroeconomic effects of the carbon cap, and that an egalitarian distribution of carbon revenues "will improve the material well-being of a majority of the agents, even without taking into account the environmental benefits of the emissions reductions."

Our analysis also does not take into account the diminishing marginal utility of income, the eminently plausible proposition that a dollar is worth more to a poor person than to a rich one. A cap-and-dividend policy would transfer dollars from richer households, where the marginal utility of a dollar is relatively low, to poorer ones, where the marginal utility of a dollar is relatively high. The incorporation of such "interpersonal comparisons" into a welfare-based accounting of distributional impacts would further reinforce the progressivity of the cap-and-dividend policy's outcome.

Non-household users of fossil fuels. The Consumer Expenditure Survey (CEX) data on which we rely for our calculations omit non-household end-users of fossil fuels and other goods and services. According to the national income accounts (NIA), consumption represented 71% of U.S. GDP in 2003 (the remaining items are investment, net exports, and government spending).[27] This is fairly close to the ratio of our CEX-based measure of carbon emissions reported in Table 4 (3.67 mt/person/year) to total

U.S. emissions reported in Figure 1b (5.46 mt/person/year).[28]

Carbon permits will raise prices to non-household end-users, too. For simplicity, we have omitted these from our calculations of both revenue and dividends, but the distributional outcome is not greatly affected by the omission. Assuming that carbon charges associated with investment are passed to consumers in the same way as variable input costs, the inclusion of investment would simply increase the magnitudes of revenue and dividends without altering substantially the distributional pattern of net benefits.[29] Since carbon permit charges are levied on exports but not imports, omission of trade effects leads to a modest understatement of net benefits to U.S. households: part of the revenue rebated to them comes from foreign consumers, while the permit charges do not raise import prices.[30]

In the case of government, there are two ways to offset the impacts of higher fossil-fuel prices on real expenditure while providing the governments with an incentive to improve energy efficiency and shift to alternative energy sources. The first is to earmark a share of total carbon revenues to be directly recycled to federal, state and local governments, according to a formula based on their expenditures. Assuming this share equals what they pay in increased costs as a result of higher fossil-fuel prices, our calculations of net benefits would be unaffected. The second option is to dividend all of the carbon revenue to households, and let governments recoup their higher costs through taxation. Assuming this is accomplished through progressive taxes, this would enhance the progressivity of net benefits from the cap-and-dividend policy.

Employment effects. Finally, our calculations do not include the short-run impacts of carbon emission-reduction policies on employment. These include both negative impacts on fossil fuel-based sectors of the economy and positive impacts on other sectors, notably those involving alternative energy sources. Since the shift in relative prices raises labor demand in some sectors while lowering it in others, there is no obvious reason to expect a substantial impact on aggregate employment. But insofar as alternative energy sectors are more labor-intensive than fossil-fuel industries – and there is some evidence that this is the case – the change may generate net increases in employment, particularly if investments are channeled into communities with high unemployment rates.

Labor does not move costlessly across industries and sectors, however. As we have noted, workers in fossil fuel-intensive industries could experience income losses as a result of policies that curtail carbon emissions. These adverse impacts could be offset by the provision of transitional adjustment assistance to the affected households and communities, an issue to which we turn in the next section. It is worth noting, however, that this issue arises with any public policy to reduce carbon emissions, not only a cap-and-dividend policy. Indeed, from the standpoint of displaced workers, cap-and-dividend at least has the advantage of offsetting the impact of higher fossil fuel prices on their real incomes, in the absence of which they would face a double blow from price effects as well as employment impacts.

V. EARMARKS FOR NON-DIVIDEND USES

In this section we examine how the distributional outcome of a cap-and-dividend policy would differ if part of the revenue from carbon permits is earmarked initially for other uses, such as transitional adjustment assistance, rather than being entirely recycled as individual dividends.

The baseline results reported above assumed that all of the carbon revenues are recycled to individuals in the form of equal per capita dividends. It is possible, however, that policy makers will decide to earmark part of the revenue from the sale of carbon permits for other uses, particularly during the first few years of the policy's im-

TABLE 10: EFFECT OF WITHHOLDING CARBON REVENUES FOR OTHER USES

Per capita expenditure decile	Per capita expenditure ($)	Net benefit/expenditure with different withholding percentages					
		0%	5%	10%	15%	20%	25%
1	1927	24.0%	22.3%	20.6%	18.9%	17.2%	15.5%
2	3521	9.7%	8.7%	7.8%	6.8%	5.9%	5.0%
3	4736	5.4%	4.7%	4.0%	3.3%	2.6%	1.9%
4	5991	2.7%	2.2%	1.6%	1.1%	0.5%	0.0%
5	7380	1.4%	0.9%	0.5%	0.0%	-0.4%	-0.9%
6	8847	0.3%	0.0%	-0.4%	-0.8%	-1.2%	-1.5%
7	10711	-0.5%	-0.8%	-1.1%	-1.4%	-1.8%	-2.1%
8	13228	-1.2%	-1.5%	-1.7%	-2.0%	-2.2%	-2.5%
9	17178	-2.0%	-2.2%	-2.4%	-2.6%	-2.8%	-3.0%
10	29943	-2.7%	-2.8%	-2.9%	-3.0%	-3.1%	-3.2%

Source: Authors' calculations.

plementation. For example, part of the revenue might be devoted to transitional adjustment assistance for workers and communities that suffer employment losses as a result of the reduced production and consumption of fossil fuels.

Other possible uses of carbon revenues include spending on public goods (such as investments in renewable energy), cuts in other taxes, and what might be termed transitional adjustment assistance to corporations (for example, via give-aways of a fraction of the carbon permits free-of-charge). Each of these may have its own attractions on political grounds, but there are economic and political costs to devoting more than a modest share of carbon revenues to them for reasons explained below.

The effects of withholding carbon revenues for other uses are shown in Table 10. We vary the percentage withheld from zero to 25% in five percentage-point increments, to show the sensitivity of our results to alternative assumptions. As the percentage earmarked for other uses goes up, net benefits to households go down and the percentage of households who come out ahead (in purely monetary terms) decreases. Whereas the bottom six deciles receive positive net benefits when 100% of the revenue is distributed in individual dividends (our baseline scenario, reproduced in the first column), only the bottom half receive positive net benefits with 10% of the revenue earmarked for other uses. With 20% earmarked for other uses, only the bottom four deciles come out ahead.

Note that these results refer only to the net impact of higher fossil fuel prices and individual dividends, without taking into account the distributional effects of other uses of carbon revenues. The latter would depend, of course, on precisely what these other uses are. If the other uses benefit lower-income and middle-income households, their losses from lower dividends could be offset and the distributional progressivity of the overall result possibly enhanced. On the other hand, if the other uses primarily benefit upper-income households, this would reduce their losses and diminish the progressivity of the policy mix.

In our view, there are good economic and political reasons to minimize the extent of non-dividend uses of carbon revenues:

- *First,* the scale of other uses must be limited if we are to meet the central policy goal of reducing carbon emissions while protecting the real incomes of lower-income and middle-income households. We regard income protection as a crucial ingredient of climate policy: any policy that instead puts the economic burden on the poor and middle class risks a political backlash that could fatally undermine public support for curbing carbon emissions.

- *Second,* greater investment in energy efficiency and renewable energy sources will be induced by raising the price of fossil fuels and eliminating the implicit subsidy these now receive by virtue of the zero-pricing of carbon emissions. Such investment could – and, we believe, should – be boosted further by redirecting explicit subsidies from fossil fuels to renewables. Currently, federal subsidies for the fossil-fuel industry in the form of tax breaks and royalty-free access to public lands are worth $24 billion per year (Andrews, 2007).[31] Reorienting these would dramatically increase federal support for energy efficiency and renewables without tapping the revenue from sales of carbon permits.
- *Third,* every dollar of revenues that is devoted to other uses is deducted equally from the dividends of all Americans, rich and poor alike. In other words, it is equivalent to a head tax: by taking a fixed amount from each person, it takes a higher percentage of income from the poor than from the rich. In effect, this would be one of the most regressive taxes in the country, a retreat from the principle of using progressive taxation to fund social expenditures.
- *Fourth,* using carbon revenues to make an equivalent cut in payroll taxes – as former vice-president Al Gore has advocated – would fail to protect the real incomes of lower-income and middle-income population who do not pay these taxes, including the elderly, the disabled and the unemployed.[32] It would also tie the future of Social Security and Medicare to a funding source that ultimately will shrink as the transition to a post-fossil fuel economy moves forward.
- *Finally,* if carbon revenues are used to finance government expenditures or tax cuts, there is no guarantee as to what these uses will turn out to be. Instead of a cut in payroll taxes, for example, we could see a cut in corporate income taxes; indeed, this is the alternative to the cap-and-dividend policy that was analyzed in the CBO studies. Instead of financing expenditures on renewable energy or mass transit, we could see increased government spending on subsidies for fossil fuel corporations. We live with the administrations we have, not necessarily those we want. A policy in which the revenues are dedicated to individual dividends comes as close as possible to building a "locked box" that is not vulnerable to political vicissitudes in future years.

VI. CONCLUSIONS

A cap-and-dividend policy would combine an effective means to curb U.S. carbon emissions from burning fossil fuels with protection of real incomes of lower-income and middle-income Americans from the consequences of higher fossil fuel prices.

Any policy that reduces carbon emissions will raise the prices of fossil fuels: higher prices are the handmaiden of lower demand. Higher prices for oil, coal, and natural gas will mean higher prices for goods and services produced with them. As documented in this study, these higher prices will hit the real incomes of lower-income and middle-income households harder than those of upper-income households.

But higher prices for fossil fuels are only one side of the story. The other side is summed up by the question, "Who gets the money?" If the money is recycled to the public on an equal per capita basis, via cap-and-dividend, the impact of the emissions-reduction policy on the distribution of incomes is transformed: lower-income and middle-income households come out ahead in monetary terms, both absolutely and relative to upper-income groups.

A cap-and-dividend policy has three basic steps:

- *First,* U.S. carbon emissions are capped at a level that gradually declines over time. For example, if we reduce emissions at a rate of 4% per year starting in 2010, we will cut emissions to 20% of their 2010 level by the year 2050.

- *Second,* based on the cap in a given year, permits are auctioned to firms that bring fossil carbon into the economy (whether through domestic extraction or imports). The supply of permits in a given year is fixed by the cap; their price depends on the demand for them.
- *Third,* the revenue from the sale of permits is deposited into a trust fund and paid out to all individuals on an equal per person basis. In addition, some fraction of the revenue initially may be earmarked for other uses, such as transitional adjustment assistance.

A cap-and-dividend policy has several attractive features. It asserts the principle of common ownership of nature's wealth: rights to benefit from the U.S. share of the Earth's capacity to absorb carbon are allocated equally to all Americans. It protects the real incomes of the majority of the population, overcoming a crucial political hurdle to the adoption of effective policies to curb global warming. It results in a progressive redistribution of income, a result that does not hinge on the propensity of present and future governments to use the revenues for egalitarian purposes.

At a permit price of $200 per ton of carbon, the annual revenue from the sale of permits would amount to roughly $200 billion. If this revenue is recycled to individuals equally, the majority of households will receive positive net benefits: their dividends exceed the amount they pay as a result of higher fossil fuel prices. The net impact ranges from a 2.7% loss for the richest 10% of households to a 24.0% gain for the poorest 10%. This "baseline scenario" assumes that 100% of the cost of carbon permits is shifted to consumers. If the extent of pass-through to consumers is less than 100%, and some of the cost is absorbed via lower profit margins, then the distributional progressivity of the outcome is enhanced and the percentage of American families who come out ahead increases.

Allowing a modest fraction of the carbon revenues to be earmarked initially for other uses, such as transitional adjustment assistance, could further enhance the political appeal of the cap-and-dividend policy. Our results indicate that up to ten per cent of the carbon revenues can be dedicated to other uses while maintaining positive net benefits for roughly 50% of households; withholding carbon revenues beyond the 10% threshold pushes the net beneficiary share of the population below half.

In sum, a cap-and-dividend policy is a "win-win" option for the majority of Americans, maintaining or increasing real incomes while curbing global warming and hastening the U.S. economy's transition towards the energy sources of the future. Not only is it an attractive policy on environmental, economic, and political grounds; it is, as far as we know, the *only* policy that combines these virtues in a realistic proposal. If the American public engages actively in shaping the nation's climate policies, the cap-and-dividend policy could become not just an attractive idea but a historic breakthrough.

APPENDIX:

Distributional Impact with Less-than-100% Pass-through to Consumers

In this appendix, we examine how the distributional impact of a cap-and-dividend policy would differ if part of the cost of carbon permits is absorbed by producers in the form of lower profit margins, rather than being passed fully to consumers in the form of higher prices.

Little empirical research has been done to ascertain the extent to which the cost of carbon permits will be passed through to consumers. In a recent literature review, Parry et al. (2005, p. 32) remark that "empirical studies on the extent to which the costs of environmental policies are passed forward into higher prices of consumer products would be extremely valuable." Studies on the extent of pass-through of sales and excise taxes have generated mixed results: some studies have found close to 100% pass-through, some have found significantly less, and still others have found "overshifting" in which prices rise by more than the amount of the tax (Fullerton and Metcalf 2004, pp. 1817-1823).[33]

If firms absorb part of the cost of carbon permits via lower profit margins, this has two effects on our calculations. First, it reduces the incomes of households in proportion to their ownership of corporate stock. Second, it translates into a higher permit price and higher total revenues for a given emission cap. (Permit prices rise because the reduction in demand for fossil fuels is a function of the price increases passed through to consumers; total revenues rise because demand is price-inelastic).

To examine the effects of less-than-100% pass-through of carbon charges to consumers, we assume that reductions in corporate profits are distributed amongst households on the basis of stock ownership as reported in Table 8. We vary the share of permit costs absorbed via lower profits from 0% (our baseline scenario) to 25% in five percentage-point increments, to show the sensitivity of the results to alternative assumptions. That is, we allow the percentage of the carbon charge that is passed through to consumers to vary from 75% to 100%.

The results are presented in Table A.1. The first column – with zero charge from profits, or 100% pass-through – shows the net distributional impact of the cap-and-dividend policy as reported in Table 7. Subsequent columns show the distributional impact with rising shares of the permit price coming from corporate profits. As the pass-through to consumers diminishes, net benefits to lower-income and middle-income households increase. Insofar as the carbon charges cut into corporate profits rather than being shifted fully to consumers, our baseline results understate the favorable distributional impacts of the cap-and-dividend policy.

TABLE A.1: IMPACT OF VARYING PERCENTAGE OF CHARGE FROM PROFITS

Per capita expenditure decile	Per capita expenditure ($)	Net benefit /expenditure with different percentage of charge from profits					
		0%	5%	10%	15%	20%	25%
1	1927	24.00%	25.70%	27.60%	29.70%	32.20%	35.00%
2	3521	9.70%	10.60%	11.70%	12.90%	14.30%	15.90%
3	4736	5.40%	6.00%	6.80%	7.70%	8.60%	9.80%
4	5991	2.70%	3.20%	3.80%	4.40%	5.10%	5.90%
5	7380	1.40%	1.80%	2.20%	2.60%	3.20%	3.80%
6	8847	0.30%	0.60%	0.80%	1.10%	1.50%	1.90%
7	10711	-0.50%	-0.30%	-0.20%	0.00%	0.20%	0.50%
8	13228	-1.20%	-1.10%	-1.00%	-0.90%	-0.80%	-0.70%
9	17178	-2.00%	-2.10%	-2.10%	-2.20%	-2.20%	-2.30%
10	29943	-2.70%	-3.30%	-4.10%	-4.90%	-5.80%	-6.90%
Carbon charge (per tC)		$200.00	$210.53	$222.22	$235.29	$250.00	$266.67

Note: Assumes 100% revenue recycling via dividends.
Source: Authors' calculations.

Notes

[1] EU-15 refers to the fifteen member states of the European Union as of 1995. Emissions for Germany prior to German reunification in 1990 are the total for West Germany and East Germany.

[2] Emissions resulting from electricity use are allocated across fuel sources on the basis of total emissions from the electric power sector. Emissions by sector:
http://www.eia.doe.gov/emeu/aer/pdf/pages/sec12_5.pdf.
Emissions from electricity generation by fuel source:
http://www.eia.doe.gov/emeu/aer/pdf/pages/sec12_16.pdf.

[3] The data in Table 2 are drawn from the Consumer Expenditure Survey, conducted quarterly for the U.S. Bureau of Labor Statistics by the Census Bureau. We pooled annual consumption data for households that began participating in the survey from the 3rd quarter of 2002 through the 2nd quarter of 2003.

[4] We calculated separate price impacts for air transport and "other transport" (including trains and mass transit), categories combined in Metcalf's study, using data from the 1992 input-output accounts (Lawson 1997).

[5] The higher per capita emissions shown in Figure 1b (5.5 tC) include carbon emissions from other sources, such as government expenditure, in addition to those associated with household consumption.

[6] This is what happened when the European Union introduced carbon permits for electric power generation and gave them free-of-charge to utility companies. For accounts, see Ball (2006) and Dutzik et al. (2007. p. 22). As Paltsev et al. (2007, p. 5) note, if regulated utility markets were to prevent price rises (and windfall profits), this would dissipate the incentive for consumers to curb consumption.

[7] This is an extension of the 'feebate' concept, whereby fees are paid according to the extent of individual resource use, and the proceeds rebated equally to all use-rights holders. This idea has been applied to a variety of environmental problems; see, for example, Puig-Ventosa (2004). For an early application to gasoline taxes, see Shepard (1976).

[8] The so-called "tragedy of the commons" – in which unrestricted access to a scarce resource leads to its overuse – is more accurately termed the tragedy of open access, since communities often devise rules to protect common-property resources. Open access often leads to a second tragedy, too: those who reap most of the short-run benefits from open access are the wealthy and powerful, while those most severely impacted by the long-run costs are the poor and relatively powerless. For discussion, see Boyce (2002, pp. 7-8).

[9] It is possible to design alternative uses of carbon-charge revenues that are superior, at least in theory, to lump-sum redistribution on efficiency or distributional grounds (see Zhang and Baranzini 2004, pp. 511-2). In practice, however, these alternatives would be subject to the vagaries of fiscal politics. Moreover, Unlike the cap-and-dividend policy, they would not affirm the fundamental principle of equal rights to nature's common wealth.

[10] For discussion of administrative costs, see also Fisher et al. (1998). As the CBO (2001, p. 19) notes, administrative costs would increase if charges were levied not only on fossil fuels, but also on imports of carbon-intensive products (such as aluminum) so as to avoid placing domestic producers at a disadvantage in the absence of similar carbon policies in the exporting countries. Presumably these cost increases would be offset by the additional revenue collected.

[11] A recent study of Italy's carbon tax (Tiezzi 2005) finds that it has a progressive incidence, however, by virtue of the facts that it is designed to hit transport fuels harder than domestic fuel use and that higher-income Italian households were less responsive to higher prices.

[12] In assessing distributional impacts, researchers often stratify households on the basis of expenditure rather than income, on the grounds that expenditure is a better proxy for lifetime income and less subject to transitory shocks. We do the same in this paper. If incidence instead is calculated on the basis of income data, carbon charges generally appear to be even more regressive because expenditure-to-income ratios typically decline as incomes rise. For discussion, see Metcalf (1999).

[13] The give-away option, sometimes referred to as "grandfathering," was the main method adopted when sulfur dioxide emission permits were introduced in the U.S. in the 1990s. Insofar as the resulting windfall profits are taxed, this method generates some government revenue (albeit less than if the permits were sold by auction). In an analysis of the effects of grandfathered carbon emissions permits with profits taxed at the rate of 35%, Parry (2004) likewise finds that the distributional impact is regressive even when coupled with lump-sum redistribution of the revenues recouped by taxation, due to the skewed distribution of profit income.

[14] The stronger distributional effects in the Dinan and Rogers study arise mainly from (i) use of a lower value for average income in the lowest quintile, and (ii) incorporation of an estimated "deadweight loss" in factor markets due to the impact of higher carbon prices on real returns to capital and labor.

[15] For a tool for calculating co-benefits, see Mulholland (2007). For estimates of damages from releases of particulates, sulfur dioxide, and nitrogen oxides in the U.S., see Muller and Mendelsohn (2007).

[16] The authors assume that dividends are distributed equally per person, rather than equally per household as in the CBO (2000) and Dinan and Rogers (2002) studies.

[17] A doubling of the permit price would not quite double total revenue and net benefits, because it would entail reduced demand and fewer permits.

[18] For energy sectors, the elasticities are based on the literature review by Dahl (1993). For food, services, and in-

dustrial goods, we use Williamson's (2006) "stylized facts of demand."

[19] This falls near the middle of the $50-300 billion/year range (in 2007 dollars) that the U.S. Congressional Budget Office (2007, p. 2) reports as the likely value of carbon emission permits in 2020, based on a review of the existing literature and the range of emission-reduction goals currently being debated.

[20] One rationale sometimes offered for a cap-and-giveaway strategy is that it would compensate shareholders of fossil-fuel companies for declines in stock values arising from lower sales. At the same time, however, shareholders of renewable-energy companies would be expected to experience increases in stock values due to higher sales. Some shareholders win, others lose. We see no compelling reason for the public to insure the shareholders of polluting firms against the risk that society will adopt policies to curb pollution. In any event, as the U.S. Congressional Budget Office (2007, p. 5) notes, compensation to adversely affected shareholders would require only a "small fraction" of the total value of carbon permits. Goulder (2002) estimates that a cap-and-giveaway policy with permits rising from a modest initial price of $25/tC to a final price of $50/tC would lead to a sevenfold increase in stock values for coal companies and to a doubling of stock values for oil and gas firms.

[21] The deciles in Table 8 are grouped by per capita income rather than per capita expenditure. (The difference between the two probably explains the anomalous finding that the bottom decile owns somewhat more stock than the second lowest decile.) We have not found comparable data for expenditure deciles. These stock ownership data include both direct ownership of stocks and indirect ownership through mutual funds and other sources. For discussion, see Bucks et al. (2006).

[22] For simplicity, we assume that all windfall profits are recycled to U.S. households in proportion to their stock ownership. In practice, some profits would "leak" out of the country in returns to foreign owners of stock in fossil-fuel companies, diminishing net benefits of the cap-and-giveaway policy to U.S. households. Some profits might also be withheld from shareholders and instead used to increase executive compensation. For both reasons, the cap-and-giveaway results presented in Table 9 can be regarded as a "best-case" approximation that, if anything, understates net costs for the majority of households.

[23] This is the average per capita charge for the 5th and 6th deciles, multiplied by the average household size in these deciles, as reported in Table 7.

[24] A similar situation could arise for tradable goods producers who face competition from foreign firms not covered by the carbon permit mandate. All else equal, the introduction of carbon permits in the U.S. economy would make imports more competitive and exports less competitive. In industries where these trade effects are significant, there is a case for corrective policies: tariffs on imports (based on fossil carbon emissions in their production) and dividends on exports. Careful research is needed to assess needs for such compensating policies. We note, however, that many foreign competitors (notably in Europe) now pay higher prices for fossil fuels than U.S. producers, due to government environmental and taxation policies. In these cases, it would be difficult to argue that introducing carbon permits would place U.S. firms at an unfair disadvantage. More generally, trade competitiveness depends on many factors – including exchange rates, labor costs, taxation, and the pace of technological innovation – and these are likely to overshadow the effects of environmental policies, which empirical studies generally find to be quite small (for discussions, see Goodstein 1999 and Ackerman 2006).

[25] To be sure, lower-income households devote a higher proportion of their expenditure to necessities than to luxuries, and from this it is sometimes inferred that they tend to be less responsive, for example, to changes in the price of gasoline (Kayser 2000). But the same reasoning applies to non-fuel expenditures by lower-income households: not cutting gasoline consumption in response to higher prices would imply bigger cutbacks in other necessities such as food and health care. A more plausible reason to expect greater price responsiveness among upper-income households is that in some cases (such as buying more energy-efficient vehicles), cutbacks in fuel consumption require investments in expensive durable goods.

[26] Other studies of price elasticity differences across the income spectrum have produced mixed results. West (2004) and Archibald and Gillingham (1980) also find that lower-income US households are more responsive to gasoline prices than are upper-income households, while Kayser (2000) reports a contrary finding. In a study in the United Kingdom, Dargay and Vythoulkas (1999) also find greater price-responsiveness among lower-income households: the long-run elasticity of car ownership with respect to running costs is -0.92 for low-income groups, -0.51 for middle-income groups, and -0.38 for high-income groups (see also U.K. Department for Transport, 2006). In a study of Denmark, Brännlund and Nordstrom (2004) find little variation across income groups in the price elasticities of demand for gasoline and other goods.

[27] Unlike the CEX, the NIA consumption measure includes expenditures by non-profit institutions serving households, which account for roughly 11% of consumption, or 8% of GDP (based on 1993 data cited by Garner et al. 2006, p. 22). Subtracting this from the NIA measure, household consumption represented roughly 63% of national income.

[28] Another possible source of discrepancy between the two figures is under-reporting of consumption in the CEX. The CEX-based estimate of total consumption in the United States, derived from household surveys, is roughly 60% of the National Income Accounts-based estimate of aggregate consumption, derived primarily from economic censuses of firms (for discussion, see Garner et al. 2006). In part, this disparity arises from definitional differences (for example,

the latter includes consumption by many non-profit institutions whereas the CEX does not), and in part from measurement errors in one or both instruments. Insofar as under-reporting in the CEX accounts is to blame, this would affect the pattern of distributional impacts reported here only if the under-reporting were uneven across expenditure deciles. Since we lack adequate data on which to assess this possibility, we make do with the data at hand. If the degree of any under-reporting in the CEX is roughly constant across deciles, then its only effect on the distributional impacts of a cap-and-dividend policy reported in Table 7 would be on absolute magnitudes, not on the pattern of relative impacts across deciles.

[29] If investment per unit output and carbon emissions per dollar investment are roughly the same across sectors, inclusion of investment-related emissions would somewhat reduce the disparities in carbon content across consumption categories reported in Table 3. Since low-carbon categories account for a larger share of expenditure by upper-income households, this would reduce the regressivity of carbon charges and enhance the progressivity of the cap-and-dividend outcome.

[30] In some cases, however, trade policies may compensate for these effects; see note 24.

[31] To put this number in perspective, in 2005 public expenditure on research & development for wind energy, fuel cells and photovoltaics combined was about $250 million (Kammen and Nemet 2005, p. 86).

[32] See “Solving the Climate Crisis,” speech by Al Gore at New York University, 18 September 2006. Available at http://www.nyu.edu/community/gore.html.

NOTE TO APPENDIX

[33] A related but distinct issue is the impact of higher prices on the “welfare triangles” of consumers’ surplus and producers’ surplus. Basic microeconomic theory tells us that the ratio of these welfare losses depends on price elasticities of demand and supply: the more inelastic the demand curve, the higher the share of consumers; the more inelastic the supply curve, the higher the share of producers. These calculations assume that the full cost of carbon permits (or carbon taxes) is passed through to consumers. If the supply curve is not perfectly elastic, the reduction in output leads to a decline in marginal cost and this dampens the rise in the market price, but consumers still are assumed to pay the full carbon charge (the difference between the marginal cost of production without permits and the market price with permits). Here we do not attempt to incorporate the welfare losses from reduced consumers’ surplus and producers’ surplus, nor the welfare gains from reduced carbon emissions, for reasons explained in section 3.

REFERENCES

Ackerman, Frank (2006) "The Unbearable Lightness of Regulatory Costs," Fordham Urban *Law Journal*, May.

Andrews, Edmund L. (2007) "Democrats Press Plan to Channel Billions in Oil Subsidies to Renewable Fuels," *The New York Times,* June 18.

Archibald, Robert and Robert Gillingham (1980) "An Analysis of the Short-Run Consumer Demand for Gasoline Using Household Survey Data," *Review of Economics and Statistics* 62(4): 622-628.

Ball, Jeffrey (2006) "For German Firms, New Emission Caps Roil Landscape," *The Wall Street Journal*, September 11.

Barnes, Peter (2001) *Who Owns the Sky? Our Common Assets and the Future of Capitalism.* Washington, D.C.: Island Press.

Barnes, Peter and Marc Breslow (2003) "The Sky Trust: The Battle for Atmospheric Scarcity Rent," in James K. Boyce and Barry G. Shelley, eds., *Natural Assets: Democratizing Environmental Ownership.* Washington, DC: Island Press, pp. 135-149.

Boyce, James K. (2002) *The Political Economy of the Environment.* Cheltenham and Northampton: Edward Elgar.

Brännlund, Runar and Jonas Nordstrom (2004) "Carbon Tax Simulations Using a Household Demand Model," *European Economic Review* 48: 211-233.

Bucks, Brian K., Arthur B. Kennickell, and Kevin B. Moore (2006) "Recent Changes in U.S. Family Finances: Evidence from the 2001 and 2004 Survey of Consumer Finances," *Federal Reserve Bulletin* 92: A1-A38.

Cornwell, Antonia and John Creedy (1996) "Carbon Taxation, Prices and Inequality in Australia," *Fiscal Studies* 17(3): 21-38.

Cramton, Peter and Suzi Kerr (1999) "The Distributional Effects of Carbon Regulation: Why Auctioned Carbon Permits are Attractive and Feasible," in Thomas Sterner, ed., *The Market and the Environment.* Northampton, MA: Edward Elgar, pp. 255-271.

Dahl, Carol (1993) "A Survey of Energy Demand Elasticities in Support of the Development of the NEMS," U.S. Department of Energy, National Energy Modeling System (NEMS), Contract No. DE-AP01-93EI23499.

Dargay, Joyce M. and Petros C. Vythoulkas (1999) "Estimation of a Dynamic Car Ownership Model: A Pseudo-Panel Approach," *Journal of Transport Economics & Policy* 33(3): 287-302.

De Canio, Stephen J. (2007) "Distribution of Emissions Allowances as an Opportunity," *Climate Policy* [forthcoming].

Dinan, Terry M. and Diane Lim Rogers (2002) "Distributional Effects of Carbon Allowance Trading: How Government Decisions Determine Winners and Losers," *National Tax Journal* 55: 199-222.

Dutzik, Tony, Rob Sargent and Emily Figdor (2007) *Cleaner, Cheaper, Smarter: The Case for Auctioning Pollution Allowances in a Global Warming Cap-and-Trade Program*. Boston: U.S. PIRG Education Fund. Available at http://www.uspirg.org/uploads/Ma/3Q/Ma3Qikh9OWao1QdkyV9bHw/Cleaner-Cheaper-Smarter-USPIRG.pdf.

Fisher, Carolyn, Suzi Kerr and Michael Toman (1998) "Using Emissions Trading to Regulate U.S. Greenhouse Gas Emissions: Design and Implementation Issues," *National Tax Journal* 51(3): 453-464.

Fullerton, Don and Gilbert E. Metcalf (2004) "Tax Incidence." In A.J. Auerbach and M. Feldstein, eds. *Handbook of Public Economics, Volume 4.* New York: Elsevier.

Garner, Thesia I., George Janini, William Passero, Laura Paszkiewicz and Mark Vendemia (2006) "The CE and the PCE: A Comparison," *Monthly Labor Review* 129(9): 20-46.

Goodstein, Eban (1999) *The Trade-Off Myth: Fact and Fiction about Jobs and the Environment.* Washington, DC: Island Press.

Goulder, Lawrence H. (2002) "Mitigating the Adverse Impacts of CO2 Abatement Policies on Energy-Intensive Industries," Washington, DC: Resources for the Future, Discussion Paper 02-22.

Hamilton, Kirk and Grant Cameron (1994) "Simulating the Distributional Effects of a Canadian Carbon Tax," *Canadian Public Policy* 20(4): 385-399.

Intergovernmmental Panel on Climate Change (IPCC) (2007) "Summary for Policymakers," in Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmmental Panel on Climate Change. Available at www.ipcc.ch/SPM040507.pdf.

Kammen, Daniel M. and Gregory F. Nemet (2005) "Reversing the Incredible Shrinking Energy R&D Budget," *Issues in Science and Technology* 22(1): 84-88.

Kayser, Hilke A. (2000) "Gasoline Demand and Car Choice: Estimating Gasoline Demand Using Household Information," *Energy Economics* 22: 331-348.

Klinge Jacobsen, H., K. Birr-Pedersen K., and M. Wier (2003) "Distributional Implications of Environmental Taxation in Denmark," *Fiscal Studies* 24(4): 477-499.

Kopp, Raymond, Richard Morgenstern, William Pizer, and Michael Toman (1999) "A Proposal for Credible Early Action in U.S. Climate Policy," Washington, DC: Resources for the Future. Available at http://www.weathervane.rff.org/features/feature060.html.

Lawson, Ann M. (1997), "Benchmark Input-Output Accounts for the U.S. Economy, 1992," *Survey of Current Business* 77(11): 36-82.

Metcalf, Gilbert E. (1999) "A Distributional Analysis of Green Tax Reforms," *National Tax Journal* 52(4): 655-681.

Mulholland, Denise (2007) "Estimating and Valuing Human Health Effects of State and Local Emissions Reductions: The Co-Benefits Risk Assessment (COBRA) Screening Model," Washington, DC: U.S. Environmental Protection Agency.

Muller, Nicholas Z. and Robert Mendelsohn (2007) "Measuring the Damages of Air Pollution in the United States," *Journal of Environmental Economics and Management* 54(1): 1-14.

Paltsev, Sergey *et al.* (2007) "Assessment of U.S. Cap-and-Trade Proposals," Cambridge, MA: Massachusetts Institute of Technology Joint Program on the Science and Policy of Global Change, Report No. 146, April. Available at http://web.mit.edu/globalchange/www/MITJPSPGC_Rpt146.pdf.

Parry, Ian W.H. (2004) "Are Emissions Permits Regressive?" *Journal of Environmental Economics and Management* 47: 364-387.

Parry, Ian W.H., Hilary Sigman, Margaret Walls, and Roberton C. Williams III (2005) "The Incidence of Pollution Control Policies," Washington, DC: Resources for the Future, Discussion Paper 05-24, June.

Puig-Ventosa, Ignasi (2004) "Potential Use of Feebate Systems to Foster Environmentally Sound Urban Waste Management," *Waste Management* 24: 3-7.

Shepard, Lawrence (1976) "The Short-Run Incidence of a Gasoline Tax Rebate Plan," *Journal of Economic Issues* 10(1): 169-172.

Smulders, Sjak and Herman R.J. Vollebergh (2001) "Green Taxes and Administrative Costs," in Carlo Carraro and Gilbert E. Metcalf, eds., *Behavioral and Distributional Effects of Environmental Policy.* Chicago: University of Chicago Press, pp. 92-129.

Symons, Elizabeth, John Proops, and Philip Gay (1994) "Carbon Taxes, Consumer Demand and Carbon Dioxide Emissions: A Simulation Analysis for the UK," *Fiscal Studies* 15(2): 19-43.

Symons, Elizabeth, Stefan Speck, and John Proops (2000) "The Effects of Pollution and Energy Taxes across the European Income Distribution," Keele University Economics Research Paper No. 2000/05.

Tiezzi, Silvia (2005) "The Welfare Effects and the Distributive Impact of Carbon Taxation on Italian Households," *Energy Policy* 33: 1597-1612.

U.K. Department for Transport (2006) "Generalized Cost Elasticities & Income Level: Literature Review." Available at http://www.dft.gov.uk/foi/responses/2006/jul/aandrsternreview/informationregardinganalyses2737.

U.S. Congressional Budget Office (2000) *Who Gains and Who Pays Under Carbon-Allowance Trading? The Distributional Effects of Alternative Policy Designs.* Washington, DC: CBO, June.

U.S. Congressional Budget Office (2001) *An Evaluation of Cap-and-Trade Programs for Reducing U.S. Carbon Emissions.* Washington, DC: CBO, June.

U.S. Congressional Budget Office (2003) *Shifting the Cost Burden of a Carbon Cap-and-Trade Program.* Washington, DC: CBO, July.

U.S. Congressional Budget Office (2007) "Trade-Offs in Allocating Allowances for CO_2 Emissions," *CBO Economic and Budget Issue Brief,* 25 April.

U.S. Energy Information Administration (2007) *Energy Information Annual 2005.* Washington, D.C.: U.S. Department of Energy. Available at http://www.eia.doe.gov/emeu/iea/carbon.html.

West, Sarah E. (2004) "Distributional Effects of Alternative Pollution Control Policies," *Journal of Public Economics* 88: 735-757.

West, Sarah E. and Robertson C. Williams III (2004) "Estimates from a Consumer Demand System: Implications for the Incidence of Environmental Taxes," *Journal of Environmental Economics and Management* 47: 535-558.

Wier, Mette, Katja Birr-Pedersen, Henrik Klinge Jacobsen, and Jacob Klok (2005) "Are CO_2 Taxes Regressive? Evidence from the Danish Experience," *Ecological Economics* 52: 239-251.

Williamson, Jeffrey G. (2006) *Did British Capitalism Breed Inequality?* London: Routledge.

Zhang, Zhongxiang and Andrea Baranzini (2004) "What Do We Know about Carbon Taxes? An Inquiry into their Impacts on Competitiveness and Distribution of Income," *Energy Policy* 32: 507-518.

EXHIBIT 5

CLEAR ECONOMICS:

STATE-LEVEL IMPACTS OF THE CARBON LIMITS AND ENERGY FOR AMERICA'S RENEWAL ACT ON FAMILY INCOMES AND JOBS

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Revised July 2011

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EXECUTIVE SUMMARY

This study examines the economic impacts of the Carbon Limits and Energy for America's Renewal (CLEAR) Act, focusing on household incomes and job creation across the states.

The CLEAR Act would put a cap on the use of fossil fuels so as to reduce emissions of carbon dioxide, the most important greenhouse gas. Any policy that limits the use of fossil fuels will raise their price, impacting real family incomes. But the net impact on family incomes depends on who gets the money that is paid by consumers as a result of higher fuel prices.

The CLEAR Act recycles 75% of this money to the public in the form of equal monthly dividends, and devotes the remaining 25% to clean energy investments. Dividends will insulate household incomes from the impact of higher fossil fuel prices. Expenditures from the Clean Energy Reinvestment Trust (CERT) Fund will create jobs in energy efficiency and renewable energy.

Dividends are the same for all, so the net impact on family incomes (dividends minus the impact of carbon prices) will vary among households depending on the amount of fossil fuels they consume directly and indirectly. Families who consume more will have lower net benefits; families who consume less will have higher net benefits. But regardless of their consumption level, all will have an incentive to limit their use of fossil fuels in response to the market price signals resulting from the cap.

Because high-income households generally consume more fossil fuels than low-income and middle-income households, they will tend to pay more as a result of higher fuel prices than they receive as dividends. These income-related differences in net impacts also apply at the level of interstate comparisons: all else equal, states with lower per capita incomes will receive higher net benefits from the CLEAR Act dividends than states with higher per capita incomes.

But states also differ in other ways that will affect net impacts, such as the carbon intensity of their electricity supplies. At any given income, families in states that get most of their electricity from coal-fired plants will face bigger price increases than families in states that get most of their electricity from less carbon-intensive sources. This effect is offset to some extent, however, insofar as more coal-intensive states tend to have lower average incomes.

We find that interstate differences in impacts on household incomes are small: much smaller than differences across the income spectrum, and vastly smaller than the differences in other federal programs, such as defense spending. As a result, the CLEAR Act delivers positive net benefits to the median household — and to the majority of households — in each and every state.

Nevertheless, interstate differences may be of concern to policy makers. If so, there are two ways to address these concerns: (i) by adjusting dividends in the initial years of the policy, by providing state-specific dividends that equalize net impacts on the median household in each state; or (ii) by allocating investments under the CERT Fund so as to offset these interstate differences.

Interstate differences could be eliminated altogether by modifying the Act so as to provide state-specific dividends, calibrated to equalize net impacts on median households across the states. To avoid creating perverse long-term incentives for states to rely on dirty energy, these dividends could converge towards the national average over time. Under this approach, initially 66% of total carbon revenue would go to a base dividend received by residents in every state, and 9% to dividend supplements that vary based on the impact of higher fossil fuel prices on median households.

Interstate differences alternatively could be addressed in the allocation of the CERT Fund, by directing more investment to states with higher unemployment and/or greater potential economic dislocations from the shift away from fossil fuels. We estimate that the CERT Fund will create roughly 360,000 jobs nationwide. This estimate only counts jobs created by public expenditure; it does not count net job creation from shifting private expenditure away from fossil fuels and towards more labor-intensive spending on energy efficiency and renewable energy. An advantage of this approach is that it focuses attention on the production side of the economy, where interstate differences are likely to be more significant, rather than on the consumption side, where interstate differences are relatively small.

INTRODUCTION

This study analyzes the economic impacts of the Carbon Limits and Energy for America's Renewal (CLEAR) Act, a bill introduced by Senators Maria Cantwell (D-WA) and Susan Collins (R-ME) in December 2009. Specifically, we estimate impacts on household incomes and job creation across the 50 states.

The CLEAR Act aims to safeguard both the Earth's climate and the economic security of American families. The Act seeks to protect the climate by capping the use of fossil fuels, so as to gradually reduce U.S. carbon emissions by 80% by the year 2050. At the same time, the Act seeks to protect family incomes by recycling three-quarters of the revenues from the sale of carbon permits directly to the public, and devoting the remaining one-quarter to job-creating investments in the clean energy transition.

First, we sketch the basic features of the CLEAR Act. We then estimate its impacts on household incomes, state-by-state and across income brackets, taking into account the net impacts of higher fuel prices and the revenue recycled to households. Finally, we estimate the job creation that would result from an interstate allocation of investment funds based on differences in carbon emissions from electricity consumption, unemployment, and population.

CLEAR BASICS

The CLEAR Act is a "100-75-25-0" climate policy:

- *100%* of the permits to bring fossil carbon into the U.S. economy will be auctioned — there are no permit giveaways. The bill strictly limits the buying and selling of permits to prevent carbon market speculation and profiteering.
- *75%* of the auction revenue is returned directly to the public in the form of equal dividends per person. These "energy security dividends" are paid monthly to every man, woman, and child lawfully residing in the United States.
- *25%* of the auction revenue is deposited into a Clean Energy Reinvestment Trust (CERT) Fund to be used for investments in energy efficiency, clean energy, adaptation to climate change, and assistance to sectors that face economic dislocation during the transition from the fossil-fueled economy.
- Zero "offsets" are allowed. Polluters cannot avoid buying permits or curbing their use of fossil fuels by paying someone else here or abroad to clean up after them.

Equal treatment across firms and households

The Act provides equal treatment for producers in the fossil fuel industry, regardless of whether they are in coal, oil, or natural gas. These firms will be required to buy permits, called "carbon shares," for each ton of fossil carbon that they bring into the nation's economy. The total number of permits is set by the cap, which gradually decreases over time. Because all permits are auctioned — with no free giveaways to favored industries — the result is a level playing field: every molecule of fossil carbon is treated equally.

The Act provides equal treatment for consumers, too. All U.S. residents receive the same monthly dividend, regardless of their income and regardless of where they live. These dividends insulate family purchasing power, or real incomes, from the impact of higher energy prices that result from the cap. Households that consume below-average amounts of fossil fuels (and fewer things produced and distributed using them) will come out ahead in pocketbook terms: their dividends will exceed what they pay in higher prices. Households that consume large quantities of fossil fuels will pay more than they get back. All households have an incentive to economize on the use of fossil fuels, in response to the price signal resulting from the cap. For any given household, the net impact of the policy on real income depends on its consumption decisions.

Region-specific allocations of investment

While equal treatment across firms and households is a central feature of the bill, the CLEAR Act recognizes that weaning the economy from fossil fuels poses special challenges for carbon-intensive regions and states. For this reason, the bill specifies that the CERT Fund will provide targeted, region-specific assistance to workers, communities, industries, and small businesses that experience hardship during the nation's transition to a clean energy economy.

Other uses of the CERT Fund include investments in the reduction of emissions of greenhouse gases other than carbon dioxide; biological carbon sequestration, at home and abroad; and energy efficiency and clean energy research and development (for a complete list, see the appendix to this study). Subject to the Act's guidelines on eligible uses, decisions on how to allocate CERT Funds among alternative investments are left to the Congressional appropriations process.

Carbon revenue: Follow the money

The amount of money that will be raised annually by carbon permit auctions, and redistributed via dividends to the public and CERT Fund investments, is likely to be quite substantial. In 2020, the reference year for which we present estimates in this study, the cap will limit carbon dioxide emissions to 5.4 billion tons. If we assume a permit price of $25/ton — which is within the "collar" of minimum and maximum prices mandated in the bill[1] — this translates into total permit revenue of $135 billion.

These billions do not materialize out of thin air. The counterpart to the total value of the permits is the higher cost to consumers, as firms pass through the cost of carbon permits to end-users of fossil fuels.[2] Although higher fuel prices are a cost to consumers, they are not a cost to the U.S. economy as a whole. Instead they are a *transfer*. Unlike the situation when fuel prices rise for other reasons — such as OPEC supply caps or rising world demand — the extra dollars paid as a result of a cap-and-permit policy are recycled within the national economy. The economic pie remains intact. What changes is how the pie is sliced—and this depends on who gets the money.

THE CLEAR DIVIDEND: IMPACT ON HOUSEHOLD INCOMES

The CLEAR Act specifies that carbon permits will be auctioned to fossil fuel firms, rather than distributed free of charge. The firms will pass through the costs of the permits to consumers via higher prices. In other words, the money that the firms receive from consumers by virtue of higher prices equals what they pay for the permits.[3] The CLEAR Act specifies that 75% of the carbon permit revenue will be recycled directly to the public in monthly dividends (see box, above, for a description of how the dividends would be paid out).

The net impact of this transfer on household incomes is the difference between what the household receives as dividends and what it pays as a result of

How will dividends be paid?

The most efficient way to pay the monthly climate policy dividends to the American public is via electronic funds transfer (EFT).

ETF is now the most widely used method by which federal and state agencies distribute recurrent payments to individuals. The United States Treasury's Financial Management Service currently disburses almost one billion payments annually on behalf of the Social Security Administration, the Department of Veterans Affairs and other federal agencies, and more than 80% of these are disbursed electronically.

The two main EFT methods are direct deposit into bank accounts and Electronic Benefit Transfer cards. The first requires that the recipient has a bank account. The second transfers funds through an industry-standard magnetic-stripe debit card that is protected by a personal identification number (PIN).

Paper checks are sent to the minority of recipients who prefer non-electronic transfers. Because this method of disbursement is considerably more costly than EFT, the Treasury Department has launched its "Go Direct" campaign which has persuaded millions of recipients to switch from paper checks to EFT.

The costs of electronic transfers amount to pennies each — a tiny fraction of the payments themselves.

1 The minimum and maximum permit prices set by the bill for the year 2012 are $7 and $21, respectively. The bill specifies that the real (inflation-adjusted) minimum price will rise by 6.5%/year and the real maximum price by 5.5%/year. Therefore in 2020 the price collar (in 2012 dollars) will be $11.58-$32.23.

2 Household consumption — both direct expenditures on fossil fuels and indirect expenditures on goods and services produced and distributed using them — accounts for roughly 66% of U.S. carbon emissions. The remainder comes from local, state, and federal government expenditure, non-profit institutions, and exports (Boyce and Riddle 2008, Table 1).

3 Most economic analysts assume that firms will pass 100% of the permit cost onto consumers. For an analysis of how alternative assumptions on the percentage pass-through would affect estimated impacts on households, see Boyce and Riddle (2007).

higher fossil fuel prices. When its dividends exceed what it pays, the household experiences a net financial benefit as a result of the policy. When what it pays exceeds its dividends, the household experiences a net financial cost. In this section we describe how net benefits vary across states and income brackets.

Net impacts across the states

Table 1 shows state-by-state net impacts on median households — households whose per capita income puts them exactly in the middle of the state's income distribution. The dividend per person, shown in the first column, is the same in every state: in 2020, at a permit price of $25/ton, it comes to $297/person. What the household pays as a result of higher fossil fuel prices differs, however, because consumption patterns vary across states, due, among other reasons, to differences in median incomes, home heating and cooling needs, and the carbon intensity of the state's electricity supply.[4] As a result, net impacts vary across the states, too.

The CLEAR Act specifies that 75% of the carbon permit revenue will be recycled directly to the public in monthly dividends.

Interstate differences in the impact of higher fossil fuel prices ("carbon price impacts") are shown in the second column of Table 1. Nationwide, the annual cost to the median household is $234 per person.

TABLE 1: NET IMPACT OF CLEAR DIVIDENDS ON MEDIAN HOUSEHOLD ($ PER CAPITA, 2020)

State	Dividend	Carbon price impact	Net benefit
Alabama	297	236	61
Alaska	297	244	54
Arizona	297	213	85
Arkansas	297	226	71
California	297	205	93
Colorado	297	270	27
Connecticut	297	248	49
Delaware	297	282	15
D.C	297	282	15
Florida	297	221	76
Georgia	297	263	34
Hawaii	297	250	47
Idaho	297	201	96
Illinois	297	254	43
Indiana	297	292	5
Iowa	297	270	28
Kansas	297	270	27
Kentucky	297	262	36
Louisiana	297	234	63
Maine	297	212	85
Maryland	297	270	27
Massachusetts	297	253	44
Michigan	297	263	34
Minnesota	297	277	20
Mississippi	297	215	82
Missouri	297	270	28
Montana	297	223	74
Nebraska	297	255	43
Nevada	297	239	58
New Hampshire	297	236	61
New Jersey	297	250	47
New Mexico	297	225	72
New York	297	206	92
North Carolina	297	249	48
North Dakota	297	270	27
Ohio	297	274	23
Oklahoma	297	235	62
Oregon	297	194	103
Pennsylvania	297	233	65
Rhode Island	297	226	72
South Carolina	297	217	81
South Dakota	297	226	71
Tennessee	297	243	54
Texas	297	248	49
Utah	297	259	38
Vermont	297	197	100
Virginia	297	275	22
Washington	297	198	99
West Virginia	297	245	52
Wisconsin	297	281	16
Wyoming	297	268	29
US Average	297	234	63

4 For details on the methods of calculating net benefits, see Riddle and Boyce (2007). For a more detailed discussion of the reasons for interstate differences, see Boyce and Riddle (2009).

Differences across the states are fairly small: in the lowest-cost state (Oregon), the annual carbon price impact is $40 less; in the highest-cost state (Indiana), it is $58 more. The range is narrow because total carbon use per capita is fairly similar across the country; so when all fossil carbon is treated equally, as in the CLEAR Act, carbon price impacts are similar, too. Many of the factors that contribute to differences in carbon use across states have offsetting effects. For example, states that use more energy for home heating costs generally use less for air conditioning. Similarly, states that have more coal-intensive electricity tend to have lower median incomes, and hence lower consumption, which leads to lower carbon price impacts.

It is important to note that interstate differences in the impact of higher fossil fuel prices will occur under *any* policy to cap carbon emissions. Interstate differences in *net* impacts will depend on who gets the money. The most striking feature of the results shown in Table 1 is that *the net impact of CLEAR on the median household is positive in every state.*[5]

Nationwide, the average net benefit works out to $63 per person, or $252 for a family of four.

Net impacts across the income spectrum

Table 2 presents a more fine-grained picture: it shows how net benefits vary across the income-distribution spectrum in each state. In the lower-income deciles (a decile is 10% of the population), the net impact is invariably positive, reflecting the fact that low-income households consume less than the average amount of carbon. In the top deciles, the net impact is negative, reflecting their above-average levels of consumption. Two conclusions from Table 2 stand out:

First, *the middle class is "made whole" by the CLEAR dividends:* Approximately 70% of the U.S. population comes out ahead from the policy, including not only lower-income families but also the middle class. "Come out ahead" here means a net benefit in simple pocketbook terms, not counting the policy's main benefits in the form of reduced dependence on fossil fuels and protection from climate change.

TABLE 2: NET IMPACT OF CLEAR ACT BY STATE AND INCOME DECILE ($ PER CAPITA)

	Decile									
State	1	2	3	4	5	6	7	8	9	10
Alabama	189	152	125	100	75	47	15	-24	-82	-207
Alaska	173	137	112	89	66	41	13	-22	-72	-177
Arizona	199	166	142	119	97	72	43	7	-45	-160
Arkansas	191	156	130	107	83	58	28	-8	-61	-173
California	213	179	154	130	106	79	48	9	-50	-179
Colorado	164	123	94	68	41	12	-21	-62	-123	-254
Connecticut	189	149	119	92	64	34	-2	-47	-115	-270
Delaware	153	112	83	56	29	1	-32	-73	-132	-258
District of Columbia	184	137	102	68	33	-5	-50	-109	-197	-405
Florida	198	163	137	113	89	62	31	-9	-67	-197
Georgia	172	132	102	75	48	19	-15	-57	-119	-250
Hawaii	173	136	109	85	60	34	3	-36	-92	-212
Idaho	202	170	148	127	107	84	59	27	-19	-116
Illinois	179	139	110	84	57	29	-4	-46	-106	-237
Indiana	146	104	73	46	19	-9	-42	-82	-139	-259
Iowa	159	119	91	66	41	14	-16	-54	-107	-218
Kansas	163	122	93	67	41	13	-19	-59	-116	-235
Kentucky	173	133	104	77	50	21	-12	-54	-114	-241
Louisiana	191	154	127	102	76	49	17	-23	-81	-206

5 This reflects the fact that U.S. household incomes are skewed (in the strict statistical sense of that term) toward upper-income groups: hence the mean (average) is greater than the median (middle). The impact of higher fossil fuel prices is proportional to consumption, so this too is skewed to the top of the distribution. Because the median household is "below average" in terms of its income and consumption, it pays less than the average into the total carbon-revenue pool. An additional boost to household net benefits comes from the fact that, as noted above, household share of total carbon revenue (75%) is somewhat greater than household share of the nation's total carbon consumption (66%).

TABLE 2: NET IMPACT OF CLEAR ACT BY STATE AND INCOME DECILE ($ PER CAPITA), CONTINUED

	Decile									
State	1	2	3	4	5	6	7	8	9	10
Maine	197	164	140	118	96	73	46	12	-36	-141
Maryland	164	123	94	68	41	13	-20	-62	-122	-253
Massachusetts	181	141	112	86	59	29	-5	-48	-111	-253
Michigan	169	129	100	74	48	20	-13	-53	-111	-234
Minnesota	158	117	87	61	34	6	-27	-67	-125	-248
Mississippi	201	167	142	118	95	69	40	3	-51	-166
Missouri	166	125	95	69	42	13	-20	-61	-119	-244
Montana	189	155	130	108	86	62	34	0	-49	-153
Nebraska	170	132	104	80	55	29	-1	-37	-90	-200
Nevada	182	145	119	95	71	45	15	-23	-78	-196
New Hampshire	180	145	119	96	73	48	20	-16	-67	-177
New Jersey	182	143	114	88	61	32	-2	-45	-109	-252
New Mexico	191	157	131	108	85	59	30	-7	-60	-174
New York	213	179	153	129	105	78	46	4	-58	-200
North Carolina	179	141	113	87	62	34	3	-37	-94	-216
North Dakota	160	120	92	66	41	13	-17	-55	-109	-221
Ohio	162	121	91	64	37	8	-24	-65	-124	-248
Oklahoma	187	150	123	99	75	48	18	-19	-73	-188
Oregon	210	179	156	135	114	91	65	31	-18	-124
Pennsylvania	188	152	125	101	77	51	21	-17	-72	-192
Rhode Island	194	158	132	109	84	58	28	-10	-66	-187
South Carolina	198	164	139	116	93	68	39	3	-49	-162
South Dakota	189	154	129	106	83	59	31	-4	-53	-157
Tennessee	184	146	119	93	67	40	8	-32	-90	-215
Texas	184	145	116	90	63	34	1	-41	-101	-231
Utah	161	124	98	74	50	25	-3	-38	-89	-192
Vermont	205	174	152	131	111	89	64	32	-15	-114
Virginia	164	122	92	64	36	7	-28	-71	-134	-269
Washington	209	177	154	132	110	87	60	25	-26	-136
West Virginia	182	144	117	91	66	38	7	-32	-89	-208
Wisconsin	151	110	81	55	29	2	-29	-67	-122	-236
Wyoming	160	121	93	67	42	15	-16	-54	-109	-224
US Average	190	154	126	102	76	49	18	-22	-81	-208

Note: Each decile equals 10% of the population, ranked by per capita income (decile 1 = lowest; decile 10 – highest).

Second, interstate differences are very small compared to differences across the income spectrum: 7 Across the income classes, the average net benefit nationwide ranges from +$190 per person in the bottom decile to -$208 in the top decile. Across the states, by contrast, the net benefit to the median family (see Table 1) is always positive, and lies within a much narrower range: +$5 to +$103.

Some opponents of a cap-and-dividend policy have exaggerated regional differences in impacts by confusing interstate differences with differences across the income spectrum. For example, the chief executive of one of the nation's largest coal-based electric utilities has claimed that the policy would take money from "mom in the Midwest and dividend it to Paris Hilton."[6] This assertion stands reality on its head.

6 Michael Morris, president and CEO of American Electric Power, quoted in Juliet Eilperin & Steven Mufson, "Senators to propose abandoning cap-and-trade," *The Washington Post,* February 27, 2010, p. A1.

If "mom in the Midwest" lives in a median-income household in the 12-state Midwestern region (defined by the U.S. Census Bureau as Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin), her family receives an annual net *benefit* of $28 per person (see Table 1). If "Paris Hilton" is meant to connote someone in the top 10% of the income spectrum in California, she pays an annual net *cost* of $179 (see Table 2); and if she is meant to connote someone at the very top of the income spectrum—say, in the top 0.1%—her net cost, due to her disproportionately high carbon consumption, would be far greater than this.

The middle class is "made whole" by the CLEAR dividends.

The accurate way to characterize differences in net impacts would be to say that cap-and-dividend "takes money" from elite consumers with outsized carbon footprints and dividends it to everyone equally.

These results have political implications as well as economic significance. The fact that the policy protects the real incomes of the middle class and yields net benefits for most families can help ensure that the CLEAR Act will receive durable support from the public — support that must be sustained over several decades in order to make the clean energy transition. And the fact that interstate differences are relatively small means that the policy has the potential to attract support across the country from the public in "red" states, "blue" states, and swing states in between.

Sensitivity analysis

The results presented above are based on a permit price of $25/ton CO_2 in the year 2020 (in 2012 dollars). The actual permit price in that year will depend, among other things, on the state of the economy (economic booms put upward pressure on demand for permits, pushing prices higher, while recessions have the opposite effect) and the pace of technological change in the energy and transportation sectors (more rapid progress in energy efficiency and clean energy development will reduce demand for permits, lowering prices). In order to limit price volatility in the face of these uncertainties, the CLEAR Act specifies a "price collar"—minimum and maximum permit prices that rise (after adjusting for inflation) over time.

Table 3 presents a sensitivity analysis to examine how total permit revenue, dividends, and per capita impacts vary depending on the permit price. In addition to the price of $25/ton that we have assumed in our analysis, results are shown for the minimum and maximum prices established in the legislation for the year 2020 ($11.58 and $32.23, respectively).

TABLE 3: SENSITIVITY ANALYSIS: IMPACT OF CLEAR ACT WITH ALTERNATIVE PERMIT PRICES (IN THE YEAR 2020)

Permit price in 2020	$11.58	$25	$32.23
Total revenue	$63 billion	$135 billion	$174 billion
Dividends	$47 billion	$101 billion	$131 billion
Dividend per capita	$137	$297	$383
Carbon price impact per capita (median household)	$107	$232	$299
Net benefit per capita (median household)	$30	$65	$84
CERT Fund	$16 billion	$34 billion	$43 billion

Equalizing net impacts across the states

Interstate differences in the net impact on households of dividends and higher fuel prices are fairly small, as shown in Tables 1 and 2. Nevertheless, these differences may be of concern to policy makers. If so, there are two ways to address these concerns: (i) by adjusting dividends in the initial years of the policy, so as to equalize net impacts on the median household in each state; or (ii) by allocating investments under the CERT Fund so as to offset these interstate differences.

The aim of the first approach would not be to equalize net benefits across all households, which would destroy the incentive for households to economize on their use of fossil fuels. A key feature of the cap-and-dividend policy is that it rewards households who use less carbon: net benefits to any household depend on what and how much it consumes. The aim would be to equalize net benefits across states, and for this it makes sense to think in terms of net benefits to the median household — the household exactly in the middle of the state's income-distribution spectrum. If Congress were to insert such a provision into the final version of the bill, it could task an appropriate federal agency with calculating state-wise net impacts on median households for this purpose.

To illustrate how this would work, Table 4 shows how state-specific dividends would vary so as to equalize net impacts across states (as in our previous tables, the numbers here refer to the year 2020 with a permit price of $25/ton). Annual dividends would range from a low of $258 per person in Oregon to a high of $355 per person in Indiana. In every state, the net benefit to the median household would be equal to the national average, $63 per capita.

The state-specific dividends shown in Table 4 in effect consist of two parts: a base dividend that is received by residents in every state, plus a state supplement that varies with the impact of higher fossil fuel prices on median households. In Table 4, the base dividend is $258 per person (the Oregon dividend), and the largest state supplement (in Indiana) is $97 per person. Nationwide, 75% of total carbon revenue continues be returned to the public as dividends: with 66% going to the base dividend and 9% to the state supplements, the net impact on median households is equalized across the states.

The argument in favor of state-specific dividends is that it would achieve "equal treatment" across the states, when this is defined in terms of net impacts on consumers. This might broaden political support for the bill, although a similar effect might be obtained by addressing interstate differences via CERT Fund allocations, as discussed in the next section.

There are two arguments against different dividends for different states. The first is that these would violate the principle behind the dividends: that the American people own our country's share of the Earth's scarce carbon absorptive capacity in equal and common measure. In this view, the dividend provisions of the CLEAR Act are not only about protecting families from the impact of higher fossil

TABLE 4: STATE-SPECIFIC DIVIDENDS TO EQUALIZE NET IMPACT ON MEDIAN HOUSEHOLD ($ PER CAPITA, 2020)

State	Dividend	Carbon price impact	Net benefit
Alabama	299	236	63
Alaska	307	244	63
Arizona	276	213	63
Arkansas	290	226	63
California	268	205	63
Colorado	334	270	63
Connecticut	311	248	63
Delaware	345	282	63
D.C	346	282	63
Florida	285	221	63
Georgia	327	263	63
Hawaii	313	250	63
Idaho	265	201	63
Illinois	317	254	63
Indiana	355	292	63
Iowa	333	270	63
Kansas	333	270	63
Kentucky	325	262	63
Louisiana	298	234	63
Maine	276	212	63
Maryland	333	270	63
Massachusetts	316	253	63
Michigan	327	263	63
Minnesota	340	277	63
Mississippi	278	215	63
Missouri	333	270	63
Montana	287	223	63
Nebraska	318	255	63
Nevada	302	239	63
New Hampshire	299	236	63
New Jersey	314	250	63
New Mexico	288	225	63
New York	269	206	63
North Carolina	312	249	63
North Dakota	333	270	63
Ohio	337	274	63
Oklahoma	299	235	63
Oregon	258	194	63
Pennsylvania	296	233	63
Rhode Island	289	226	63
South Carolina	280	217	63
South Dakota	289	226	63
Tennessee	307	243	63
Texas	312	248	63
Utah	322	259	63
Vermont	260	197	63
Virginia	339	275	63
Washington	262	198	63
West Virginia	308	245	63
Wisconsin	344	281	63
Wyoming	332	268	63
US Average	297	234	63

fuel prices, but also about a democratic distribution of the property rights that are created by capping carbon emissions.

The second argument against state-specific dividends is analogous to the argument against basing dividends to households on their carbon consumption: it rewards those who use more fossil fuels, and thus dampens incentives to invest in energy efficiency and renewable energy. To be sure, as long as all households within a given state receive the same dividend, they retain incentives to reduce their use of fossil fuels. But interstate differences in carbon price impacts reflect state policies, as well as the decisions of individual consumers. In California, for example, the median household electricity bill is lowest in the nation — despite electricity prices that are roughly 50% higher than those in the Midwestern states — thanks to the state's ambitious energy efficiency policies.[7] Of course, it can be argued that differences in state policies are not the fault of the average state resident. One way to strike a balance between considerations of individual responsibility and state responsibility would be to provide state-specific dividends for the first five or ten years of the policy, converging over time to equal dividends nationwide.

THE CERT FUND: INVESTMENT AND JOB CREATION ACROSS THE STATES

Although interstate differences in CLEAR's impacts on consumers are relatively small, there are reasons to be concerned about the dislocations that any policy to reduce the use of fossil fuels will cause on the production side of the economy, particularly in states where coal mining and industries reliant on coal-fired electricity are important sources of jobs and incomes.

The CLEAR Act addresses this concern by specifying that the CERT Fund shall be used, among other things, to carry out programs, provide incentives, and make loans and grants "to provide targeted and region-specific transition assistance to workers, communities, industries and small businesses" in states that experience "the greatest economic dislocations due to efforts to reduce carbon emissions and address climate change."

The CERT Fund, as noted above, is the vehicle specified in the CLEAR Act for allocating the 25% of total carbon revenue that is not recycled directly to the public as monthly dividends. The act provides guidelines for eligible uses of the CERT Fund, but it does not micro-manage its allocation, leaving this to legislative priorities that may change over time.

Interstate allocation of CERT investment: An illustration

Here we provide an example of how CERT resources could be used to address interstate differences in economic impacts of climate legislation on production sectors. In our calculations, we assume that 85% of CERT funding will flow back to the states in one way or another—either through federal agencies such as the Department of Energy's Weatherization Assistance Program or through block grants to the state governments.[8]

In our calculations, the interstate allocation of the CERT funds is based on three variables:

Carbon emissions from electricity: the state's share of total U.S. carbon emissions associated with the consumption of electricity.

Unemployment: the state's share of total U.S. unemployment.

Population: the state's share of total U.S. population.

Our allocation formula puts 25% of the weight on carbon emissions, 25% on unemployment, and 50% on population (for details and data, see the appendix.)

Table 5 shows the resulting allocation of the CERT Fund by state, again for the year 2020 with a permit price of $25/ton. The total amount of money invested in the states is roughly $28.8 billion, or $84 per person. States with larger populations receive more dollars, but the amount per person varies across the states because we include unemployment and carbon emissions from electricity in our allocation formula. CERT allocations range from $60 to $134

7 See Boyce and Riddle (2009, Table 2). For electricity rates, see U.S. Energy Information Agency, "Average Retail Price of Electricity to Ultimate Customers by End-Use Sector, by State," online at www.eia.doe.gov/cneaf/electricity/epm/table5_6_a.html.

8 We assume that the remaining 15% is devoted to international climate change mitigation and adaptation. Economic benefits from these uses are not included in the analysis that follows.

TABLE 5: CLEAR ACT: INTERSTATE ALLOCATIONS OF CERT INVESTMENTS + DIVIDENDS ($ PER CAPITA, 2020)

State	CERT investment	Dividend	Total state receipts
Alabama	96	297	393
Alaska	73	297	371
Arizona	76	297	373
Arkansas	84	297	381
California	78	297	375
Colorado	81	297	379
Connecticut	72	297	369
Delaware	94	297	391
D.C	109	297	406
Florida	89	297	386
Georgia	88	297	386
Hawaii	75	297	373
Idaho	79	297	376
Illinois	83	297	380
Indiana	108	297	405
Iowa	93	297	391
Kansas	91	297	388
Kentucky	119	297	416
Louisiana	89	297	387
Maine	72	297	369
Maryland	80	297	377
Massachusetts	77	297	374
Michigan	93	297	390
Minnesota	86	297	383
Mississippi	87	297	384
Missouri	95	297	392
Montana	84	297	382
Nebraska	84	297	381
Nevada	93	297	390
New Hampshire	67	297	364
New Jersey	76	297	373
New Mexico	84	297	381
New York	70	297	367
North Carolina	87	297	384
North Dakota	103	297	400
Ohio	97	297	394
Oklahoma	89	297	387
Oregon	73	297	371
Pennsylvania	80	297	377
Rhode Island	83	297	381
South Carolina	88	297	386
South Dakota	74	297	371
Tennessee	91	297	389
Texas	85	297	382
Utah	80	297	377
Vermont	60	297	357
Virginia	81	297	378
Washington	68	297	365
West Virginia	99	297	397
Wisconsin	89	297	386
Wyoming	134	297	431
US Average	84	297	381

per capita, and hence total revenue recycling (dividends plus CERT funds) ranges from $357 in Vermont to $431 in Wyoming.

Unlike defense spending, the CLEAR Act would have strikingly equal economic impacts across the states.

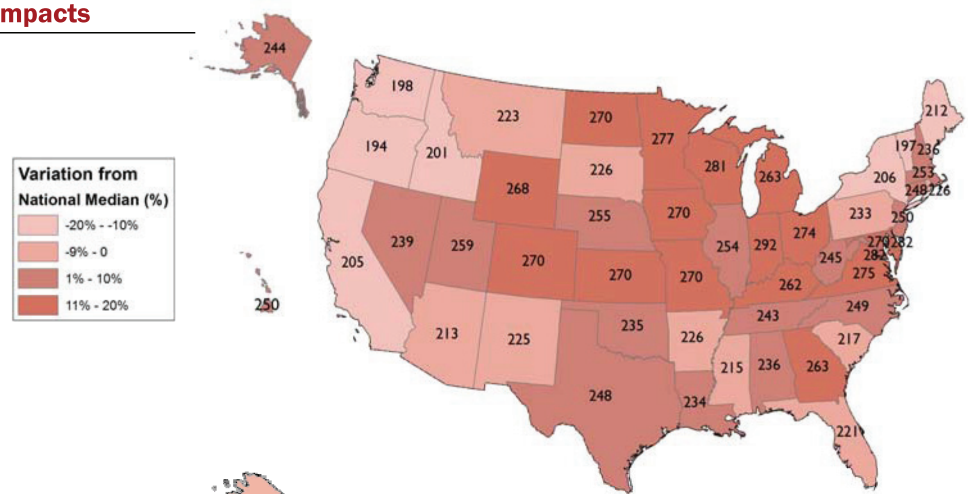
The maps on page 11 summarize interstate differences in the economic impacts of the CLEAR Act:

- Map 1 shows the impact of carbon prices on the median household, at a permit price of $25/ton CO_2 in the year 2020, based on the results reported in Table 1. The nationwide average annual cost is $234 per person. The lowest cost is in Oregon ($194) and the biggest is in Indiana ($292).
- Map 2 shows dividends under the CLEAR Act (for the same year at the same carbon price). The annual dividend of $297 per person is the same in every state.
- Map 3 shows dividends plus CERT investments, when the CERT Fund is allocated as shown in Table 4. The nationwide average is $381 per person ($297 in dividends plus $84 in CERT investments).
- Map 4 shows federal defense expenditures, helping to put interstate differences in the CLEAR Act in perspective. Unlike defense spending (indeed, compared to most government programs), the CLEAR Act would have strikingly equal economic impacts across the states.

Interstate differences in economic impacts

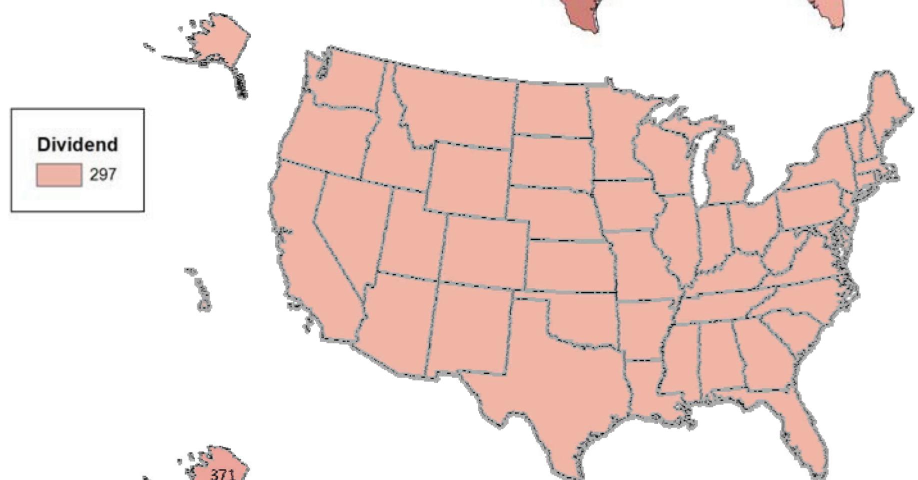
MAP 1. CARBON PRICE IMPACT
($ PER PERSON, MEDIAN HOUSEHOLD)

Impact of fuel price increases in 2020 at a permit price of $25/ton carbon dioxide. Any policy that caps carbon emissions will raise fuel prices to consumers. The question is: *who gets the money?*



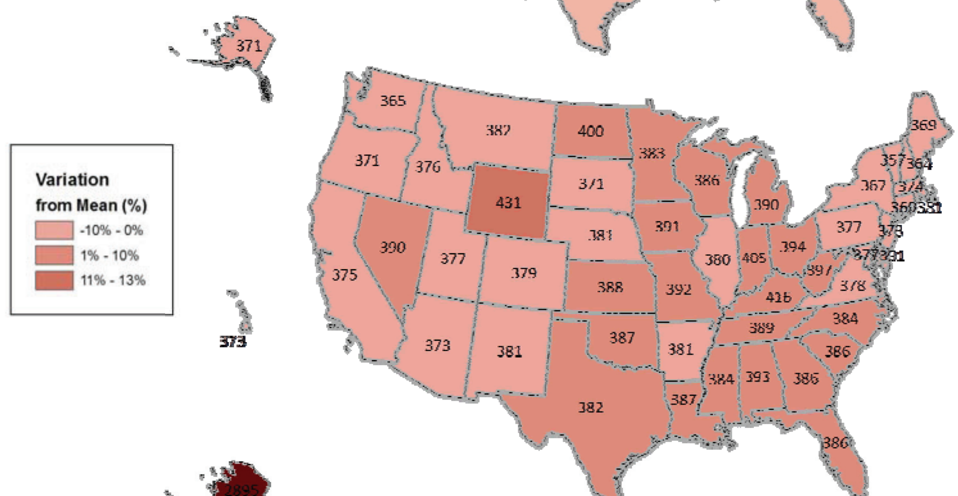
MAP 2. CLEAR DIVIDENDS ($ PER PERSON)

The CLEAR Act would refund 75% of carbon revenues directly to the public as monthly dividends. At a permit price of $25/ton, annual dividends will amount to $297 per person, nationwide.



MAP 3. DIVIDENDS PLUS CERT INVESTMENTS
($ PER PERSON)

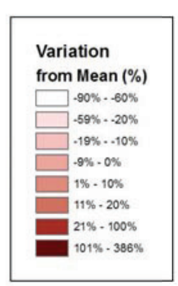
The CLEAR Act would devote 25% of carbon revenues to the Clean Energy Reinvestment Trust (CERT) Fund. Targeting CERT funds to states with more carbon-intensive electricity and higher unemployment would create modest variations across states in total returns (dividends plus CERT investments).

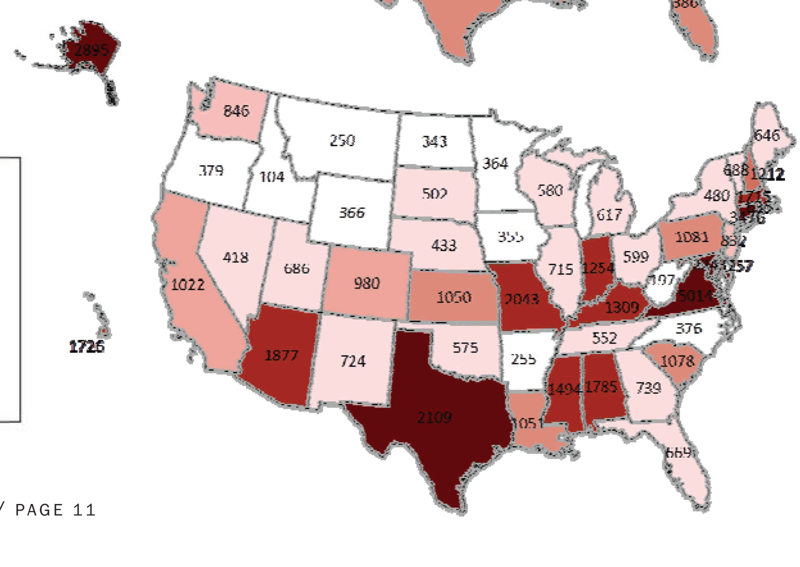


MAP 4. FEDERAL DEFENSE EXPENDITURES
($ PER PERSON)

All federal policies have disparate economic impacts across the states. The interstate differences are typically much larger than those of the CLEAR Act. Defense expenditures, for example, vary from$106 per person in Idaho to $5,014 per person in Virginia.

Source: National Priorities Project





Comparing the distribution of CERT funds under this formula to the net benefits from dividends to consumers, reported in Table 1, we find that states with lower net benefits to consumers generally receive higher allocations from the CERT Fund. Four of the ten locations with the lowest net benefits to consumers (Indiana, Delaware, Ohio, and the District of Columbia) would be among the top ten recipients of CERT funds per capita. At the other end of the spectrum, five of the ten states with the largest net benefits to consumers (Oregon, Vermont, Washington, New York, and Maine) are among the bottom ten recipients of CERT funds per capita. In no case does a state rank in the top ten or bottom ten in both respects. This balancing effect is not coincidental, since the carbon intensity of the state economy affects both net impacts on consumers and the allocation of the CERT Fund.

In other words, in allocating investments from the CERT Fund, Congress can further promote interstate equity under the CLEAR Act in two ways: by addressing the impacts of the carbon cap on the production side of the economy and, at the same time, channeling greater investment to states that receive smaller net benefits on the consumer side.

Job creation impacts

The CLEAR Act will lead to job creation in two ways:

- First, the shift of private expenditure from fossil fuels to greater spending on energy efficiency and renewable energy will boost jobs, since the latter sectors are more labor-intensive.
- Second, public investments from the CERT Fund will create jobs. The distribution of these jobs across the states can be influenced by Congressional decisions on the allocation of CERT expenditures.

The market price signals created by the cap on carbon emissions will lead to a reorientation of household and business expenditures away from fossil fuels, and boost private spending on energy efficiency and renewable energy. There will be job losses in the fossil fuel sector, and job gains in other sectors such as construction, mass transportation, wind power, solar power, and alternative liquid fuels. Spending on energy efficiency and renewables generates considerably more jobs per dollar than spending on fossil fuels (see Table 6), in part because they are more labor-intensive and in part because they have higher domestic content. So the net effect of this private expenditure shifting will be job creation.

TABLE 6: EMPLOYMENT IMPACTS OF SPENDING ON FOSSIL FUELS, ENERGY EFFICIENCY AND RENEWABLE ENERGY

Sector	Job creation (# of jobs per $ million)
Fossil fuels	
Oil and natural gas	3.7
Coal	4.9
Energy efficiency	
Building retrofits	11.9
Mass transit/freight rail	15.9
Smart grid	8.9
Renewables	
Wind	9.5
Solar	9.8
Biomass	12.4

Job growth resulting from private expenditure shifting may surpass the jobs created by public investment from the CERT Fund. Here we focus on public investments, however, since this is the main avenue by which Congress can shape the interstate distribution of job creation resulting from the CLEAR Act.

To estimate how many jobs CERT Fund investments would create in each state, under the investment allocation formula used above, we translate public expenditures into jobs using the methodology developed by our colleagues at the Political Economy Research Institute (PERI) in the study, *The Economic Benefits of Investing in Clean Energy* (Pollin *et al.* 2009). This study used input-output data at the state level from the U.S. Department of Commerce to estimate the number of jobs per dollar of spending on energy efficiency (building retrofits, smart grid, public transportation, and co-generation) and renewable energy (on-grid renewable electricity, off-grid renewables, and alternative motor fuels). Our estimates include the jobs created in these industries and in other industries that supply intermediate goods (such as steel and building supplies) to them.[9]

9 We assume that CERT Funds are allocated across different types of energy efficiency and renewable energy investments in the same proportions assumed in the earlier PERI study. We do not count induced employment effects from the consumption multiplier (that is, jobs created when workers in these industries spend their earnings to buy goods and services), because CERT Fund investments recycle carbon permit revenues rather than creating additional demand as in an economic stimulus program.

TABLE 7: CERT FUND INVESTMENT AND JOB CREATION BY STATE (2020, WITH PERMIT PRICE OF $25/TON)

State	CERT investment ($ million)	Jobs created
Alabama	501	7,012
Alaska	57	667
Arizona	559	6,873
Arkansas	270	3,888
California	3,189	33,683
Colorado	454	5,705
Connecticut	280	3,160
Delaware	93	1,067
D.C	73	767
Florida	1,828	23,807
Georgia	967	13,080
Hawaii	108	1,377
Idaho	135	1,828
Illinois	1,193	14,182
Indiana	770	10,177
Iowa	312	4,178
Kansas	285	3,808
Kentucky	571	8,081
Louisiana	447	5,962
Maine	106	1,583
Maryland	508	6,012
Massachusetts	565	6,574
Michigan	1,029	13,012
Minnesota	504	6,462
Mississippi	284	4,143
Missouri	631	8,585
Montana	91	1,294
Nebraska	168	2,246
Nevada	273	2,959
New Hampshire	99	1,312
New Jersey	736	8,354
New Mexico	187	2,647
New York	1,515	17,355
North Carolina	909	11,996
North Dakota	74	1,011
Ohio	1,244	16,715
Oklahoma	367	5,436
Oregon	312	4,151
Pennsylvania	1,120	14,435
Rhode Island	97	1,148
South Carolina	449	6,168
South Dakota	67	979
Tennessee	639	9,167
Texas	2,346	29,479
Utah	248	3,283
Vermont	42	619
Virginia	707	9,414
Washington	505	6,161
West Virginia	201	2,913
Wisconsin	560	7,319
Wyoming	81	1,057
US Average	28,757	363,287

CERT Fund investments would create roughly 360,000 jobs nationwide.

The results are presented in Table 7. The data again refer to the year 2020, with a permit price of $25/ton CO_2. We estimate that CERT Fund investments would create roughly 360,000 jobs nationwide. The interstate differences in job creation that are shown in the table roughly mirror the interstate allocation of CERT dollars.[10] A different allocation formula would yield a different interstate pattern of job creation. The CLEAR Act itself does not prejudge what is the "best" distribution across states or sectors, leaving allocation decisions up to the annual legislative process.

CONCLUSIONS

The CLEAR Act would put a cap on the use of fossil fuels so as to reduce emissions of carbon dioxide, the most important greenhouse gas. Any policy that limits the use of fossil fuels will raise their price, impacting real family incomes. But the net impact on family incomes depends on who gets the money that is paid by consumers as a result of higher fuel prices. The CLEAR Act recycles 75% of this money to the public in

10 The number of jobs per dollar varies somewhat across the states, however, for two reasons: first, the input-output data from the Commerce Department show some interstate differences in the ratio of jobs per dollar in any given sector; and second, some of the job creation in the supply of intermediate goods spills across state borders (we allocate the out-of-state portion of this indirect job creation across states in proportion to the relative size of the state economies.)

the form of equal monthly dividends, and devotes the remaining 25% to clean energy investments.

Although the dividends are the same for all, the net impact on family incomes (dividends minus the impact of carbon prices) will vary among households, depending on the amount of fossil fuels they consume directly and indirectly. Families who consume more will have lower net benefits; families who consume less will have higher net benefits. And regardless of their consumption level, all will have an incentive to limit their use of fossil fuels in response to the market price signals resulting from the cap.

Because high-income households generally consume more fossil fuels (and more of just about everything) than low-income and middle-income households, they will tend to pay more as a result of higher fuel prices than they receive as dividends. These income-related differences in net impacts also apply at the level of interstate comparisons: all else equal, states with lower per capita incomes will receive higher net benefits from the CLEAR Act dividends than states with higher per capita incomes.

Of course, all else is not equal: states differ not only in average incomes, but also in other ways that affect net impacts, such as the carbon intensity of their electricity supplies. At any given income level, families in states that get most of their electricity from coal-fired plants will face bigger price increases than families in states that get most of their electricity from less carbon-intensive sources. To some extent, this effect is offset by the fact that more coal-intensive states tend to have lower incomes.

Analyzing the economic impacts of the CLEAR Act across the states, we can draw the following conclusions:

- Interstate differences in impacts on household incomes are small: much smaller than differences across the income spectrum, and vastly smaller than the differences in other federal programs, such as defense spending. As a result, the CLEAR Act delivers positive net benefits to the median household—and to the majority of households—in each and every state.
- Interstate differences could be eliminated altogether by modifying the Act so as to provide state-specific dividends, calibrated to equalize the net impact on the median household across the states. To avoid creating perverse long-term incentives for states to rely on dirty energy, these dividends could converge towards the national average over time.
- Interstate differences alternatively could be addressed in the allocation of the CERT Fund, by directing more investment to states with higher unemployment and/or greater potential economic dislocations from the shift away from dependence on fossil fuels.

An advantage of the latter approach is that it focuses attention on the production side of the economy, where interstate differences are likely to be more significant, rather than on the consumption side, where they are small. Our estimates indicate that investments from the CERT Fund will create roughly 360,000 jobs nationwide. The economic and political implications of how this employment creation is distributed across the states may turn out to be more important than relatively minor interstate differences in the impacts of the cap-and-dividend policy on consumers.

REFERENCES

Boyce, James K. and Matthew E. Riddle (2009) *Cap and Dividend: A State-by-State Analysis*. Amherst, MA: Political Economy Research Institute and Portland, OR: Economics for Equity and Environment Network.

Boyce, James K. and Matthew E. Riddle (2008) *Keeping the Government Whole: The Impact of a Cap-and-Dividend Policy for Curbing Global Warming on Government Revenue and Expenditure.* Amherst, MA: Political Economy Research Institute, Working Paper No. 188.

Boyce, James K. and Matthew E. Riddle (2007) *Cap and Dividend: How to Curb Global Warming while Protecting the Incomes of American Families*. Amherst, MA: Political Economy Research Institute, Working Paper No. 150.

Pollin, Robert, James Heintz, and Heidi Garrett-Peltier (2009) *The Economic Benefits of Investing in Clean Energy.* Amherst, MA: Political Economy Research Institute and Washington, DC: Center for American Progress.

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APPENDIX

Formula for interstate allocation of CERT Fund

The CLEAR Act does not specify how the revenues from carbon permit auctions that are deposited into the Clean Energy Reinvestment Trust (CERT) Fund will be allocated across uses and across states. The Act simply specifies a list of eligible uses (see sidebar). Decisions on allocations will be up to Congress.

In our analysis, we assume that 85% of CERT funds will flow to the states, either through federal expenditures or block grants to the states. We assume that the remaining 15% will be devoted to international expenditures for climate change mitigation and adaptation.

To allocate expenditures across the states, we use a formula based on three variables:

C = state's share of the nation's carbon emissions from electricity consumption

U = state's share of the nation's unemployment

P = state's share of the nation's population

We assign weights of 0.25 to each of the first two variables, and a weight of 0.5 to population. The state's share of CERT investments, *I,* is thus:

$I = 0.25C + 0.25U + 0.5P$

The data used to obtain the three component variables are reported in Table A.1. The dollar allocations for each state shown in Table 4 are simply the product of *I* multiplied by the total amount of the CERT Fund distributed to the states in 2020, which is $28.75 billion (with a permit price of $25/ton CO_2, 100% of permits auctioned, 25% of total auction revenues devoted to the CERT Fund, and 85% of CERT funds flowing to the states).

Eligible uses of CERT Fund

Section 6(c) of the CLEAR Act provides that Clean Energy Reinvestment Trust (CERT) Fund will be used to "provide incentives, and make loans and grants" for the following purposes:

a) targeted and region-specific transition assistance to workers, communities, industries, and small businesses experiencing the greatest economic dislocations due to efforts to reduce carbon emissions and address climate change and ocean acidification;

b) targeted and region-specific compensation for early retirement of carbon-intensive facilities, machinery, or related assets;

c) targeted and region-specific transition assistance to residents, communities, industries, and small businesses that experience the greatest negative impacts from climate change;

d) targeted relief to energy-intensive industries that export goods and services to countries that do not have similar restrictions on fossil carbon;

e) training and development programs to prepare workers for careers in energy efficiency, renewable energy, and other emerging clean energy technologies;

f) to curtail emissions of other greenhouse gases and substances that contribute to climate change;

g) international projects that verifiably reduce net greenhouse gas emissions through modification of agriculture, forestry and land use;

h) investment in research, development and deployment of clean energy and fuels;

i) initiatives that increase energy efficiency or energy productivity;

j) financial support to low-income families that experience difficulty paying high seasonal utility bills;

k) projects or initiatives that support residential fuel switching;

l) matching grants to low-income energy efficiency consumer loan recipients;

m) weatherization and improved energy efficiency of public and low-income buildings;

n) climate change mitigation and adaptation;

o) programs that protect or advocate for energy consumers; and

p) to ensure that the program does not contribute to the budget deficit of the federal government.

TABLE A1: DATA USED IN INTERSTATE ALLOCATION OF CERT FUNDS

State	Population (2009)	Unemployment rate (% of labor force, November 2009)	Unemployed persons (seasonally adjusted, November 2009)	Total CO_2 emissions from electricity consumption (million tons CO_2)
Alabama	4,708,708	10.5	216,300	66.0
Alaska	698,473	8.4	30,100	3.6
Arizona	6,595,778	8.9	279,800	42.8
Arkansas	2,889,450	7.4	101,900	32.2
California	36,961,664	12.4	2,272,700	132.8
Colorado	5,024,748	6.9	183,500	48.8
Connecticut	3,518,288	8.2	155,600	15.1
Delaware	885,122	8.6	36,500	12.6
D.C	599,657	11.8	39,000	9.6
Florida	18,537,969	11.5	1,063,600	166.8
Georgia	9,829,211	10.1	476,800	103.5
Hawaii	1,295,178	6.8	43,700	10.0
Idaho	1,545,801	9.1	68,900	11.1
Illinois	12,910,409	10.9	722,600	89.2
Indiana	6,423,113	9.6	297,600	122.4
Iowa	3,007,856	6.7	111,900	44.1
Kansas	2,818,747	6.4	97,100	39.8
Kentucky	4,314,113	10.6	218,500	99.0
Louisiana	4,492,076	6.7	138,400	63.7
Maine	1,318,301	8.0	56,300	6.3
Maryland	5,699,478	7.3	215,800	51.4
Massachusetts	6,593,587	8.7	302,100	41.2
Michigan	9,969,727	14.7	712,400	81.3
Minnesota	5,266,214	7.4	218,900	57.0
Mississippi	2,951,996	9.8	125,200	32.0
Missouri	5,987,580	9.4	282,100	80.5
Montana	974,989	6.4	32,100	11.4
Nebraska	1,796,619	4.6	44,800	23.3
Nevada	2,643,085	12.3	169,200	25.2
New Hampshire	1,324,575	6.7	49,600	4.8
New Jersey	8,707,739	9.7	441,100	42.8
New Mexico	2,009,671	7.8	75,100	21.3
New York	19,541,453	8.6	832,200	73.4
North Carolina	9,380,884	10.7	486,900	87.7
North Dakota	646,844	4.1	14,900	13.7
Ohio	11,542,645	10.6	624,000	150.8
Oklahoma	3,687,050	7.1	126,300	50.0
Oregon	3,825,657	10.7	208,000	11.9
Pennsylvania	12,604,767	8.5	540,900	100.4
Rhode Island	1,053,209	12.7	72,400	4.9
South Carolina	4,561,242	12.3	266,800	39.7
South Dakota	812,383	4.9	22,000	6.8
Tennessee	6,296,254	10.2	304,400	73.9

TABLE A1, CONTINUED

State	Population (2009)	Unemployment rate (% of labor force, November 2009)	Unemployed persons (seasonally adjusted, November 2009)	Total CO_2 emissions from electricity consumption (million tons CO_2)
Texas	24,782,302	8.0	970,300	269.0
Utah	2,784,572	6.3	86,300	28.4
Vermont	621,760	6.4	23,100	0.5
Virginia	7,882,590	6.6	271,300	77.6
Washington	6,664,195	9.0	316,200	14.9
West Virginia	1,819,777	8.4	66,100	31.5
Wisconsin	5,654,774	8.2	250,600	65.3
Wyoming	544,270	7.2	20,900	17.1
US Total/Average	307,006,550	9.0	14,782,800	2,709.0

EXHIBIT 6

Schools of the Future Report

Tom Torlakson

State Superintendent of Public Instruction
California Department of Education

September 2011

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Co-chairs' Message

Over the past 13 years, the state's voters have approved over $35 billion for the construction and modernization of schools. As a result, the state and local educational agencies (LEAs) have successfully partnered in the planning and construction of hundreds of new schools and the modernization of thousands of schools, creating improved learning environments for millions of students. As impressive as this is, there is still more to do to ensure that all of California's six million students attending 10,000 schools have high quality and energy efficient facilities. Given the concerns about the economy and the increasingly limited state and district resources, it is time to be even more strategic, resourceful, and creative.

Tom Torlakson, our State Superintendent of Public Instruction, stated that we cannot educate the next generation of students in schools that are relics of the past. Thus, he charged us to lead the Schools of the Future (SOTF) initiative dedicated to addressing this issue. The SOTF team was tasked with looking at school planning, design and finance, and energy efficiency. More than 90 members participated including representatives from schools, architectural firms, colleges, construction manager organizations, unions, builder associations, energy firms, and businesses.

We are grateful for the contributions of the individuals who took part in this effort as our advisory team.

Contained within this document are the recommendations of the team. We may not all agree on every recommendation; however, taken in totality, this document, together with the Superintendent's recently released *A Blueprint for Great Schools* provides a foundation for action.

Many of the recommendations contained in this document will require additional resources and legislation to implement. Many, however, are areas the California Department of Education can consider administratively now.

The work of this team is just the beginning of an initiative to improve the way we invest in the buildings our students interact in every day. And in doing so, we can create efficient and powerful learning environments that will prepare our students for bright and productive futures.

Sincerely,

Cesar Diaz	Steve Rogers
Legislative Director	President
State Building and Construction	San Mateo Union High School
Trades Council, AFL-CIO	District Board

Executive Summary

On January 14, 2011, State Superintendent of Public Instruction Tom Torlakson announced the Schools of the Future (SOTF) Initiative as part of his new administration and convened a 90-member stakeholder team.

The team was co-chaired by Cesar Diaz, Legislative Director of the State School Building and Construction Trades Council and Steve Rogers, President of the San Mateo Union High School District Board. Kathleen Moore, Director of the School Facilities Planning Division at the California Department of Education, coordinated the effort and her team provided the staff support.

The SOTF initiative gathered educators, business professionals, architects, school facility practitioners, green advocates, energy professionals, and policy makers to focus on two key policy areas: state school facility program reform and the design of high performance, green schools. "We're going to create a working team that will be looking at how our schools are constructed from top to bottom and how we can prepare the next ballot measure to meet the needs of 21st century students, as well as save tens of millions of dollars," Superintendent Torlakson stated. "Further, we will work to build energy efficiency for every school."

Superintendent Torlakson charged the team with providing him with advice in eight policy areas:

- Educational Impact of Design
- School Site Selection and Community Impact
- Modernization
- Funding and Governance
- High Efficiency Schools
- Renewable Energy
- Grid Neutral Schools
- Financing of High Performance Schools

The team met three times over a four month period, and each policy sub-committee met frequently between SOTF meetings and produced a strategy memo articulating the context and key recommendations in their respective policy areas.

Results and Recommendations

Each sub-committee strategy memo follows in this report. High priority recommendations include:

- **Educational Impact of Design:** Create the next state facility funding program to leverage multiple sources of funding, reconstruct and upgrade existing school structures, and advance 21st century design through sustainable and innovative features. Establish a *California Code of* Regulations, Title 5 (5 *CCR*) working group to ensure regulations support the creation of school sites and learning spaces that reflect the needs of 21st century teaching and learning, as well as the increasing awareness of the impact of school siting and size on environmental, economic and fiscal goals. Collect and disseminate research, resources, and best practices to assist local planning groups as they site and design schools that are learner-centered, safe, healthy, sustainable centers of communities.

- **School Site Selection and Community Impact:** Align future state school facilities funding with state sustainability goals, including modernization/rebuilding existing schools and funding for local educational agency (LEA) master planning. Develop guidance documents and a training program on cross collaboration for LEAs and local governments and seek out opportunities for greater joint use. Encourage early communication and collaboration for land use planning processes between LEAs and local agencies. Add the State Superintendent of Public Instruction to the Strategic Growth Council.

- **Modernization:** Base funding for a new 21st Century Renovation Program on a holistic analysis of both the educational and physical plant needs and use renovation as an opportunity to improve building performance. Recognize that infrastructure components have a useful and finite life. Restore dedicated and sustained maintenance funding. Eliminate relocatable classrooms that are beyond their useful life. Increase modernization funding for renewable energy.

- **Funding and Governance:** Consider changes in the governance structure for oversight of the state's school facility investment. Prepare a comprehensive assessment of new construction and modernization needs using existing information as well as data produced from a state-wide school facility inventory. Investigate, analyze, and consider alternative funding structures for the state's school facilities investments.

- **High Efficiency Schools:** Develop the California Green Schools Recognition Program. Adopt a California Environmental Literacy Plan. Develop a low energy retrofit program and create innovative funding mechanisms to support high efficiency sustainable schools for design and construction. Leverage school procurement to promote high efficiency operations through the purchase of healthy and sustainable products and consumables.

- **Renewable Energy:** Develop standardized policies and processes to help LEAs address issues with the evaluation, procurement, financing, and construction of renewable energy systems. Support new laws and initiatives that fund renewable energy projects and broaden opportunities for schools to participate in the generation and use of the full range of renewable energy options. Develop an energy schools academy. Create an Energy Liaison position at the California Department of Education.

- **Grid Neutral:** Make regulatory changes to allow for more cost effective solar installations. Develop and implement effective energy efficiency programs and provide sufficient funding. Encourage new school construction projects and major modernization projects to be designed for true grid neutral operation.

- **Financing of High Performance Schools:** Provide new and expanded funding sources. Maximize energy production at school sites. Expand Joint Power Authorities. Incentivize local financing and the creation of Renewable Energy Credits marketplace.

School Facility Program Reform Recommendations

Educational Impact of Design
Policy Sub-committee Memo

I. Sub-committee Topic: Educational Impact of Design

Chair
- Laura Knauss, Lionakis

Members
- Tom Herman, California Department of Education, Learning Support and Partnerships
- Chuck Kluenker, Vanir Construction Management
- Carolyn Nelson, California State University, East Bay
- Linda Rondeau, Pittsburgh Unified School District
- Wendell Vaughn, Perkins+Will
- Jose Vilar, Baker-Vilar Architects
- Shannan Young, California Department of Education, Nutrition Services

Support Staff
- Barbara Ross, California Department of Education, School Facilities Planning

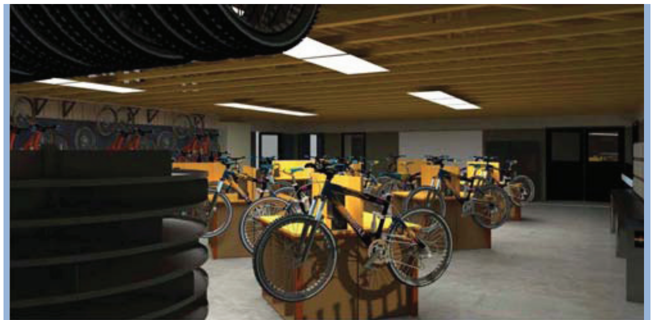
Sub-committee Charge
There is a substantial body of research on the impact of school facilities on educational achievement. What design principles and features should a 21st century learning environment include? The sub-committee was charged with making recommendations on design principles and features that should be considered in a 21st century learning environment.

II. Context

Recognizing that curriculum developers and instructional leaders are responding to the call for alignment to the needs of the 21st century learner, the design of learning environments will need to respond to this shift toward more personalized learning. The emergence of online learning and other instructional delivery modes affect the design and need for additional facilities. The sub-committee discussed elements of high performance schools that support student health and well-being which directly impact academic readiness, student achievement and teacher performance. Our intent with these recommendations is to create future generations of environmental stewards who are healthy, safe, engaged, supported, and challenged at their schools.

Natural day lighting and exposed building systems are integrated sustainable features in this Career Technical Education renovation project

San Juan High School Culinary WILLIAMS + PADDON Architects, Inc.



Nevada City School District has been the host of a unique bicycle recycle program at their Seven Hills (Middle) School Campus for the past 10 years.

Seven Hills Middle School
HIBSER YAMAUCHI Architects, Inc.

The body of research is clear, relevance is a key determinate of student engagement/success and is a cornerstone of 21st century instruction, so the recommendations include commitments to "hands-on" and project based learning as well as industry partnerships. These partnerships often bring with them specific facilities needs – whether project workspaces or technical lab spaces. The use of more mobile technologies in schools and the increasing use of online and hybrid courses also impacts facility design. In addition, community and family involvement were determined to be significant factors in student well-being; so providing spaces that invite the community and parent involvement were discussed.

Other areas where attention to school designs can support healthy, safe students and communities include pre-kindergarten programs, school food programs, gardens, sports and recreations programs, and routes to school that encourage walking and bicycling. All have implications for facilities design.

The ongoing significant funding shortage in maintenance and operations (M & O) commitment from the state has undermined student pride in their schools and affected academic achievement. Over the past decade districts have struggled to provide appropriate upkeep of school sites. Students are aware of the lack of funding and subsequent care in keeping schools safe, clean, and healthy places. Well designed schools that are maintained can remain in service to the community longer and are a wise investment of tax dollars.

This sub-committee looked at four broad areas that they felt could most substantially create a construction environment grounded in design principles that would help California create educational facilities responsive to educational trends, student and community needs, and develop the next generation of environmental stewards while protecting the state's infrastructure investments.

We address the future with recommendations that suggest:

1) Providing focus areas for projects in the next bond program.

2) Reviewing the regulatory guidelines and minimum standards known as *California Code of Regulations,* Title 5 (5 *CCR*).

3) Exploring ways to invest in the ongoing maintenance.

4) Collecting and disseminating research and resources on innovative school design.

Recommendation 1: Create and incentivize priorities, definitions and formulas within the next state bond program that a) leverage multiple sources of funding in a community b) re-construct and upgrade existing school structures, and c) advance 21st century design through sustainable and innovative features which are key to building high performance schools.

- **Joint Use:** Community partnerships and services can extend the use of the infrastructure investment through joint use projects to support healthy, safe communities such as: child care centers, health centers, sports and recreation facilities, community gardens, libraries, and linkages to higher education institutions.

In the process of designing **Gratts Primary Center and Early Education Center** (Los Angeles Unified School District), many groups came together in the dense urban neighborhood just west of downtown Los Angeles to focus on the joint use of the school facility, strengthening bonds between school and community through a joint use approach.

JUBANY NAC Architecture

- **Re-use/Remodel/Re-Envision Older Schools:** A new definition of modernization is needed that supports educational programs designed to meet the needs of 21st century learners, keep existing schools open in communities to prevent urban sprawl and encourage walking. Technology upgrades, re-designed classroom/lab spaces, updated food preparation, and eating areas are among the needs as well.

- **Recalculate**: A new formula should support flexible spaces characteristic of 21st century learning environments and would likely not rely on the number of "teaching stations" or "traditional classrooms" present on a schematic. The formula should put students' learning needs and teaching methods first by incentivizing high performance, sustainable features, and innovative educational delivery such as career technical education.

National research and promising projects, both here in California and across the country, are demonstrating the power of the "schools as centers of community" concept. The concept advances wise land use policies, supports safer, healthy communities, and leverages multiple state and local resources. Multiple stakeholders are recognizing the social, economic, and academic benefits to a community when various sources of funds are leveraged and infrastructure is planned strategically. Since each individual community will decide its priorities, the new bond program should be designed with flexibility to accommodate the diverse needs of California communities and ensure balance across the urban, suburban, rural, large, medium, and small districts. Some districts will find partners at the city level to develop parks and recreation while others may find a county health outreach program, a regional library board, the YMCA, or the Boys and Girls Club. The funding program should be structured to support this whole community approach to reinforce the very tenets of healthy, safe, and supported individuals.

Secondly, special attention should be given to existing facilities that will need extensive renovation and upgrades for seismic safety, utility upgrades, and technology upgrades to make them available for future electronic and 21st century teaching methods**.** These new relevant teaching strategies impact school facilities. Project-based learning, group projects, global learning, career technical education, and the wide variety of teaching and learning styles, when combined with the budget driven trend of larger class size, has a significant impact on the size, room arrangements, furniture, and equipment required in our school settings. Smaller, flexible furnishings, for example, may allow us to utilize existing spaces to accommodate more students in a group setting.

Did you know? 71% of California's classrooms are more than 25 years old. We need strategies that allow us to use these existing spaces in ways that accommodate evolving technology and pedagogy.

CDE Fingertip Facts

Healthy dining options in a food court setting make school lunch a healthy and inspiring part of the student day.

MLK Jr. Middle School Dining Commons
Berkeley Unified School District
JUBANY NAC Architecture

Just as instructional practices continue to change, so do the methods for food preparation and service in schools. With greater attention to balanced nutrition and healthy lifestyles, our school kitchens, cafeterias, and lunchrooms need to be reconfigured. Frankly, redesign of existing schools is a health and equity issue as we enter the second decade of the 21st century.

Lastly, we note that in 2008, at a roundtable event sponsored by the California Department of Education, leaders in the school facilities arena noted that "any effort to encourage more innovative and flexible school design … would likely only be minimally effective without concurrent changes to the state's funding model." There is some contention that the current funding model which counts classrooms ignores innovative school designs through a limited definition of "teaching station" and a mathematical formula that does not account for new distributed, online/hybrid teaching strategies. In any new bond program, attention will need to be paid to the development of the allocation formula to avoid the presumption that all students should sit in rows of desks in a square room in the 21st century.

Flexible, small group and individual spaces support 21st century learners.

Paramount High School
Paramount Unified School District
LPA

We recommend these three features – joint use, re-use, and recalculate – be included as state goals for the new bond and that portions of the bond be earmarked for joint use projects and re-use of existing facilities.

Selected Research: Designs

Bingler, Steven, Linda Quinn, and Kevin Sullivan. *Schools as Centers of Community: A Citizen's Guide for Planning and Design.* 2nd. edition ed. Washington, DC: [sponsored by] National Clearinghouse of Educational Facilities, 2003. http://www.ncef.org/pubs/scc_Cover_page_Table_of_Contents.pdf

California Department of Education, School Facilities Planning Division. *Healthy Children, Ready to Learn: Facilities Best Practices.* Sacramento: CDE Press, 2007. http://www.cde.ca.gov/ls/fa/sf/documents/hcrtlfacilities.pdf

California Public School Construction Process Review*: A Collaborative Approach by Practitioners, Customers, and Stakeholders.* Sacramento: Department of the State Architect, 2010. http://www.documents.dgs.ca.gov/opsc/PREWG/CPSC_Report.pdf

Crampton, Faith E. *"Spending on School Infrastructure: Does Money Matter?"* Journal of *Educational Administration* 47, no. 3 (2009): 305-322.

Schools for Successful Communities: An Element of Smart Growth. Scottsdale, AZ: Council of Educational Facility Planners International, 2004.

Recommendation 2: Explore options to ensure ongoing funds for maintenance and operations of school facilities to protect California taxpayers' capital investments and improve student well-being. Provide best practice guidelines to train staff on the best use of new and upgraded facilities so that improvements are realized.

School facilities are but one way that student achievement, well being, and success are impacted. They are also an excellent catalyst to inspire change and improvement. By integrating the vision for 21st century learning environments into a broader district vision, real change can happen. A new "food court" for example can inspire a healthier food service program while the inclusion of a community room may create a joint use program that previously didn't exist. And with each of these new changes, improvements in operations and maintenance will emerge. How do we deal with the increased bio-waste in a kitchen when more fresh fruits and vegetables are offered? Who stays late and which entity pays for the clean up in a joint use space? Among other operational and maintenance issues that need a dedicated fund are:

Integrated technology must be continually upgraded in order to keep "hands-on programs relevant.

Walnut Elementary School
Turlock Joint Elementary School District
LIONAKIS

- **Integrated technology:** Once the initial capital investment is made, the success of our technology rich learning environments lies in our ability to maintain and upgrade hardware and software and train teachers (and students). Trained technology specialists will certainly become an important position on 21st century school sites. This operational cost must be met and many questions answered regarding student owned or district owned hardware, responsibility of the school district for safety on the Web, etc.

- **Furnishings:** Tables and chairs with wheels, soft furniture, built-in benches, and covered shelters with solar panels…all of these items need refreshing and on-going maintenance.

- **Commissioning:** The sub-committee recommends that schools use a commissioning process and that this be built into the funding formula for new construction and all remodels. This tenet of successful, high performance schools optimizes the performance of building systems and includes a level of training that improves long term maintenance procedures. It is also important to train and educate the users of the facilities, including students, as user behavior is a key ingredient in realizing long term operational efficiency.

Did you know? Users typically underestimate their energy usage by 2.8 times. Real time energy displays can help improve user's understanding of energy usage – and students are often the ones to hold us accountable!

Public Perceptions of Energy Consumption and Savings. August 2010, vol. 107, no. 37, Proceedings of the National Academy of Science.

- **Prioritize deferred maintenance funding**: The investment we make in capital facilities programs is diminished if we cannot maintain our schools. For many years districts have struggled to maintain their facilities. Now with newer building systems – lighting controls, energy management systems, for example – require a higher level of understanding and fine tuning on a regular basis. The efficiency of high performance schools and their systems is impacted over time when regular maintenance does not occur. Ongoing funding is necessary.

Selected Research: Building Conditions

Branham, David. *"The Wise Man Builds His House Upon the Rock: The Effects of Inadequate School Building Infrastructure on Student Attendance."* Social Science Quarterly 85, no. 5 (2004). http://dx.doi.org/10.1111/j.0038-4941.2004.00266.x.

Kumar, Revathy, Patrick M. O'Malley, and Lloyd D. Johnston. *"Association Between Physical Environment of Secondary Schools and Student Problem Behavior."* Environment and Behavior 40, no. 4 (2008): 455-486.

Plank, Stephen B., Catherine P. Bradshaw, and Hollie Young. *"An Application Of "Broken-Windows" And Related Theories to the Study of Disorder, Fear, and Collective Efficacy in Schools."* American Journal of Education 115, no. 2 (2009): 227-247.

Recommendation 3: Create a working group to focus on regulations in Title 5 that need updating and revision to ensure the creation of school sites and learning spaces that reflect the needs of 21st century teaching and learning, as well as the increasing awareness of the impact of school siting and size on environmental, economic, and fiscal goals.

Soft comfortable furnishings make 21st century libraries inviting places for children.

Alder Creek Middle School
Tahoe Truckee Unified School District
Lionakis

In recent years, there have been a number of suggested revisions to Title 5 from a variety of interested constituents: some seeking relief from what they believe are "one-size-fits-all" square footage minimums, others hoping to align siting and acreage requirements with the state's smart growth initiatives; while still others want to see all school site designs reviewed for site safety and educational appropriateness even when no state funds are leveraged.

The state clearly must find the right balance and respond to the trend of more personalized learning, not just grade level groupings. The state must respond to 21st century neighborhoods, not just the suburban school paradigm. The state has a regulatory obligation to assure minimum design standards that assure safety and educational equity while still creating a regulatory environment that supports school designs that embrace the new instructional pedagogies, healthy lifestyles, and technology tools demanded in the 21st century.

Selected Resources: Regulatory Revisions

California Department of Education, School Facilities Planning Division. *Re-Visioning School Facility Planning and Design for the 21st Century: Creating Optimal Learning Environments*, prepared by University of California Berkeley, Center for Cities & Schools, 2008. http://www.cde.ca.gov/ls/fa/sf/documents/roundtablereport.pdf

Lee, Valerie E., Douglas D. Ready, and Kevin G. Welner. *Educational Equity and School Structure: School Size, School Overcrowding, and Alternative Organizational Structures.* Williams Watch Series: Investigating the Claims of Williams v. State of California. Los Angeles: UCLA's Institute for Democracy, Education, and Access, 2002. http://escholarship.org/uc/item/2zx2b0w5

Recommendation 4: Collect and disseminate research, resources, and best practices to assist local planning groups as they site and design schools that are learner-centered, safe, healthy, sustainable centers of communities.

Recently educators have been focused almost exclusively on the academic side of student achievement. Some would say California has not had a comprehensive view of student learning. Educational research is increasingly focusing on a broader view of student achievement. Often called “whole child” initiatives in the literature, this philosophical approach stresses the integration of mind, body, and spirit of each individual child. And in facilities design one would expect to find support for the ‘mind’ in an academic wing; support for the ‘body’ in fitness, physical education, nutrition and health; and support for the ‘spirit’ in theaters, rooms for art and music, choir, band, and a library or digital commons.

Technology was another area that the sub-committee discussed at some length. Some districts have robust instructional technology integration programs that include internet devices for students, digital content, staff development, and a sustainable replacement policy. Sufficient infrastructure (electrical and internet), security and storage, size of classrooms, and types of furniture are just a few of the facilities issues that emerge when increasing the use of technology in schools.

But what does this look like? The California Department of Education should expand its guidance and technical assistance to schools during the planning stages of modernization and new construction to include more digital resources and disseminate current research on topics that affect facilities design to support the broad view of student achievement. The work should include the posting of a gallery of innovative spaces, virtual tours, and interviews with the occupants and designers that would assist local groups. We do not mean for this work to produce “prescriptions” for what schools should look like. This gallery should be a broad collection of design solutions to inspire the design of schools of the future. Additionally, the state should consider providing planning facilitation to districts that are developing educational specifications and master plans.

Selected Resources: Design of Learning Environments

California Department of Education, School Facilities Planning Division. *Healthy Children, Ready to Learn: Facilities Best Practices*. Sacramento: CDE Press, 2007. http://www.cde.ca.gov/ls/fa/sf/documents/hcrtlfacilities.pdf

California Department of Education, School Facilities Planning Division. *Educational Specifications: Linking Design of School Facilities to Educational Program.* Sacramento: CDE Press, 1997. http://www.cde.ca.gov/ls/fa/sf/documents/edspecs.pdf

School Site Selection and Community Impact
Policy Sub-committee Memo

I. Sub-committee Topic: School Site Selection and Community Impact

Co-chairs
- Cynthia Bryant, California Charter Schools Association
- Mamie Starr, San Joaquin County Office of Education

Members
- Scott Clark, Local Government Commission
- Chris Cox, San Bernardino County Schools Superintendent's Office
- Gary Gibbs, California Building Industry Association
- Christopher Grimes, Roseville Joint Union High School District
- Steven Ladd, Elk Grove Unified School District
- Dwayne Mears, The Planning Center

Support Staff
- Michael O'Neill, California Department of Education, School Facilities Planning

Sub-committee Charge
The sub-committee was charged with reviewing how local educational agencies (LEAs) and communities should better collaborate in the selection of school sites. The sub-committee developed recommendations to foster joint use, smart growth, and schools as centers of community.

II. Context

In California today, school siting decisions are made by the school district with a focus on the projected population of students and a location that can meet the requirements of the *California Code of Regulations,* Title 5 (5 *CCR*) as established by the California Department of Education (CDE). Generally speaking, this system works to achieve a goal of building new schools in areas where development is occurring, with the site often "designated" by the developer. However, the current system does not often allow the school siting decision to be part of a coordinated effort to achieve a complete or sustainable community.

The relationship between school districts, land developers, and cities or counties around school siting and joint use can be tense, particularly where there is little or no coordination during each phase of the community planning process or the development approval process. Yet, all sides recognize that a quality school is a key component of a successful community and neighborhood, and vice-a-versa.

The lack of mutual understanding and collaboration between LEAs and cities and counties on school siting often leads to land use decisions that are less than optimal. There are often political and funding tensions between all affected agencies, developers, and even community members.

When this is coupled with a lack of knowledge of the planning processes, which are frequently "siloed," the ability to effectively interact for the long-term benefit of all parties is stymied.

In addition, current state funding programs, school planning processes, and siting analyses are often not aligned with the state's sustainability/health goals or the leveraging and efficient use of resources. Under the current funding regulations, districts are often more likely to seek new larger enrollment schools on larger sites, on less expensive land, farther away from the populations that are to be served, rather than reusing, rebuilding, or expanding existing sites. This is in contrast to the community and academic benefits of smaller neighborhood schools.

Actions that would address leadership, early planning collaboration, and the promotion and maintenance of healthy, sustainable schools and communities, generally include these major themes:

- Policies, practices, and funding for alignment with state sustainability goals.
- Education on, and mutual understanding of, school siting/planning processes and requirements.
- Integration of school site planning and community land use planning.

There is a tangential and related consideration when it comes to school siting – what will be the effect of future learning modalities and delivery methods, including ever-burgeoning electronic technologies, on the size and number of school sites, as well as the future of existing school sites? The implications of this do seem to support the conceptual, if not the actual, goals of sustainability.

III. Key Recommendations and Options

Recommendation 1: Align future state school facilities bond measure provisions and CDE regulations and guidance documents with state sustainability goals, including modernization/rebuilding existing schools and funding for LEA facility master planning.

- **Rationale:** Providing financial incentives and funding for pilot programs is often the best route to effect behavioral changes and to allow serious exploration and evaluation of the effects of new concepts and theories.

  The un-adopted November 2003 version of the *Governor's Environmental Goals and Policy Report* (required by state law in 1970 and consistent with the state planning priorities enacted by Assembly Bill 857 (AB 857, Statutes of 2002 [*Government Code (GC)* Section 65041.1]) states that "Schools are an important part of our "brick and mortar" infrastructure, but are also an education reform, human health, and sustainable planning issue." The overall focus of the report is on what actions the state should/could take to turn around California's fragmented and non-integrated land use planning patterns (sprawl) and the resultant high costs in infrastructure and resource utilization. School facility siting is singled out in two areas: as an example of "silo" decision making inconsistent with local growth policy; and as a development "disaster." The report states, "The location of new schools, for example, has an important influence on land use, but siting decisions are not always made in cooperation with local land use planning agencies. This is the source of one of the most volatile and troublesome problems in California land use planning." The report continues, " '[s]chool sprawl' is another challenge for responsible land use planning."

Agree or disagree, a significant amount of funding for school site purchases, and development, does come from state bond measures. Therefore, it is not unreasonable that state goals be a part of the considerations. However, school facilities are an important part of the local infrastructure, which naturally necessitates accord at all levels.

The emerging concept of modular-student centric learning dictates only that there be a "place" for students to "sit (or stand) and connect." That does not have to be a stand-alone school facility as we know it now. It could be in the mall or the office complex or the city hall or the local entertainment venue (sports stadium). This same technology now allows students to receive information via the internet from their own home, resulting in significantly more programs that allow (and promote) greater flexibility in the delivery of educational services. This could have the long-term effect of decreasing the number and/or size of school sites. However, the school facility has been, and will probably continue to be, the social hub for young people, which raises the question of how big, how many, and where.

- **Suggested Actions to Implement Recommendation 1**
    - In future state school facility funding programs, include a restricted category of funds for pilot programs that focus on the siting or development/redevelopment of school facilities to align with local and/or state sustainability goals, including projects which focus on the development and implementation of non-traditional learning environments. (Intermediate or long term depending upon future bonds)
    - Modify Title 5 to include the requirement of a locally-approved, current school facility master plan to obtain the CDE approval of school sites or plans. This could involve listing what must be contained in an acceptable plan. (Intermediate term)
    - Require that all school facility master plans include an explanation of how the elements of the plan (specifically the location of new schools, the closing or conversions of schools, and the renovation of older schools) align with the sustainability goals of the state and with the local general plan. (Intermediate term)
    - Have the CDE provide all school districts with information on the state's sustainability goals (and policies) and how they relate to the siting and development of school facilities at the local level. (Short term)
    - Have the CDE develop guidance documents and/or procedures concerning the benefits of creating or re-creating school facilities that are consistent with

- Sustainable Communities Strategies (SCS). These SCS's have not yet been adopted, but as they are, school districts will have the opportunity to benefit from streamlining of the California Environmental Quality Act (CEQA) process as provided by Senate Bill 375 (SB 375), Statutes of 2008. Alignment with SCS will also demonstrate consistency with state planning policies and goals. (Intermediate term)

- Expand Collaborative for High Performance Schools (CHPS) criteria and any similar tools which may be used for evaluating high performance projects, to include sustainability criteria related to school siting, such as multi-story and smaller acreages, joint use, and focused use of technologies. (Intermediate to long term)

- In future state school facility funding programs, include funding priority incentives for planning and development of community-centered campuses. The regulations could include standards or criteria for defining community-centered campuses and what levels would be considered significantly above the "norm" to warrant priority considerations. (Intermediate or long term depending on funding)

- Expand the "list" of "high performance criteria" that might be considered in the review of school projects to include additional siting considerations such as, but not limited to, air quality, reductions in waste or energy for transportation, or increased health benefits. (Short to intermediate term)

Recommendation 2: Develop guidance documents and a training program on cross collaboration for LEAs and local governments. Seek out opportunities for greater joint use through collaboration.

- **Rationale:** Education of all stakeholders and decision makers, and team work are the keys to success. Collaboration will be a new paradigm for all funding programs.

    - There is a need for city/county leaders to better understand school siting processes, and for school leaders to better understand city/county planning processes in order to better collaborate.

    - There are mutual benefits of collaboration that have been demonstrated.

    - There are examples of successful collaboration to share.

    - There are existing opportunities to educate stakeholders.

Although there are examples of successful joint use collaborations and cooperative relationships, and existing resources that can facilitate collaborations, for the most part there is a limited understanding of the distinct planning processes guiding each local entity. With no policy framework or incentive to guide local agency collaboration, communities struggle to work together on school siting. There is evidence that cross collaboration on school siting is limited, and when dialogue does occur, it tends to be late in the process when it is very costly to make changes. Local planners do not receive training on all that is involved in the school siting process, including the extensive state requirements. School districts are not often involved in community planning processes, such as General Plan updates or development of community blueprints or sustainable communities strategies. The leaders within each "silo" do not tend to have a good understanding of the other's reality, perspective, or mandates.

Opportunities exist now that allow for innovation of which stakeholders may not be aware. Charter schools, for example, have greater flexibility on school size that can be leveraged to develop model approaches in the area of infill. Improved knowledge of examples like these can increase the opportunity to collaborate and provide maximum benefits of working together. In a forum on school siting collaboration held in Sacramento in 2008, a diverse set of stakeholder participants reported that the primary take-away theme was a need to educate peers about the distinct planning processes.

- **Suggested Actions to Implement Recommendation 2**

    - Development by the CDE, in cooperation with California school facility organizations, the Local Government Commission, local government organizations, and other related collaboratives, of a comprehensive reference list on joint use, school/local government collaboration, and examples of "sustainable" school siting. (Short term)

    - Development by the CDE of a white paper on local collaboration, that includes both school and city/county perspectives, that could be produced and disseminated primarily via e-mail. Key points to cover would include the benefits of collaboration, such as: better use of limited resources; fewer legal challenges; increased ease of implementation; and more effective policies. Readers could be reminded that:

        1) Collaboration happens along a continuum, ranging from networking and coordinating to joint activities that are based on shared vision and goals;

        2) Different levels of collaboration can be appropriate based on the circumstances;

        3) Levels of trust, "turf" issues, and time availability are factors in determining the success of a collaborative group; and

        4) The sharing and joint discussion of case studies is a valuable exercise.

    The white paper could also explore the vision of schools as anchors for their community, explaining how collaboration will benefit the multiple stakeholders within the district and community partner agencies. For example, describe how school location and joint use impact operating budgets, particularly transportation, staffing, and other operating costs (including custodial and lock/unlock services), free/reduced meals, preschool and school readiness, parent involvement, and board issues. Both school and city/county perspectives should be included. (Short term)

- Update the CDE's school siting guidance documents such as the *School Site Selection and Approval Guide* (Blue Book) and the *Guide to School Analysis and Development* (Yellow Book) with a discussion on collaboration and how it can help the school siting process, similar to what was outlined in the previous bullet point. Both sustainability and joint use could be included. The Office of Planning & Research could issue related recommendations for cities and counties. Other entities might have guidance documents that could provide similar information. (Short term)

- Update the guidance documents to facilitate development of non-traditional campus models and partnerships for the purpose of encouraging more use of existing buildings and educational facility opportunities instead of construction of new facilities. (Short to intermediate term)

- Review, and amend as appropriate, elements of the code, regulations, rules and procedures, and funding programs to assure that collaboration in school siting and the implementation of joint use is not hindered. (Intermediate term)

- Update the guidance documents to include school siting in infill areas and the effective re-use of sites for schools as well as the re-use of existing school sites. (Intermediate term)

- Prepare a white paper that focuses on joint use best practices. This could also include consideration of school sites as emergency centers. (Intermediate term)

- Develop a PowerPoint presentation and notes with key points that could be reproduced, and identify speakers to serve as the basis for session proposals at the next round of upcoming conferences where key stakeholders are involved, such as:

    - ✓ California Association of School Business Officials
    - ✓ California Chapter of the American Planning Association
    - ✓ California Charter Schools Association
    - ✓ California School Board Association
    - ✓ California State Association of Counties
    - ✓ Coalition for Adequate School Housing
    - ✓ League of California Cities
    - ✓ Local Government Commission's New Partners for Smart Growth Conferences (in San Diego in February 2012

- ✓ Or even smaller functions such as regional school facility directors meetings (Short to intermediate term)

- o Create an internal training program at the CDE that could be conducted regionally, inviting other agency participants. (Short to intermediate term)

- o Through the CDE, establish a group to explore ways to achieve greater collaboration with community colleges and state universities for the purpose of increasing facility joint use opportunities for school districts while at the same time maximizing the investments in higher education facilities. (Short to long term)

Recommendation 3: Reduced enrollment and school size.

- **Rationale:** Smaller enrollments are safer, require smaller sites which facilitates infill and promotes renovation of existing facilities within neighborhoods, and they are better for service to constituent neighborhoods. Smaller sites, more centrally located within the neighborhood or community, facilitate neighborhood-based activities, more biking and walking, and less driving.

  California is among the nation's leaders in high school site enrollment. A *National Center for Education Statistics* report for the 2008-2009 school year shows the average size of California schools is 31% higher than the national average. Enrollment in California primary schools is seventh highest in the 50 states plus the District of Columbia and 18% higher than the national average. The disparity is more pronounced at the secondary level. California middle school enrollment is third highest in the nation behind Florida and Nevada and is 43% higher than the national average; high school enrollment is second highest in the nation after Florida and 74% higher than the national average.

  Districts and communities realize several benefits from reduced school size. Small campuses and class size allow for greater teacher/student/parent interaction. Parental involvement in the educational program is therefore enhanced and community support and interaction becomes the norm. Additional benefits include reduced home-to-school transportation needs and increased student/staff safety and security. Urban districts may also find smaller campuses easier to accommodate utilizing smaller in-fill properties. This may reduce land acquisition costs and lessen the need to acquire property through eminent domain. A smaller, more intimate environment, especially at the secondary level, has also shown promise in reducing dropout rates and raising graduation rates.

  The report *Transforming the High School Experience*[1], highlights the successes of New York City's efforts to increase student achievement and graduation rates. Since 2002, New York City has closed many of its lower performing high schools and replaced them with smaller school sites. The effect has been positive:

  > "This report presents encouraging findings from that study, providing clear and reliable evidence that, in roughly six years, a large system of

> small public high schools can be created and can markedly improve graduation prospects for many disadvantaged students. Specifically:
>
> - By the end of their first year of high school, 58.5% of SSC ("small schools of choice") enrollees are on track to graduate in four years compared with 48.5% of their non-SSC counterparts, for a difference of 10.0 percentage points. These positive effects are sustained over the next two years.
> - By the fourth year of high school, SSCs increase overall graduation rates by 6.8 percentage points, which is roughly *one-third the size of the gap in graduation rates* between white students and students of color in New York City.
> - SSCs' positive effects are seen for a broad range of students, including male high school students of color, whose educational prospects have been historically difficult to improve."[1]

Student safety and security are also enhanced at smaller sites as research indicates larger schools face increased discipline issues. *Indicators of School Crime and Safety: 2010*, a joint publication of the Bureau of Justice Statistics and the National Center for Education Statistics, found:

> "During the same school year, in general, the percentage of schools reporting discipline problems was higher in larger schools than in smaller schools. For example, 52% of schools with 1,000 or more students reported that gang activities occurred during the school year compared to 10 to 22% of schools with fewer than 1,000 students who reported this discipline problem."[2]

The apparent tie between higher enrollment and increased discipline problems should also be at the forefront of alternative education site selection and sizing discussions. Alternative education settings should be central to the students they serve with class sizes reduced to provide a lower student-to-teacher ratio, facilitate student learning, and enhance security. However, pupil grants must be increased sufficiently to offset the reduced construction dollars available to districts and county offices that result from reduced loading standards.

A National Institute of Building Sciences study identifies four mechanisms for creating smaller schools: 1) renovate and redesign existing schools, 2) reorganize existing schools, 3) utilize satellite facilities, and 4) build new small schools. School Facility Program grants can directly support two of these options.

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[1] Howard S. Bloom, Saskia Levy Thompson, Rebecca Unterman. *Transforming the High School Experience: How New York City's New Small Schools are Boosting Student Achievement and Graduation Rates*. New York: MDRC, 2010.

[2] Daniel L. Duke, Thomas DeRoberto, Sarah Trautvetter. *Reducing the Negative Effects of Large Schools*. Washington D.C.: National Clearinghouse for Educational Facilities, 2009.

Through the use of modernization grants, districts may renovate and redesign existing facilities to create a "school within a school." This is especially effective at the secondary level where campuses can be divided into specific areas and reorganized along curricular lines.

New construction grants used to build smaller schools must be adequate to fund the loss of economies of scale that occur with building larger sites. A restructuring of new construction grants must also address a move towards high performance and "green" schools which will enhance the educational environment and help reduce long-term operational costs. Districts utilizing a combination of these approaches will quickly realize their transition to smaller schools.

Reduced site size implies districts will be required to operate a larger number of campuses. It is assumed that this may increase personnel costs if additional administrative overhead is required. Furthermore, the district might also see an increase in overall operational cost, especially utility costs, due to running multiple campuses. However, there is at least one out-of-state study which suggest that this does not have to be the case, and that purported savings from consolidations or having larger plants might be misstated or overstated. This dichotomy indicates that each district should analyze their individual situations rather than having the creation of mandates. If the desire is to have schools improve their impact on the community, considering a smaller school should be part of the equation, even in tough fiscal times.

It is probable that increased costs would not occur when a district elects to renovate and redesign an existing school, assuming that it is in a location that can effectively and efficiently serve a student attendance area and/or neighborhood.

- **Suggested Actions to Implement Recommendation 3**
    - Develop legislation to formulate new funding mechanisms to offset the costs of smaller campuses. As with the class size reduction program, districts will be required to hire additional staff and fund additional operational needs. Additional district funding may be accomplished through increased average daily attendance funding or by creating a separate funding category for site size reduction. (Intermediate term)
    - Develop a library of case studies that demonstrate successful joint use projects that effectively result in a more efficient use of land and other resources while at the same time facilitating smaller school sizes. Rural schools are generally smaller than their urban or suburban counterparts and they often have special needs; however, they also tend to function very well in meeting rural community needs. There are elements of rural schools that could provide effective models for joint use collaboration. (Intermediate term)
    - Convene a series of meetings to examine and develop ways in which smaller school sizes can be effectively and economically implemented, particularly in urban and suburban areas. (Intermediate term)

- Research the hypothesis that smaller plants are less costly to operate on a per student, or per square foot basis, than larger plants. (Intermediate term)

Recommendation 4: Encourage the formation of local school site selection committees and require that LEAs consider local land use plans and state sustainability goals in the analysis of school siting.

- **Rationale:** LEA decision making needs to be expanded to recognize that the decision to provide enough schools for projected population can take into account other community impacts as well.

  School buildings are physical infrastructure and have an impact on the community beyond providing space for educating students. Even under today's system of siloed planning, school siting can be done taking into consideration all state and local community goals for sustainability if they are included in the local deliberations.

  For example, if an LEA considers the desire of a community to reduce the health impacts from infrastructure projects, it may choose smaller school sites that would allow children to safely walk or ride bikes to school. Even if the city or county government organization is ignoring sustainability principles, the LEA can provide leadership by looking for ways to site schools in a manner that encourages infill, for example:

- **Suggested Actions to Implement Recommendation 4**

  - Development by the CDE of a suggested checklist of sustainability features of site selection that LEAs can consider as they make siting decisions. (Short term)

  - Establishment of a recognition program by the State Superintendent of Public Instruction (SSPI) for sustainable site selection efforts. (Short term)

  - Require a resolution by the LEA at the time of approval of a school site describing how the site meets sustainability goals. Requires legislation. (Long term)

Recommendation 5: Encourage and/or mandate early communication and collaboration for land use planning processes between LEAs and local agencies and joint statements from affected local agencies.

- **Rationale:** Collaboration can stretch state and local dollars and create schools and neighborhoods that support each other. Collaboration at early planning stages can drastically reduce later "development time" conflicts between developers, local governments, and school districts.

  With the billions of local and state dollars invested in school facilities statewide, and with California in the midst of a massive and unprecedented budget deficit, it is critical that the state look at every possible opportunity to ensure that funding is used as efficiently as possible. There can be overall cost savings where school districts are collaborating with cities and counties as early as possible to choose new school sites that maximize use of existing or planned infrastructure (e.g., roads, utility lines) and services (emergency response, public transportation), and to ensure that schools are located central to the existing and/or projected school attendance areas. Schools are an element of infrastructure that is directly related to the existing or planned housing stock. Consideration of school sites is as important in development of redevelopment, or conversion areas, as it is in areas of new development.

Where there is communication between school districts and cities/counties on school siting, it often comes late in the process. The later in the process, the more money and energy has been invested making it more difficult to change a plan. School districts have the authority to overrule local land use plans created by local governments, but where a school is located impacts cities and counties, which can include budget impacts related to providing key infrastructure and critical services. An early, long-range view of transportation and infrastructure allows for the purchase of school sites at lower cost with the guarantee that the planning outlined will come to fruition. This will also help reduce the friction that comes when districts move to purchase property. In the absence of a comprehensive clear long-term plan, districts often end up at odds with developer(s) and/or the local governmental entity because these latter institutions may have “other plans” for specific properties. Assuring that school sites are integrated into long-range local plans at the outset, and in subsequent specific or community plans, is essential.

School districts also have major limitations on where a school can be located, when all regulations and costs are considered. Yet, all can agree that a quality school is a key part of a thriving neighborhood, and that a quality neighborhood helps make a successful school. If conversations about future school location can happen early and regularly, with each side supporting the other’s planning efforts with data, neighborhood quality of life and district quality of education can be aligned. With a more collaborative process, there is less chance that cities/counties will treat school districts as a developer with land use authority, and instead consider them more of an ally in community building. Where relationships are positive, cities and counties can serve as advocates for districts, helping in the acquisition of sites near existing or planned infrastructure and services, or possibly to mitigate some of the costs related to infill siting or modernization.

- **Suggested Actions to Implement Recommendation 5**
    - Issue a joint memo and/or pronouncement from key agencies, such as the SSPI, the heads of League of California Cities/California State Association of Counties which describes the benefits of collaboration. (Short to intermediate term)
    - Regulatory approaches could include changes that would require early communication with cities and counties by the school districts, but that strive to minimize impact on an already challenging process. For example, the *Education Code* and/or Title 5 could be modified and/or clarified in a variety of ways:
        - Require notification of local government agencies when a facility planning process is initiated.

        - Required communication could be expanded from notification to soliciting local government participation, such as a formal invitation to join a site selection committee (if the district has one).

        - Encourage districts to consult with cities/counties to assess essential public services/infrastructure that are already in place, costs of providing any missing services, and any potential joint use facilities owned/operated by the local government.

        - In the section, "determining who will select the site," the CDE's *School Site and Selection Approval Guide* (Blue Book) suggests using a "selection team" process as opposed to a staff-only process. This recommendation could be reinforced in statute or regulation; however, to ensure that the process is not overly burdened or delayed, such a change should be carefully considered before enacting. The list of stakeholders to invite to participate as part of a team should include key local government agency staffers, appointed officials (for example, planning commissioners), and elected officials. Comprehensive inclusion of school siting in the local general plan process could be a very effective alternative to a committee. The general plan process automatically brings together local appointed and elected officials, as well as providing a solid and repetitive venue for public participation. Funding for development of collaborative prototypes (pilots) could be part of a state school facilities bond. (Short to intermediate term)

    - Require that all local general plans: include general locations of school sites relative to the existing and projected housing densities shown on the general plan land use map; specifically include consideration of high schools and colleges in the circulation element of the plan; include Title 5 school siting "safety hazards" in the safety element of the plan; and have policies relative to the joint development, operation, and use of community facilities, including schools. This will require legislation. (Intermediate to long term)

    - Expand the parameters of *Government Code* Section 65402 (and related *Education Code* Section) relative to general plan review for school sites. The focus should be on the process which causes the local planning agency (ies) to collaborate with the local school district in good land use planning. (Long term)

Recommendation 6: Add the State Superintendent of Public Instruction to the Strategic Growth Council and education stakeholders to state planning workgroups.

- **Rationale:** Coordination needs to be at all levels of government. The Strategic Growth Council is a cabinet-level committee tasked with coordinating the activities of state agencies to: improve air and water quality, protect natural resources and agriculture lands, increase the availability of affordable housing, improve infrastructure systems, promote public health, and assist state and local entities in the planning of sustainable communities and meeting Assembly Bill 32 (AB 32), Statutes of 2006, goals. The goal is a more sustainable California, environmentally, socially, and economically.

The Strategic Growth Council is developing new systemic processes that increase interagency coordination and cooperation around state sustainability goals and objectives; is working to improve the understanding of the importance of comprehensive land use/infrastructure planning, resource planning and management, and quality of life issues including health and economic opportunity and the roles of state, regional, and local government; and is finding ways to increase the ability of the state to facilitate innovative ideas and projects and distribute best practices that help cities, counties, and regions incorporate state sustainability goals and objectives.

The glaring absence of "school" persons involved in the development of the 2003 *Governor's Environmental Goals and Policy Report* provides a good example of policy-making in this area without the input of the SSPI. If the goal of the school siting decision is to be part of a coordinated effort to achieve a complete or sustainable community, then the state needs to provide the leadership by adding the education silo to the body charged with increased interagency coordination.

- **Suggested Actions to Implement Recommendation 6**
  - Sponsor legislation to add the SSPI to the Strategic Growth Council. (Intermediate term)
  - Encourage full participation of the CDE and local school district representatives (board members, staff, or administration) in all Strategic Growth Council working groups. (Short to intermediate term)
  - Include school facility representatives in the review and revision of the Environmental Goals and Policy Report as well as other activities or report undertakings that deal with collaborative land use planning. (Short term)

Modernization
Policy Sub-committee Memo

I. Sub-committee Topic: Modernization

Co-chairs
- Terry Bradley, School Business Consulting, Inc.
- Bruce Hancock, Hancock, Gonos & Park, Inc.

Members
- Paul Cohen, Northern California Carpenters Regional Council
- Joe Dixon, Santa Ana Unified School District
- Tom Duffy, Coalition for Adequate School Housing
- Richard Duncan, DC Architects
- Patti Herrera, Murdoch, Walrath, & Holmes
- Stuart Markey, Parsons
- Mary Morris, HMC Architects
- Robert Olin, Brutoco Construction Management Group, Inc.
- William Orr, Collaborative for High Performance Schools

Support Staff
- Dave Hawke, California Department of Education, School Facilities Planning
- Fred Yeager, California Department of Education, School Facilities Planning

Sub-committee Charge
The Modernization Sub-committee was charged with developing recommendations related to the following topics:

- Improving the current modernization program including, but not limited to, modifying facilities to meet the Americans with Disabilities Act (ADA) and taking into consideration the importance of providing adequate funding on an annual basis for campus maintenance.

- Developing a future modernization program that will allow for the transformation of existing school space into 21st century learning environments.

II. Context:

Research has consistently shown that students' academic performance increases when the schools they attend are clean, well maintained, and possess the classroom teaching tools that support a 21st century learning environment. Studies also show that student attendance rates increase when students know their school leaders and their communities are willing to invest in quality school facilities. Finally, the ability to attract and retain talented, high quality teachers and support staff is unequivocally related to the presence of well-maintained facilities equipped to support a 21st century learning environment; and it is quality teacher and support staff who play a significant role in students' successful performance both in and out of the classroom.

Since the late 1970's, with the implementation of the Deferred Maintenance Program, the state of California has recognized the need for school districts to maintain the investment taxpayers have made in public K-12 school facilities through the passage of state and local school bond measures. Unfortunately, the current economic downturn has resulted in a significant reduction in resources at both the state and local level devoted to maintaining California's schools presenting additional challenges to the preservation of a high quality learning environment in the state's schools.

Since the beginning of the state modernization program in the 1980s, the state has provided billions of dollars of matching funds for modernization projects. Despite this investment, the need to direct additional state and local funds for the modernization, renovation, and/or replacement of school buildings continues. As the following points illustrate, thousands of students throughout the state are housed in buildings that were built more than 50 years ago.

- Approximately 30% of all California public school buildings are 50 years old or older.
- The average age of the public school buildings in the Los Angeles Unified School District, even after including the more than 130 new schools built and opened within the last decade, is 41 years.
- Senate Bill 50 (SB 50), which created the current state school building program, was a response to the rapid growth in student population in the state which created a tremendous need for new school facilities. The modernization and renovation needs of the state's aging school buildings were a secondary consideration throughout the debate on SB 50.
- The need to renovate, repair, and upgrade the state's aging inventory of school buildings is critical if California children are going to be afforded the opportunity to receive a first class education that will allow them to compete in our global society.

In order for California public school students to reach their highest potential and compete both nationally and internationally, state and local school district leaders must place a renewed emphasis on immediately providing the resources necessary to maintain and modernize the state's aging schools and in the long-term to convert our once state-of-the-art campuses built during the past 100 years into 21st century learning environments.

III. Key Recommendations and Options

After reviewing the three topic areas given to the Modernization Sub-committee, members of the team condensed the topic areas to two main areas by combining recommendations related to the "current" modernization program, campus maintenance, and the Americans with Disabilities Act (ADA) into one topic area and folding educational modernization into the "future" modernization topic area. Team recommendations along with the rationale, analysis of the source of the problem, and description and analysis of the proposed solution follow.

Current Modernization Program

Recommendation 1: Restore dedicated and sustained maintenance funding. (Short Term)

- **Rationale:** School campuses throughout the State of California are falling into a state of disrepair because of a lack of resources dedicated by local school districts to the daily upkeep of campuses, the regularly scheduled maintenance of campus infrastructure, and the major repair and/or replacements of roofs, HVAC units, flooring, painting, etc.

- **Analysis of the Source of the Problem:** Because of the state's financial crisis that started impacting school districts in 2007-08, legislation was enacted effective with the 2008-09 fiscal year to assist school districts in dealing with their budget shortfalls by providing "flexibility" to school districts on the allocation of funds for certain categorical programs including the use of deferred maintenance funds. In addition, school districts are no longer required to dedicate 3% of its combined state and local revenue into a Routine Restricted Maintenance (RRM) account to be used solely for campus maintenance.

- **Proposed Solution:** Restore and sustain the Local educational agency (LEA) requirement to set a deposit at combined 3% of state and local revenues into their RRM and Deferred Maintenance Accounts. Further, ensure that RRM eligible expenditures follow the definition of maintenance included in the California Accounting Manual, but that routine maintenance performed by custodial staff members be classified as an eligible expenditure as long as the expenditure can be documented for audit purposes. Legislative action is required.

Recommendation 2: Eliminate relocatable classrooms that are beyond their useful life. (Short Term)

- **Rationale:** School districts should have the option to replace relocatable classrooms that are beyond their useful life without incurring a reduction in eligibility for new construction funding under the State Allocation Board (SAB) regulations adopted to implement SB 50, the current state school building program.

- **Analysis of the Source of the Problem:** Unless a school district qualifies for the replacement of a relocatable classroom under the Overcrowding Relief Grants Program (ORG), a school district cannot replace a relocatable classroom with a permanent classroom without having a negative impact on its new construction eligibility as determined through SB 50. Thus, school districts typically repair and/or modernize relocatable classrooms that no longer provide an educationally adequate classroom environment.

- **Proposed Solution:** When the cost to adequately renovate a portable classroom reaches 50% or more of the cost to replace the portable, districts should be given the choice to replace the portable with new construction student grants and that the portable be taken out of use. Legislative action is required.

Additionally, a new generation of high performance prefabricated classrooms designed and manufactured to be permanent structures are now available. These classrooms are third party "pre-certified" to meet the Collaborative for High Performance Schools (CHPS) criteria.

Recommendation 3: Improve access and fire and life safety regulatory interpretations. (Short Term)

- **Rationale:** Laws and regulations, and the interpretation of such by state agencies, can create delays in, and add cost, to modernization projects.

- **Analysis of the Source of the Problem**: Existing statutes and interpretation of regulations by the SAB and the Division of State Architect (DSA) limit flexibility in complying with minimum code requirements, nor do they provide sufficient funding to meet those requirements.

- **Proposed Solution:** Following are proposed solutions to improving access and fire and life safety regulatory interpretations:

    - The SAB should amend its Excessive Cost Hardship Grant for Accessibility and Fire Code Requirements (Section 1859.83) to provide a true 60% of the cost to upgrade facilities to meet the minimum work required by the DSA, including, but not necessarily limited to, a grant augmentation of at least 7% that was originally discounted from the modernization grant when it was developed in 2006. Additionally, the SAB should eliminate the cap on the grant augmentation. The cap is the difference between the new construction grant and the sum of the state and local share of the project's base grant. Regulatory action is required.

    - The DSA should consider streamlining the approval process for high proprietary systems such as Automatic Fire Sprinkler Systems (AFSS) through the possible implementation of a program similar to the former deferred approval process. Regulatory action required.

Recommendation 4: Increase modernization funding for renewable energy. (Short Term)

- **Rationale:** In order for school districts to consider renewable energy solutions when developing plans and specifications for the modernization and/or renovation of existing facilities throughout the school district, the state should financially support the cost of the solutions in a manner similar to what it does for new construction projects. Further, in tandem with energy efficiency, adding renewable energy components to modernization projects will result in a reduction in energy costs thus providing school districts with increased funds for the general operation of their schools.

- **Analysis of the Source of the Problem**: The existing modernization funding model does not provide adequate funds to truly modernize existing school facilities that are at least 25 years old into 21st century learning environments and to add renewable energy components. An increase in modernization funding would increase the limited funds available for much needed educational environmental improvements.

- **Proposed Solution:** Improve the ability of school districts to include renewable energy components in their modernization projects by implementing the following changes:
    - Support Senator Lowenthal's current legislation Senate Bill 128 (SB 128) which would allow modernization grants to be used for renewable energy technology, such as solar projects.
    - Encourage the California Department of Education (CDE) through its representative on the SAB to lead a regulatory change that would provide matching grants (60-40) for energy renewable components. Regulatory action required.

Recommendation 5: Establish an additional grant for modernization infrastructure. (Short Term)

- **Rationale**: Unlike new school construction projects that receive additional grants for service site, utility, off-site, and general site improvements except in limited circumstances, the modernization program was not designed to provide additional grants for these types of projects even though service site, utility, and general site improvements must be dealt with when modernizing schools that are at least 25 years old, and, in many situations, over 50 years old. Further, the current state modernization program does not provide financial assistance for school districts to implement seismic mitigation measures at school sites that have been identified with seismic issues, and the current seismic mitigation program has proven difficult for schools to access.
- **Analysis of the Source of the Problem**: Infrastructure needs unrelated to a building are mainly overlooked on modernization projects because the funding for modernization is inadequate to upgrade learning environments.
- **Proposed Solution**: Encourage school districts to address much needed infrastructure improvements by establishing an infrastructure grant allowance for modernization projects (60/40 match) such as the additional grant allowances provided for infrastructure needs for new construction projects. The infrastructure grants should be based on documented needs. Regulatory action required.

Future Modernization

It is an inescapable reality that most of California's "schools of the future" are already built and in use. Thus, a future renovation/rehabilitation program that will allow for the transformation of *existing* school space into 21st century learning environments is vital. To achieve the goal, the 21st Century Renovation Program should contain the following:

Recommendation 1: Funding in the 21st Century Renovation Program is based on a holistic analysis of both the educational and physical plant needs. (Intermediate Term)

- **Rationale:** The requirements to renovate an existing school building sufficiently to make it a true 21st century learning environment differ dramatically from school to school and district to district. Even if the current funding model were more generous and state building regulations less restrictive, it would still underfund some buildings while conceivably overfunding others. Available resources should be targeted to accomplishing a defined outcome using standards agreeable to all.

- **Analysis of the Source of the Problem:** The current School Facility Program (SFP) modernization funding model relies on a per pupil grant which has no relationship to the needs of the facility being modernized. Today, school buildings eligible for modernization range in age from 25 to as much as 100 years or more; yet, except for a modest supplement given to those more than 50 years old and a capped supplement for access compliance requirements, no other consideration is given to the scope of the need in each building. Because the funding bears no connection to the need of each project, even increased grant amounts would perpetuate the funding inequity by underfunding some projects and overfunding others.

- **Proposed Solution:** Create a 21st Century Renovation Program through legislation that funds the "needs" of a school classroom, building, and site to bring it to 21st century standards in the following ways:

    - Under the guidance of the CDE with assistance from the DSA, develop minimum educational and building performance standards. Permit "state level" standards to be enhanced and/or altered through locally created, CDE approved five-year master plans that contain a thoroughly developed educational specifications component.

    - Perform a "needs" assessment of eligible buildings using a uniform, statewide building condition index that rates and prioritizes the physical condition of the building and the ability to support the delivery of 21st century education. The building condition index measures the state and local minimum educational and building performance.

    - Using the results of the assessment, needed educational, building system, and energy efficiency renovation are identified and a cost assigned. A projected life-cycle cost analysis assists in prioritizing system needs and funding. District developed five-year plans are used to prioritize educational support funding.

Recommendation 2: Use building renovation as an opportunity to improve building performance. (Intermediate Term)

- **Rationale**: Many existing buildings can be renovated to meet 21st century educational standards with properly focused, knowledgeable planning and funding. California's existing schools present an opportunity for significant energy efficiency gains with minimum financial commitment.

- **Analysis of the Source of the Problem**: The current SFP modernization funding model provides limited incentives for energy efficiency, but it does not fully recognize the unique renovation needs of older school buildings.

- **Proposed Solution**: Within the 21st Century Renovation Program, incentives in the form of funding and education target an energy efficiency improvement of at least 50% over the baseline performance of the existing building through existing building renovation utilizing a variety of techniques. In addition, 21st century renovations should utilize an integrated design approach to upgrade the major building systems including heating and cooling, natural daylight and electric lighting, building envelope, and interior finishes.

A percentage of the operational savings realized as a result of 21st Century Renovation Program funding is dedicated by the district to a revolving fund for additional energy conservation projects and/or on-going maintenance needs within the district.

Post occupancy performance evaluations using available tools and metrics are funded to ensure that energy efficiency and building performance targets are met and sustained.

Recommendation 3: Shared funding for mandated, legally required components.
(Intermediate Term)

- **Rationale:** The 21st Century Renovation Program recognizes that seismic safety, fire and life safety, and ADA compliance requirements benefit all and are a shared responsibility and require full state participation. All building and educational needs, including those created by state and federal mandates, are recognized within the funding model.

- **Analysis of the Source of the Problem:** The laws governing modernization of public school buildings in California impose significant and costly requirements on every project. In some cases, simply meeting these basic safety and civil rights needs completely exhausts the available modernization funding leaving the local district unable to fund even fundamental system upgrades. Educationally related improvements cannot even be considered. Worse yet, in the most severe situations, even the state modernization funding is insufficient for safety and ADA mandated improvements, and district resources must be used to accomplish nothing more than state and federal requirements leaving modernization of any real sort impossible.

- **Proposed Solution**: The 21st Century Renovation Program recognizes all needs - - both systems and educational. The project needs are assessed using a complete scorecard of requirements, mandates, and essentials, as well as improvements, to bring the facility into the 21st century as a learning environment. School district planners, parents, and teachers are never required to choose between having operational heat, modern technology, or access compliance improvements.

Recommendation 4: Recognize that infrastructure components have a useful and finite life.
(Intermediate Term)

- **Rationale:** Replacement of existing buildings that cannot be made into 21st century learning environments is an essential tool that must be available to districts.

- **Analysis of the Source of the Problem**: Under the current modernization program, there is no funding available to replace existing buildings. While modernization funding may be combined with additional district funding to do “replacement-in-kind”, the additional burden on the local resources can be, and usually is, prohibitive. Districts are forced to spend modernization funds on buildings which cannot be made educationally, environmentally, or physically adequate. The buildings remain on the district's "inventory of adequate classrooms" virtually forever no matter how inadequate they actually are.

- **Proposed Solution**: Using the building condition index mentioned previously, the overall adequacy of a facility is measured. The costs for renovating it to 21st century standards are developed and are compared against a true replacement cost. When the renovation costs exceed a specified percentage of replacement, or when the building cannot be made adequate at any cost, a replacement option with appropriate funding is provided. Additionally, the replacement of aged, energy inefficient, and educationally inadequate portables is encouraged and incentivized. A first priority is given to sites with disproportionate numbers of portable classrooms. The decision to modernize, reconstruct, or replace is a district choice based on community needs and building analysis.

Recommendation 5: Protect the investment in our schools.

- **Rationale:** Funding based on need assumes and requires a commitment from districts to maintaining facilities to a prescribed standard. Failure to do so should not impose a funding burden on the state.

- **Analysis of the Source of the Problem**: In the current program, the failure to adequately maintain buildings does not directly impose a statewide burden since the modernization funding is the same for buildings of all conditions and ages. However, when funding is based on need, a standard of care must be established, measured, and maintained as a matter of equity.

- **Proposed Solution:** Requests for participation in the 21st Century Renovation Program are accompanied by evidence of on-going local efforts to maintain and operate facilities efficiently and effectively within available resources. Master plans, five-year maintenance plans, and educational specifications are a part of an effective local effort. Following a renovation project, a district will ensure that the project is maintained in good repair, working order, and condition.

Funding and Governance
Policy Sub-committee Memo

I. Sub-committee Topic: Funding and Governance

Chair

- William Savidge, West Contra Costa Unified School District

Members

- Cathy Allen, Coalition of Adequate School Housing
- Eric Bakke, Los Angeles Unified School District
- Steve Castellanos, Caldwell, Flores, Winters, Inc.
- Stephen English, Advancement Project
- Mahendra Mehta, Prefast Plant Crafted Buildings
- Jeff Vincent, University of California, Berkeley, Center for Cities & Schools

Support Staff

- Monique Ramos, California Department of Education, Legislative Affairs

Sub-committee charge

The sub-committee was charged with reviewing current funding proposals such as Assembly Bill (AB) 331 (Brownley, 2011) and develop recommendations for cost savings while considering the need for complete schools. The sub-committee reviewed the current governance structure of the Office of Public School Construction, Division of State Architect, Department of Education, and State Allocation Board and made recommendations for streamlining.

II. Context

In 1998, the Legislature passed Senate Bill (SB) 50 (Greene, 1998) which created the School Facilities Program (SFP). The SFP encouraged the building of new schools and modernizing older schools to ensure students had quality educational facilities.

Over the past 12 years the state has invested $35.4 billion dollars in schools facilities – matched by billions of local bond dollars. With the collapse of the housing market and economic downturn in 2008, the State of California suffered unprecedented budget deficits. The ongoing deficit has prevented the state from going out for a 2010 school bond; it remains to be seen if the state will proceed with a 2012 school bond.

With limited dollars remaining from Proposition 1D of 2006, and lack of data to demonstrate the state's need for new school construction, school modernization, and seismic safety, this document makes short and long term recommendations to fund California school facilities.

III. Key Recommendations and Options

Overall Recommendation: The state should continue to provide school facilities funding, in combination with shared local funding, as a priority infrastructure investment for California.

Recommendation 1: Immediately as a precursor to a complete inventory, and to inform consideration of the next state school bond measure, the California Department of Education (CDE) should prepare a comprehensive assessment of new construction and modernization needs using existing capacity and demographic information and projections, as well as, data produced from a statewide school facility inventory as proposed under Recommendation #3 .

- **Rationale:** To properly assess the need for – and the most appropriate structure and size of – a new state school bond measure, the state needs to collect and analyze information from several agencies, specifically the Office of Public School Construction (OPSC), the Department of Finance (DOF), and the California Department of Education (CDE), to determine:

  a) The number of new facilities needed to accommodate expected enrollment growth and remedy existing overcrowding, and

  b) The extent to which older facilities are in need of state assisted modernization.

- **Analysis of the Source of the Problem:** Information necessary to determine the need, best structure, and size for a new bond measure is presently spread over several agencies, with none having responsibility for making a comprehensive analysis. Accordingly, for some prior bond measures, the legislative process has not been informed by reliable need projections, but rather by an absence of such projections or by differing estimates of need based on different data sets.

- **Description of Analysis of the Proposed Solution/Strategy:** The State Superintendent of Public Instruction (SSPI) should direct the CDE's School Facilities Planning Division to prepare a comprehensive projection of the state's new construction and modernization needs using information from the OPSC and the DOF, as well as its own records, and those of other agencies where appropriate. For new construction, existing overcrowding and expected enrollment growth should be assessed by districts. Need should be projected through 2016 and also for the next ten years.

Recommendation 2: (Short term) The CDE should develop and implement detailed proposals for changes in the current funding structure so that:

- ✓ The state's share of new construction and modernization costs is realistically aligned with the state's historic cost sharing commitments and is sufficient, in combination with the designated local share, to enable districts to provide schools with high-quality learning environments.

- ✓ Provide flexible, efficient, and cost effective school project delivery methods.

- ✓ The state's purchasing power is utilized.
- ✓ State funds are distributed equitably in accordance with need, and districts and county offices of education without local funding capacity are enabled to complete needed projects.
- ✓ There are dedicated and predictable state funds for maintenance and repair.

- **Rationale:** These five proposals were suggested to address needs for the next generation of the SFP. The goal was to strike a balance ensuring high-quality learning environments, stretching limited facility dollars, and keeping the current investments in good condition so they last as long as possible.

- **Analysis of the Source of the Problem:** The SFP has constantly tried to balance the limited dollars for school construction and modernization with Californians' desire for schools that meet students' needs. Regardless if construction money comes from developer fees, local, or state bonds, districts face a finite amount of resources and an ever growing list of needs. This recommendation looks into the system to find possible cost-savings so districts can utilize saved dollars to meet their individual needs.

- **Description of Analysis of the Proposed Solution/Strategy:** When the legislature flexed categorical funds in 2009, maintenance and repair dollars were some of the first things districts were forced to re-direct. Once the state budget begins to stabilize, it will be important for the state to dedicate an annual appropriation specifically for maintenance and repair of facilities. If schools and facilities are not maintained, they will not have long lifecycles.

  Since the state system has limited resources, the state needs to ensure those resources are being equitably distributed so that California does not end up with "haves" and "have-nots" in relation to school facilities. The next bond or state funding model should provide specific relief to school districts that are unable to raise revenue for their school facilities needs.

  Utilizing state purchasing power for construction or modernization supplies could help save districts money. This could be as simple as a state message board where districts freely work together to communicate their purchase needs and work with other districts to leverage their combined purchasing power. Another option is allowing school districts to work through their county office of education or create a Joint Powers Authority (JPA) for the purpose of purchasing power.

  Often best practices are shared among school districts at school facilities conferences. However, small districts that rarely build or modernize may not participate in school facilities conferences given their limited building needs. Sharing best practices on an online message board or through webinars at the OPSC Web site will allow all districts to learn from each other.

Finally, if the state continues with a percentage match program, districts need to be assured the percentage they were promised in the bond covenant will be what they actually receive. Although high-quality learning environments differ from district to district, the state's share should be enough to provide a high-quality learning environment in all school districts.

Recommendation 3: (Short Term) The state should structure and compile a state-wide school facilities inventory that includes:

- ✓ Existing school facilities, including charter schools, and assessments of their condition, including but not limited to, structural seismic and Americans with Disabilities Act (ADA) compliant building systems[1]
- ✓ Existing energy efficiency and renewable energy systems, capabilities, and potentials[2]
- ✓ Educational needs

- **Rationale:** California has operated the SFP program for 12 years, without any statewide data on the need for new school facilities, modernization, or maintenance and repairs. Operating without any data makes it challenging to estimate the short and long term needs for adequate school facilities in California.
- **Analysis of the Source of the Problem:** Assuming Recommendation 1 is adopted, the state would only have information on the schools that have been built or modernized. There would still be a lack of data on facilities that have not been modernized during the last 12 years. The state has no information about the condition of those school facilities. Without that information the state cannot ensure the most dilapidated facilities are being repaired or replaced. In addition, the lack of data makes it very difficult to evaluate the success of California's SFP and plan for the future of the SFP.
- **Description and Analysis of the Proposed Solution/Strategy:** A statewide school facilities inventory could range from the condition of a facility to the education appropriateness of each classroom. Given the amount of data that could be collected in a school facilities database, it is important to thoroughly consider what the state wants from a facilities inventory and how much it wants to spend. The SSPI should take a leadership role in bringing legislative leaders and the Governor together to discuss the need for a school facility inventory and the goals of the inventory.

[1] For this purpose the state should evaluate the relative benefits of using (1) outside vendors who have prepared such inventories for other states, or (2) district-populated databases such as FORMAT-Pro, or (3) data collection structures such as those employed by the American Society of Civil Engineers in its survey of the nation's school facilities.
[2] For this purpose the state should consider utilizing the U.S. Environmental Agency's Portfolio Manager.

Recommendation 4: (Intermediate term) The State Superintendent of Public Instruction should investigate, analyze, and consider alternative funding structures for state school facilities investments, with particular attention to:

- ✓ The possible use of dedicated revenue sources or dedicated general fund facilities investment formulas as previously recommended by the Legislative Analyst's Office 2001 report
- ✓ Other states' funding structures
- ✓ A state infrastructure bank
- ✓ Varying levels of state regulatory authority relative to the level of state funding
- ✓ Providing districts with increased bonding capacity

- **Rationale:** The building or modernization of a school involves years of planning before the first shovel ever goes into the ground. School districts put in thousands of dollars for a school construction project before they come to the state for matching funds. Because school districts are investing their own bond dollars with the promise of matching state dollars, it is important districts have some assurance that state matching dollars are available in a reasonable amount of time.

- **Analysis of the Source of the Problem:** Prior to the 2008 financial crisis, the three-leg stool of school building finance worked very well. The partnership of school districts, home builders, and the state built thousands of schools and housed tens of thousands of students. Subsequent to the 2008 financial crisis, state bond funds became less predictable funding sources. The instability of the state matching bond dollars has caused substantial problems for school districts. Regardless of how school construction is funded in the future, stability of funding is imperative.

  While stability of state funding is an important priority, another issue is looming: the state is about to run out of school facility bond dollars. Given the state's budget deficit of $15 billion dollars, it is unclear if the state can afford the debt services of another school facilities bond. In addition, there is still the possibility of a 2012, $10 billion water bond with debt services of $800 million annually. Given the ongoing state budget problems, it is unclear if voters would have the appetite for another bond.

- **Description of Analysis of the Proposed Solution/Strategy:** With the uncertainty of a 2012 bond, the sub-committee looked to options for school construction funding other than state bonds. The sub-committee assumes once the state budget stabilizes and California recovers from the economic downturn, school facilities funding may not be the same. The SSPI should take a leadership role and work with the Governor and Legislature to investige other funding options for the SFP.

Recommendation 5: (Short term) The State Allocation Board (SAB) would be chaired by the SSPI and the SAB would exercise direct control over the OPSC, the Division of State Architect (DSA), and the CDE's School Facilities Planning Division that would be housed in one independent agency. The board would appoint an Executive Officer to run the day to day operations of the agency. A Project Coordinator would be responsible for seeing each project through the process.

OR

The SAB would exercise direct control over a small staff focused on appeals, regulations, reports, agenda preparation, and legal services. The SSPI would coordinate, through an Executive Officer, the functions of the OPSC, the DSA, and the CDE. A Project Coordinator, also within the CDE, would be responsible for coordinating the functions of the OPSC, the DSA, and the CDE with respect to particular projects.

- **Rationale:** When the SFP was created in 1998, one of the goals was to streamline the process for school districts to access state matching dollars. Today, the program is complex with four different state departments writing state regulations. Some school districts even hire outside consultants to navigate the application process. After 12 years, it is time to re-evaluate the program and ensure that it is as streamlined of a program as possible.

- **Analysis of the Source of the Problem:** A school district must get approval from four different state agencies to build a school: the CDE, the Department of Toxic Substances Control (DTSC), the DSA, and the OPSC. Each of the four agencies has their own set of regulations, project tracking systems, applications, and four different approvals. The burden of having to go through four separate state agencies is time consuming and expensive for school districts.

  The four agencies' approval process lends itself to accountability and policy issues. While each of the agencies has a distinct role in the application process, some of their areas overlap. For example, the CDE has historically approved classrooms size. As the educational agency, the CDE is best suited to determine how many students should fit into a Career Technical Education (CTE) classroom compared to a traditional classroom. The problem is the OPSC also approves classroom size for the purpose of eligibility and student enrollment. Both approvals are necessary, but problems can arise when the two agencies differ in opinion. Because the eligibility/enrollment approval is the last of the two classroom approvals, the eligibility/enrollment point of view will often decide the classroom size.

- **Description of Analysis of the Proposed Solution/Strategy:** Combining three of the four agencies involved in school construction into a single state agency would save school districts time and money. A single agency would have one set of regulations, a single tracking system, one application, and one approval. With the SSPI as chair of SAB, we believe schools will be built and modernized as high-quality learning environments.

Moving all the agencies into one organization will result in a more focused policy and accountability. For example, when an application needs to get approval for classroom size, one person could consider both the educational purpose of the classroom and student eligibility/enrollment. Because this approval happens at the same time, a balance can be struck between the educational purpose and eligibility/enrollment accountability.

Project Coordinators would make the SFP process much simpler for small districts that may only use the SFP every 10-15 years. Small school districts often struggle through the SFP, so Project Coordinators would help them though the complex process. In addition, Project Coordinators could be a help to all school districts if they find a project is getting stuck somewhere in the process.

High Performance Schools Recommendations

High Efficiency Schools
Policy Sub-committee Memo

I. Sub-committee Topic: High Efficiency Schools

Chair

- Deborah Moore, Green Schools Initiative

Members

- Paul Chapman, Inverness Associates
- Gary Dillabough, The Westly Group
- Chip Fox, Sempra Energy Utilities
- John Ivey, Prefast Plantcrafted Buildings
- Greg Larkins, Sacramento Central Labor Council
- Alice Sung, Greenbank Associates
- Ashleigh Talberth, U.S. Green Building Council

Support Staff

- Lisa Constancio, California Department of Education, School Facilities Planning

Sub-committee Charge

The sub-committee was charged with reviewing and making recommendations on how to promote green and sustainable school construction and operational practices, including sustainable behaviors and best practices of students, teachers, staff, and parents/guardians. Work included recommendations to eliminate legislative and regulatory obstacles.

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II. Context

California has been a leader in energy efficiency, renewable energy, and environmental sustainability. However, there are a number of barriers and disincentives that inhibit schools from fully embracing high performance and high efficiency in facilities, operations and maintenance, and school occupant behaviors costing schools scarce funds and contributing to environmental degradation and poor health. Such barriers and disincentives include: cumbersome state requirements that inhibit the use of existing incentive grants and eligibility requirements that restrict access to other programs, lack of awareness of high performance and high efficiency criteria, programs, and benefits; few incentives for individual schools to conserve because funds saved do not generally benefit the particular school; missed opportunities for schools to cost effectively bid for and purchase products with environmental and health attributes; and no clear guidance to promote efficient and sustainable behaviors by students, staff, or teachers. There is an enormous need to concentrate on transforming existing schools into high performance learning environments.

The state of California can make a strong case for the triple bottom line benefits of high efficiency, sustainable, healthy, green schools of the future that:

- Save money through efficient use of resources in high performance school facilities and operations;

- Promote the health and productivity of students and staff through ensuring healthy learning environments; and

- Improve student academic achievement through hands-on, rigorous inquiry-based learning that promotes high-efficiency behaviors and practices.

By strengthening existing programs, filling some gaps, and removing some barriers, California can better leverage existing state and local funds and ensure the state's eligibility for federal funds possibly forthcoming. Because both physical facilities and occupant behavior change are fundamental to achieving the goals of high efficiency schools, our sub-committee broadened our scope to include recommendations to engage students and staff in educational programs to promote sustainable behaviors.

III. Key Recommendations and Options

Recommendation 1: Develop the California Green Schools Recognition Program.

The sub-committee recommends that the State Superintendent of Public Instruction (SSPI) establish a task force to create a voluntary, statewide California Green Schools Program to recognize exemplary environmentally sustainable schools using a comprehensive framework that integrates high efficiency school facilities, operations, and curricula coupled with student engagement.

- Results for recognized schools that meet the criteria are significant: save money, boost academic achievement, improve attendance and health, and reduce environmental and climate change impacts.
- The recognition program can leverage existing rating systems and best practices. It can reference and be modeled after existing programs such as the new Green Ribbon Schools Program announced April 26, 2011, by Education Secretary Arne Duncan; the California Distinguished School Program; Collaborative for High Performance Schools (CHPS); High Performance Incentive (HPI) Program; Leadership in Energy and Environmental Design (LEED); ENERGY STAR; and Green Business Programs; as well as other existing guidance, criteria, and recognition programs from California, national organizations, higher education organizations, and programs from at least seven other states.
- The program will streamline and integrate existing rating systems and best practices in facilities, operations, and curricula across the sustainability continuum to make it easier for individual schools and whole school districts to understand what they can do, how to get started, take actions, track and report results, and receive public recognition. The program can include a Web site that better coordinates and disseminates information from public, private, and non-profit sectors criteria and guidelines, training programs, resources, and funding mechanisms available to schools and districts statewide.

Timeline: 6-12 months for task force; opportunity to coordinate with federal Green Ribbon program in fall 2011. Full launch of state program in 1-2 years, following pilot test and identification of funds (private, public, partnerships) for program development and administration.

Context:

The California green schools movement has grown rapidly in recent years in an effort to help develop more environmentally sustainable schools for the students in our state. In many respects California has become a leader in the national sustainability efforts, especially in the area of building and renovating highly efficient schools and reducing energy consumption through the use of solar and other renewable sources of power. Model green schools operate within a framework that has three distinctive features: efficient use of resources in facilities construction and operation; curriculum and instruction focused on ecological literacy; and sustainable community practices that engage students in active learning and sustainable behaviors. Green schools play an important role in the effort to reduce pollution, decrease waste, conserve water, and reduce carbon emissions to help California achieve the ambitious goals established by Assembly Bill 32 (AB 32) in 2006 and other waste diversion and pollution prevention mandates. With 6.2 million students enrolled in more than 10,000 schools and over 1,000 separate districts, sound environmental policies and practices contribute significantly to the welfare of all Californians. Importantly, recent studies have shown that green schools can reduce costs in operation, construction, and education, a critical matter for our state (Kats, 2006).

A growing body of research demonstrates that green, environmentally sustainable schools improve student achievement. (D. Sobel, 2010). Natural day lighting of classrooms improves academic performance by as much as 20% in math and reading, as scientifically researched by Lisa Heschong. ("*Windows and Classrooms: A Study of Student Performance and the Indoor Environment*,'" Heschong Mahone Group, 2003.) Environmental education fosters the development of the skills students need to be successful citizens in the 21st century, including critical, creative, and problem-solving thinking; effective written, oral, and digital communication; and constructive citizenship that nurtures young leaders who can make a difference in their communities. Various studies have demonstrated that students taught in programs with an environmental focus "academically outperform their peers in traditional programs." (NAAEE, 2008, p.3; Sobel, 2010; MAEOE Maryland Association of Environmental and Outdoor Educators, Green Schools Program, 2010, p.2). Several studies sponsored by the California Department of Education (CDE) and the State Education and Environment Roundtable (SEER) corroborate this finding: "Students in the environment-based study schools scored higher than their traditionally educated peers on standardized tests scores in the content areas of reading, math, language, and spelling." (CDE and SEER, "*The Effects of Environment-based Education on Student Achievement*," 2005). Research shows that environmentally sustainable schools improve attendance, increase academic achievement, decrease behavior challenges and attrition, improve morale, and prepare students for the 21st century workforce, while helping restore the environment.

The California Green Schools Program will help enhance the number and quality of schools in the state that embrace high performance and sustainability across school facilities, operations, and curricula.

Analysis of the Source of the Problem:

A growing number of schools now want to be considered "high performance" or "green," and they are hungry both for practical steps on how to become healthy and sustainable and for public recognition of their efforts. Certification programs exist for newly constructed green school buildings – such as the U.S. Green Building Council's Leadership in Energy and Environmental Design program (LEED) for Schools and the Collaborative for High Performance Schools (CHPS) – but the majority of existing schools want guidance and recognition for efforts outside arenas of new construction and retrofits. Furthermore, meeting high performance and efficiency standards requires not only infrastructure that is sustainable, but also behaviors as well. Encouraging waste reduction, recycling, energy conservation, and transit, for example, requires educating and engaging students, staff, and parent community in behavior change.

At present there is no singular comprehensive program to guide and honor the sustainability efforts of schools that fully integrate high performance facilities, green operations, and environmental curriculum. Some efforts have been made to certify schools as green businesses, but these have focused only on the facilities, maintenance and operations aspects of efficient activities, and have ignored the unique opportunities schools offer to educate and mobilize students and teachers to take actions that will contribute to the sustainable and cost-effective operations of the schools. The CHPS green schools rating system includes a prerequisite and several voluntary credits that provide for buildings that teach, and calls for integration of educational components, such as school gardens, demonstration areas, signage, energy dashboards and more, that support environmental sustainability education embodied in the physical facility. However, it is teachers and students themselves who must perform the educational activities within these environments to gain the full educational benefits. In addition to the identified need to reduce the environmental impact of schools, there is also the need to address the achievement gap by engaging students with compelling, experiential curricula. Recent research shows that environmental education and hands-on, real world problem solving projects help to improve test scores, student behavior, and dropout rates. (Place-Based Education Evaluation Collaborative)

Several states have established clear frameworks, criteria, and guidelines to define, certify, and recognize schools that implement facilities, operations, and curricula that reduce a school's environmental footprint. These include Kentucky, Maryland, Michigan, Washington, and Wisconsin, among others (see references at end). California does not yet have such a program. Currently, the state recognizes green school facilities through its High Performance Schools Incentive Program only, with third-party building certifications for new construction, modernized buildings, or existing operations and maintenance recognition, provided through CHPS or LEED on a voluntary basis. Many environmental education programs are provided to schools through county level facilities such as Walden West, in Santa Clara County, or other institutions, such as Ardenwood Farm in Fremont. Other project-based learning happens on many campuses throughout California. There are few recognition programs that outline and honor best practices for rigorous service learning and hands-on Science Technology Engineering and Math (STEM) programs in schools.

In the Bay Area, a partnership of city and county agencies and non-profits have formed the Green Star Schools Program, modeled on the California Distinguished School Program, which recognizes exemplary academic achievement in schools, and the Bay Area Green Business Program, which recognizes businesses for following certain environmental guidelines and checklists.

Nationally, the National Wildlife Federation (a non-profit) has launched Eco-Schools USA, part of the international Eco-Schools federation, that recognizes schools following its program. The newly-formed National Green Schools Network has developed "Green School Design Essentials" that lay out their version of Core Practices and Benchmarks for green schools. In the higher education sector, the Association for Advancement of Sustainability in Higher Education (AASHE) has developed its "Sustainability Tracking, Assessment, & Rating System," (STARS) for rating the practices of colleges and universities across facilities, operations, education and research, and administration. Lastly, the U.S. Department of Education (DOE) announced on April 26, 2011, the Green Ribbon Schools recognition program, based on the existing Blue Ribbon Schools program. The DOE intends to launch the program by fall 2011, relying on states to nominate schools by the end of the year, and to announce the first winners on Earth Day 2012.

California is home to many pioneering and leading high performance school facilities, environmental education organizations, and healthy and sustainable school non-profits. What is needed is a clear and coherent framework and set of guidelines and criteria to make it easier for schools to make effective and coordinated use of the available resources. Such a framework and program will also facilitate the engagement of more schools and districts in promoting best practices for healthy and high performance learning environments that successfully engage students in learning 21st century skills.

Recommended Solution:

The sub-committee recommends that the SSPI establish a task force to create a voluntary, statewide California Green Schools Program to recognize exemplary environmentally-sustainable schools using a comprehensive framework that integrates high performance school facilities, operations and maintenance, and curricula with student engagement that results in saving money, boosting academic achievement, improving attendance and health, and reducing environmental and climate change impacts.

The task force should be comprised of representatives of: state and local education and natural resources agencies, environmental and service learning organizations, schools and districts, education organizations, and other school facility and operation organizations with expertise in the areas of sustainability, high performance schools, green school operations, and environmental education. The task will be to leverage and better coordinate existing government, private, and non-profit programs for schools across facilities, operations, and curricula. This voluntary program would provide a uniform set of standards to help promote and recognize schools that are high performance and environmentally sustainable. The program will build upon important work already achieved by educators and other organizations, such as the existing California Distinguished Schools Program, the Department of General Services (DGS), the Division of State Architect (DSA), CHPS, LEED, HPI, ENERGY STAR, Green Business Programs across the state, and the pilot Green Star Schools Program in bay area counties. It can borrow from other successful programs like the Maryland or Washington Green Schools Programs and recognition programs in the business community. The program can also be designed to incorporate a system of metrics that would allow schools to measure their performance over time and in comparison with a benchmark group.

The California Green Schools Program can be implemented in several ways, either administered by the CDE or a non-profit group to ensure on-going tracking and accountability. Project costs are estimated to be relatively modest for the recognition program based on experience in other states. A more complex program based on metrics and benchmarking would require more resources to administer but might well contribute to significant savings in school operations. The budget for the Green Schools Program could possibly come from the CDE (perhaps tied to existing programs related to Distinguished Schools and Blue Ribbon Schools) or be raised from the private sector and charitable foundations to ensure swift implementation.

The timeframe for this recommendation is 6-12 months to establish the task force and develop the program framework. The task force would further analyze whether such a voluntary program could be established as a public-private partnership without new legislation. Ideally, the short-term objective would be to take advantage of the new federal Green Ribbon Schools program in the fall 2011, perhaps as a pilot phase. A more complete program could be ready for the 2012-2013 school year.

Resources and References:

Heschong Mahone Group, 2003. "*Windows and Classrooms: A Study of Student Performance and the Indoor Environment* – CEC PIER 2003." http://www.h-m-g.com/projects/daylighting/summaries%20on%20daylighting.htm

Kats, Gregory, 2006. "*Greening America's Schools: Costs and Benefits*." A Capital E Report. www.cap-e.com. http://www.cap-e.com/Capital-E/Resources_%26_Publications.html

Maryland Association for Environmental and Outdoor Education, "*The Maryland Green School Program Reference Guide.*" http://www.maeoe.org/greenschools/application/index.php

North American Association for Environmental Education (NAAEE), 2008. "*Developing a State Environmental Literacy Plan*." http://eelinked.naaee.net/n/elp

Place-Based Education Evaluation Collaborative, http://www.peecworks.org/PEEC/PEEC_Reports/

Sobel, David, 2010. "Place-Based Education, Test Scores, and More," presentation at Wellborn Evaluation Symposium, Kimball Union Academy. http://www.peecworks.org/PEEC/PEEC_Reports/S051F8D99

State Education and Environment Roundtable (SEER), 2005. "*The Effects of Environment-based Education on Student Achievement*." www.seer.org/pages/csap.pdf

SEER, 2006. "*Closing the Achievement Gap: Using the Environment as an Integrating Context for Learning*." http://www.seer.org/pages/GAP.html

Links to Some Comprehensive Green Schools Recognition Programs:

- Eco-Schools USA: www.nwf.org/Global-Warming/School-Solutions/Eco-Schools-USA.aspx
- Kentucky Green and Healthy Schools Program: www.greenschools.ky.gov/
- Maryland Green Schools Program, www.maeoe.org/greenschools/application/index.php
- Michigan Green Schools: www.michigangreenschools.us/
- Washington Green Schools: www.wagreenschools.org/
- Wisconsin Green and Healthy Schools Program: dnr.wi.gov/greenandhealthyschools/
- *Primarily facilities*: Collaborative for High Performance Schools, CHPS Verified program: www.chpsnet.org
- *Primarily facilities*: Center for Green Schools: www.centerforgreenschools.org

Recommendation 2: Adopt a California Environmental Literacy Plan.

The sub-committee recommends that the SSPI establish an Environmental Literacy Plan (ELP) Task Force that will create an official ELP – building on the state's existing environmental curricula and programs - for adoption by the Superintendent.

- An official ELP will ensure that California is eligible for federal funds to support environmental education that may become available as part of the reauthorization of the Elementary and Secondary Education Act (ESEA).
- A California ELP will deepen our commitment to the 2007 California Children's Outdoor Bill of Rights, will amplify the existing K-12 Education and the Environment Initiative (EEI) curriculum, and will strengthen partnerships and coordination among EEI, the California Regional Environmental Education Community (CREEC) Network, and informal environmental education groups, thereby reaching more schools.
- An ELP, sanctioned by the CDE, can be easily integrated into any California Green Schools Recognition Program (Recommendation 1), and link lesson plans and project-based learning activities with high efficiency action and behaviors.

Timeline: 6-12 months. Opportunities for private foundation funding to facilitate a task force to develop an ELP.

Context:

A central feature of the national movement to create environmentally sustainable, green schools is the development of a K-12 curriculum in ecological literacy that engages students in critical thinking about the environment and their behaviors and choices. To promote this initiative, Congressman John Sarbanes (D-MD-3) and Senator John Reed (D-RI), have introduced legislation in the U.S. Congress called No Child Left Inside (H.R. 2054, S. 866) as part of the reauthorization of the Elementary and Secondary Education Act, which would include environmental education for the first time. The legislation, which is supported by a coalition of over 1,900 educational, environmental business, and health organizations, would provide new funding for environmental education, stimulate the development of rigorous curricular standards, and provide professional development and training for teachers. The legislation would also require that states adopt Environmental Literacy Plans in order to access these new funds.

The need for California to adopt such a plan is clear because we do not want to be left behind when the national legislation is passed and find ourselves ineligible for crucially needed funds. Based on California's experience with meeting eligibility requirements for the federal Race to the Top grants, being proactive is prudent. According to the North American Association for Environmental Education (NAAEE) in "*Developing a State Environmental Literacy Plan*," having a plan will contribute the improvement of our K-12 educational program since "environmental education prepares all citizens with 21st century essential skills that contribute to healthier, more environmentally sustainable, and economically prosperous communities." (NAAEE, 2008)

Various studies have demonstrated that students taught in programs with an environmental focus "academically outperform their peers in traditional programs." (NAAEE, 2008, p.3; Sobel, 2010; MAEOE Maryland Association of Environmental and Outdoor Educators, Green Schools Program, 2010, p.2). Several studies sponsored by the CDE and the SEER corroborate this finding: "Students in the environment-based study schools scored higher than their traditionally educated peers on standardized tests scores in the content areas of reading, math, language and spelling." (CDE and SEER, "*The Effects of Environment-based Education on Student Achievement*," 2005) The benefits of environmentally based education also include improved classroom management; reduced disciplinary problems; increased engagement, enthusiasm, and attendance; and increased pride in achievements. Finally, there are many opportunities to integrate environmental education into STEM programs.

Regarding the ELP, there are many benefits according to NAAEE because the plan will:

- Ensure that environmental education activities are aligned with student graduation requirements and help achieve state education goals.

- Ensure that environmental education is fully, efficiently, and appropriately integrated into formal education systems.

- Ensure that teacher professional development opportunities in environmental education are aligned with student achievement goals in environmental literacy.

- Ensure consistency, accuracy, and excellence in environmental content knowledge.

- Engage underserved communities through an inclusive process so that all stakeholders are beneficiaries of environmental education in schools.

- Ensure that non-formal environmental education providers, state natural resource agencies, community organizations, and other partners are involved appropriately and effectively in environmental education activities in schools.

- Serve as a necessary component of a comprehensive state environmental education program.

Based on the No Child Left Inside Act (NCLI), each plan must include these five elements:

1. Specific content standards, content areas, and courses or subjects where instruction will take place.

2. A description of how state high school graduation requirements will ensure that graduates are environmentally literate.

3. A description of programs for professional development of teachers to improve their environmental content knowledge, skill in teaching about environmental issues, and field-based pedagogical skills.

4. A description of how the state education agency will measure the environmental literacy of students.

5. A description of how the state education agency will implement the plan, including securing funding and other necessary support.

NAAEE also recommends the following:

- That the ELP include instructional opportunities like outdoor education, service learning, and STEM Programs.

- The development of the ELP should include the SSPI, the CDE, the state affiliate of NAAEE, and environmental education providers such as state and national parks, museums, nature centers, zoos, and aquariums, among other non-profits, county boards of education, and local agencies.

Analysis of the Source of the Problem:

Currently, California has a strong environmental curriculum but needs to prepare an ELP, which fortunately can be developed flexibly and build on important work that has been done already. With the leadership of the California Environmental Protection Agency (Cal EPA), the state has created the California Education and the Environment Initiative (EEI) Curriculum, a bold vision to increase environmental literacy in K-12 students and promote responsible stewardship of the Earth. The California EEI Curriculum was formally approved by the State Board of Education (SBE) and offers 85 units that are aligned with more than 100 science and history-social science academic content standards, and also supports K-12 English Language Arts standards. Originally mandated by legislation (AB 1548, Pavley, Chapter 665, Statutes of 2003 and AB 1721 Pavley, Chapter 581, Statutes of 2005) that was shaped with the leadership of SSPI Torlakson, the EEI curriculum was created by an educational and environmental partnership involving many agencies and key partners including the SBE, the Office of the Secretary for Education, the CDE, and the California Natural Resources Agency. The initiative received further support when Governor Arnold Schwarzenegger signed in 2007 the California Children's Outdoor Bill of Rights to "encourage parents, educators, and other concerned citizens to do all they can to help our state's children experience and enjoy the wonders of Mother Nature," a declaration that has been used as a model by other states in developing the case for environmental education.

California is close to having a fully developed ELP that could serve as a model for other states in the nation, but additional work will be required to address fully the five required elements of an ELP. California's plan could move from good to great by 1) incorporating the resources of the significant non-profit, non-formal environmental education network that already exists in California as allies and resources for the school-based educators, and by 2) adding more explicit outdoor educational learning and hands-on service learning to augment the EEI curriculum. Improving coordination between EEI and the CREEC Network would also help reach more schools. Recent public reports indicate that only four states—Oregon, Nebraska, Maryland, and Maine—have approved ELPs that meet the standards articulated in No Child Left Inside. It is vital that a systematic effort be made to secure for California an approved ELP so that our state can be recognized nationally for the work that is being done to foster environmental literacy. As it stands now, the lack of coordination among EEI, the CREEC Network, and the multitude of non-governmental environmental education service providers means that schools and students cannot make full use of these resources.

Recommended Solution:

The sub-committee recommends that the SSPI establish an ELP task force that will create an official ELP for adoption by the State Board of Education (SBE) to enhance sustainability and efficiency in the California schools' curriculum, facilities, and operations, and to ensure that California is eligible for federal funds to support environmental education that may become available.

The task force should be composed of approximately a dozen organizational leaders in the field including: CDE, the Environmental Education Advisory Committee (EEAC), Cal EPA, California Association of Environmental and Outdoor Education (CAEOE), California Natural Resources Agency (NRA), California Environmental Education Foundation (CEEF), California

Environmental Education Interagency Network (CEEIN), California Outdoor School Association (COSA), California Regional Environmental Education Community (CREEC) Network, as well as representatives from the non-profit world of museums, foundations, and environmental groups. The task force should determine how best to build on California's significant engagement in environmental education and develop a strategy and timetable to produce a formal ELP that can be submitted for approval and certification by the SSPI no later than June 30, 2012. Once approval has been granted by the SSPI, the task force should outline how to promote the ELP in the California educational sector, the national environmental movement, and to the broader population.

There are private funding opportunities available to support the development of an ELP.

Resources and References:

Maryland Association for Environmental and Outdoor Education, "*The Maryland Green School Program Reference Guide,*" http://www.maeoe.org/greenschools/application/index.php

North American Association for Environmental Education (NAAEE), 2008. "*Developing a State Environmental Literacy Plan*." http://eelinked.naaee.net/n/elp and a link to information about approved plans in Oregon and Maine: http://eelinked.naaee.net/n/elp/topics/Final-Plans

Place-Based Education Evaluation Collaborative, http://www.peecworks.org/PEEC/PEEC_Reports/

Sobel, David, 2010. "Place-Based Education, Test Scores, and More," presentation at Wellborn Evaluation Symposium, Kimball Union Academy. http://www.peecworks.org/PEEC/PEEC_Reports/S051F8D99

State Education and Environment Roundtable (SEER), 2005. "*The Effects of Environment-based Education on Student Achievement*." www.seer.org/pages/csap.pdf

SEER, 2006. "*Closing the Achievement Gap: Using the Environment as an Integrating Context for Learning*." http://www.seer.org/pages/GAP.html

Recommendation 3: Leverage school procurement to promote high efficiency operations through the purchase of healthy and sustainable products and consumables.

The sub-committee recommends that the current regulations governing bidding requirements and procurement processes be reviewed and revised to encourage and ease environmentally preferable purchasing (EPP) that will promote high efficiency day-to-day operations in California schools, leveraging the billions of dollars spent annually by California schools towards healthy sustainable products. School procurement covers healthy and sustainable building materials, schoolyard and grounds supplies, janitorial and maintenance products, food and food service items, school, office and art supplies, equipment/technology, and other products or consumables. Barriers for schools include bureaucracy to access state purchasing contracts, lack of capacity and training to include EPP specifications in bids, perceptions of higher costs, and mandates or practices that often favor lowest bids over life-cycle analysis. Recommendations include:

- The CDE and the Department of General Services (DGS) should collaborate to better promote and disseminate to schools a green purchasing toolkit with user friendly tools and opportunities for districts to take advantage of huge cost savings on environmentally preferable purchases (EPP) made through existing state contracts, piggybacking on other contracts, or purchasing cooperatives, building on the DGS Buying Green Guide and others.
- School districts should include high performance, life cycle, total cost of ownership, environmental, and health attributes in purchasing orders and bid specifications.
- Many such revisions in purchasing practices and policies, particularly for day-to-day products and consumables, can be achieved administratively. Further research is needed to determine whether some revisions, especially related to new construction bidding requirements, would require administrative changes or legislation to revise the California Public Contract Code. There are numerous precedents encouraging – and sometimes mandating – EPP in California, including the University of California's Policy on Sustainable Practices, municipal ordinances, school district purchasing policies, California *Public Contract Code,* sections 12400-12404, and California *Education Code,* sections 32060-32066.

Timeline: 6-12 months for actions that can be done administratively; 1-2 years if legislation is necessary.

Context:

School purchasing can support high-efficiency, high performance, healthy school facilities, operations, and maintenance. California schools spend billions of dollars annually to purchase building materials, office and school supplies, janitorial and maintenance supplies, food and food service items, and more. All of these products – anything from toilet paper to paints, from notebooks to cleaning products, from lighting fixtures to carpets, from food to computers – have an impact on the environment and health from its manufacture, use, and disposal. The cleaning products generally used in California schools, for example, have been shown to contain hazardous chemicals that cause asthma, cancer, and reproductive health problems (Expert Work Group study and the California Department of Public Health). Paints and carpets offgas Volatile Organic Compounds (VOCs) that contribute to poor indoor air quality, smog, and respiratory illnesses. Computers, equipment, and lighting bought by schools – if not Energy Star rated – can increase school energy bills.

High performance and high-efficiency schools are built and operated using products and materials that have fewer environmental and health effects because they are made from less-toxic, renewable materials, recycled materials, and/or use less energy and have a longer lifespan. Purchasing these types of products can help reduce a school's environmental footprint, improve indoor air quality, conserve energy, water or other resources, lessen the wastestream, reduce exposures of students and staff to hazardous materials, and save money and labor.

There are a variety of mechanisms to encourage or require schools to purchase products with fewer health and environmental impacts – so-called "environmentally preferable products" – while also meeting financial, maintenance, and facility goals. These include mechanisms in the bidding process, the procurement and purchasing process, and the process of allocating state grants and funds.

Analysis of the Source of the Problem:

While California's *Public Contract Code* is actually quite good for promoting "environmentally preferable purchasing" (California *Public Contract Code*, sections 12400-12404), it is only mandatory for state agencies to purchase through the state contracts, whereas it is voluntary for schools. Few public schools take advantage of the price discounts that state procurement contracts offer – though state contracts offer both "green" and conventional products. In addition, existing California *Education Code*, sections 32060-32066 establishes a precedent that prohibits schools from purchasing toxic art supplies that pose a danger to children's health as determined by the California Department of Public Health (CDPH) and the California Health and Safety Code, and requires the purchase of less-toxic art supplies.

The California *Public Contract Code*, sections 20110-20118.4 requires that school districts accept the lowest bid, which can have unintended consequences of accepting cheaper upfront costs that can result in higher operational costs or a lower product lifespan or ignore other important health or environmental attributes. Life Cycle Analysis and Total Cost of Ownership (TCO) analysis can help to evaluate the overall best value of a product to help weigh both capital and operational costs, performance, lifespan, and health and environmental attributes, showing that some products that have a higher capital cost can result in lower operational costs over the life of the product. Indeed, many existing policies, including the University of California's Policy on Sustainable Practices, several municipal ordinances, and many school district purchasing policies require life cycle or TCO analysis and other measures.

The new Cal Green Code came into force in 2011, which requires the purchase of many green building materials.

Recommended Solution:

The sub-committee recommends that the current regulations governing bidding requirements and procurement processes be reviewed and revised to encourage and ease "environmentally preferable purchasing" (EPP) that will promote high-efficiency day-to-day operations in California schools, leveraging the billions of dollars spent annually by California schools towards healthy sustainable products. School procurement covers healthy and sustainable building materials, schoolyard and grounds supplies, janitorial and maintenance products, food and food service items, school, office and art supplies, equipment/technology, and other products or consumables. Barriers for schools include: bureaucracy to access state purchasing contracts, lack of capacity and training to include EPP specifications in bids, perceptions of higher costs, and mandates or practices that often favor lowest bids over life-cycle analysis. Recommendations include:

- The CDE and the DGS should collaborate to better promote and disseminate to schools a green purchasing toolkit with user-friendly tools and opportunities for districts to take advantage of huge cost-savings and volume discounts on EPP made through existing state contracts, piggybacking on other contracts (Ed Buy, Western States Contracting Alliance, U.S. Communities, or others), or purchasing cooperatives, building on the DGS "*Buying Green Guide*" and others. Local districts could also consider pooling their purchases through county offices of education. Other resources include: "*Local Government Green Purchasing Guidelines*," 2010 published by the California Sustainability Alliance; advisory organizations such as the Responsible Purchasing Network; and the Green Schools Buying Guide, developed by Green Schools Initiative.
- School districts should include high performance, life cycle, Total Cost of Ownership, environmental, and health attributes in purchasing orders and bid specifications.
- Many such revisions in purchasing practices and policies can be achieved administratively. Further research is needed to determine whether some revisions, especially related to new construction bidding requirements, would require administrative changes or legislation to revise the California *Public Contract Code*. The DGS can be charged with addressing or revising regulations and administrative policies related to the bidding process under *Public Contract Code* (sections 20110-20118.4).
- There are numerous precedents encouraging – and sometimes mandating – EPP in California, including University of California's Policy on Sustainable Practices, municipal ordinances, school district purchasing policies, California *Public Contract Code* (sections 12400-12404), and California *Education Code* (sections 32060-32066). In addition, California *Public Contract Code* (sections 22150-22154) require local public entities to purchase recycled products whenever they are available at the same or less cost, and they are also allowed to give preferences in their bidding to suppliers of recycled products. This could apply to schools as public entities. Or building on the *Education Code* (sections 32060-32066) requiring the purchase of less-toxic art supplies, a similar approach could be used to require or encourage purchasing for operational supplies (cleaning products and janitorial supplies, paper and office supplies, etc.). Or the CDE and the Office of Public School Construction (OPSC) could consider creating eligibility requirements for schools to receive state funding for operations and maintenance to a requirement that schools purchase environmentally preferable products for these maintenance and operations activities.

Timeline: 6-12 months for actions that can be done administratively; 1-2 years if legislation is necessary.

References and Resources:

California Department of General Services. *Environmentally Preferable Purchasing and "Buying Green" Guide.*
http://www.dgs.ca.gov/Default.aspx?alias=www.dgs.ca.gov/buyinggreen

California Sustainability Alliance, 2010. "*Local Government Green Procurement Guide*."
http://sustainca.org/library/publications

Green Schools Initiative, "*Green Schools Buying Guide*."
http://www.greenschools.net/display.php?modin=54

Responsible Purchasing Network, http://www.responsiblepurchasing.org/

University of California, UC Policy on Sustainable Practices,
http://www.universityofcalifornia.edu/sustainability/policy.html

Recommendation 4: Develop a low energy retrofit program maximizing passive systems like day lighting and non-mechanical heating and cooling to transform any existing school facility regardless of the OPSC eligibility. (Links to Group 8 on Grid Neutral and Group 6 on Renewable Energy).

The sub-committee recommends that the SSPI direct the CDE School Facilities Planning Division staff – together with key stakeholders, the Coalition for Adequate School Housing High Performance Working Group, the DSA, the California Energy Commission (CEC), and other CDE partners – to define criteria and guidelines for a low energy retrofit program that utilizes an integrated whole building approach and sustainable design practices to aggressively seek deep energy savings in any existing school by maximizing natural, passive systems (natural day lighting, ventilation, non-mechanical heating and cooling, changes to building envelopes). Thus, our existing school buildings should be retrofitted to best prepare them to ultimately achieve Grid Neutral and Zero Net Energy and energy efficiency goals established in the CPUC's statewide strategic plan. Current barriers are that an estimated 60-70% of existing school buildings are excluded by current OPSC eligibility requirements; access to existing modernization funds is limited; funds often do not cover these kinds of low energy retrofits; and modernization funds are woefully inadequate to meet all modernization needs, let alone cover upgrades required using a low energy and integrated whole building approach. Specific action steps include:

- Work to restore deferred maintenance funds and target funds for energy efficiency maintenance, retrofits, and repairs.
- Actively participate in the CEC's rulemaking for implementation of Assembly Bill (AB) 758 (Chapter 470, Statutes of 2009), "Comprehensive Energy Efficiency Program for Existing Buildings", which will include school buildings, and covers energy assessments, benchmarking, financing, and green workforce training. Influence program to include low energy retrofits and to benefit school facilities.
- Develop high efficiency school facility maintenance and operating guidelines to better monitor, manage, and reduce energy, water, and waste, building on existing guidelines such as CHPS Operations Report Card (ORC), LEED Existing Buildings Operations and Maintenance (LEED EBOM), and the CASH Planning for Energy Efficiency best practices checklists, among others.

- Promote and expand existing training and apprentice programs with the various California Building Trades, Career Technical Education, and the green academies to prepare students for clean energy jobs and to promote High Performance/Zero Net Energy schools.

Timeline: Mix of short and long-term.

Overall Context and Problem Analysis:

Most of the initiatives to promote High Performance Schools have focused on new construction and modernization projects. However, the biggest barrier to promoting "schools of the future" is the difficulty in transforming our existing school facilities to meet high performance criteria and standards. The vast majority of our schools are already built. And this aging building stock needs many retrofits to drive down energy use and meet sustainable design criteria. While Zero Net Energy and Grid Neutral schools are laudable goals, the first and most cost-effective step in transforming existing buildings is to aggressively seek deep savings in energy use by maximizing natural, passive systems, such as natural day lighting, ventilation, and non-mechanical heating and cooling through building envelope changes like insulation and superior windows, as well as other energy efficiency measures. Once the energy use is driven down – using an integrated whole building approach and sustainable design practices – the renewable energy offsets needed to achieve Zero Net Energy will be much less costly and more readily achievable.

There have been several barriers to promoting the transformation of our existing schools into high performance schools. First, there have been constraints and difficulties with schools accessing the High Performance Incentive (HPI) Grants established under the Proposition 1D bonds (discussed further under Recommendation 5). In addition, the fact that access to the HPI grant funding is tied only to those projects with "OPSC eligibility" in select OPSC programs (mainly new construction and modernization) excludes a majority of our existing school building stock. We estimate this to be at least 60-70% of our existing school facilities that do not have OPSC eligibility. Furthermore, widespread adoption is hampered by misperceptions that the costs of high performance schools are too high, coupled with the reality that modernization funding of existing school buildings is woefully inadequate. The reality is that only a small fraction of school facilities meet the high performance criteria that have emerged in recent years, since the vast majority of schools were already built when CHPS, LEED, and HPI came about during the last decade.

Another barrier to the implementation of energy retrofits to reduce energy use in existing buildings is the lack of trained staff. To develop the workforce for a future green economy will require education, training, and apprentice programs in the "building trades." President Obama has tasked his Recovery through Retrofit Working Group with developing strategies to promote the green technology industries and the training programs needed to create a qualified workforce for careers in these emerging fields.

An example of this is the training program established by the International Brotherhood of Electrical Workers-National Electrical Contractors Association (IBEW-NECA). They have developed an industry partnership training program called the California Advanced Lighting Controls Training Program (CALCTP). CALCTP convenes industry stakeholders and partners with existing state training and education institutions to implement training programs that directly tie training to middle class green technology careers.

Investor Owned Utilities (IOUs), (like Pacific Gas & Electric, Southern California Edison, and San Diego Gas & Electric) also administer the smaller Connections initiatives, which include five programs targeting K-12 and college student populations. These are energy awareness initiatives carried out in collaboration with schools and colleges, but they have begun to integrate career education. For the K-12 programs, the IOU's are developing deeper ties with the career preparation programs in California high schools. To assist in building career awareness and career exploration that serves K-12 students and support career preparation programs in career academies, IOU's collaborate with the California Partnership Academies (green academies), which are the state's primary career technical initiative aimed at lowering drop-out rates and guiding students into post-secondary training and career tracks in these specific occupations.

In the last few years, the California State Building & Construction Trades Council's affiliated organizations have spent a significant amount of resources training and certifying its workforce for careers in the emerging energy efficient technologies. Its training programs range from the beginning stages of energy efficiency – energy audits, to developing recommendations and energy efficient systems, installing these energy efficient upgrades and systems, and maintaining the systems once installed. The Industry also partners with the higher education establishment to provide the training opportunities that lead to careers in these emerging energy efficiency fields. These programs offer the building blocks to significantly expand the number of trained workers to implement energy retrofit programs. In addition, there are opportunities to partner with Career Technical Education and the "Green Academies" to develop training and apprentice programs for students to implement energy efficiency and retrofit programs at their own schools (depending on safety and liability issues). Several bills in the last few years have been sponsored to address such "green collar jobs" issues: Senate Bill 1672 (SB 1672) failed (Renewable Energy, Climate Change, Career Technical Education, and Clean Technology Job Creation Bond Act of 2010), AB 3018 passed (Green Collar Jobs Act of 2008).

Recommended Solution:

The sub-committee recommends the SSPI direct the CDE School Facilities Planning Division staff – together with key stakeholders, the CASH High Performance Working Group, the DSA, the CEC, and other CDE partners – to define criteria and guidelines for a low energy retrofit program that utilizes an integrated whole building approach and sustainable design practices to aggressively seek deep energy savings in any existing school – regardless of OPSC eligibility – by maximizing natural, passive systems (natural day lighting, ventilation, non-mechanical heating and cooling, building envelope changes). Thus, our existing school buildings should be retrofitted to best prepare them to ultimately achieve grid neutral and zero net energy and energy efficiency goals established in the CPUC's statewide strategic plan. This will build on the DSA's existing Sustainable Schools Resources, but applied to transforming existing facilities.

In focusing on our vast majority of existing school facility stocks with no OPSC eligibility, the state should analyze our existing school facilities, to identify where it can drive down energy and water utilization through physical transformation of our buildings, installation of management systems, and coordination of district staff and site – occupant (administrators, teachers, students, and even parent community) behaviors linked to educational curricula is critical to maximize cost savings and reap all the cost and carbon footprint savings.

Criteria for the scope of work to be done per building(s) or per school site could be based on meeting criteria from the already-adopted High Performance Schools Scorecard in the areas of energy efficiency, water efficiency, climate, and indoor environmental quality. This new program should include developing state maintenance and operating guidelines, which could be based on existing systems such as CHPS Operations Scorecard, LEED EBOM, and others, to better monitor, manage, and reduce energy and water consumption, as well as move districts towards zero waste and best practices to improve indoor air quality. This program could easily be integrated into the California Green Schools Recognition Program (Recommendation 1), creating a paradigm-shift towards saving millions of dollars of operating expenses annually.

Furthering the objective of public education, the building and construction trades crafts can serve as a partner with the CDE in preparing students for further education and energy-related career opportunities. The building and construction trades crafts, who will perform many of the construction activities to transform our educational facilities into low energy use/high efficiency schools, can assist in providing the training programs and certification requirements associated with career technical education and green techology academies, that will ensure quality craftsmanship while providing the training for those apprentices seeking career opportunities in the craft. Proper training to complete energy or efficiency projects on-time and on-budget while ensuring safety requirements that will guarantee a safe environment for both the installer and the end-user would be an additional benefit of any Trades Council involvement with this important work.

Given the economic state of our school budgets, this shift of emphasis from mere energy efficient to one of low energy by design first, followed then by integrating high efficiency systems, and finally, energy conserving operations and use, in order to move quickly towards Grid Neutral and Zero Net Energy/Zero Carbon, is imperative.

References and Resources:

California Division of State Architect, Sustainable Schools Resource - http://www.sustainableschools.dgs.ca.gov/SustainableSchools/sustainabledesign/energy/energy.html

Coalition for Adequate School Housing (CASH), 2009. "*Planning for Energy Efficiency*." www.cashnet.org/EnergyBrochure09.pdf

Grid Neutral Schools - www.dgs.ca.gov/dsa/Resources/pubs.aspx

U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Federal Energy Management Program, 2000. "*Passive Solar Design: The Foundation for Low-Energy Federal Buildings*." http://www1.eere.energy.gov/femp/pdfs/26015.pdf

U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Federal Energy Management Program, 2001. "*Low-Energy Building Design Guidelines: Energy-efficient design for new Federal facilities*." http://www1.eere.energy.gov/femp/pdfs/25807.pdf

Recommendation 5: Create innovative funding mechanisms to support high efficiency sustainable schools for design and construction, retrofits, and district level maintenance and operations, for both new and existing schools, and better publicize the business case along with the funding mechanisms.

5A. The sub-committee recommends that the CDE enhance existing funding mechanisms and explore a variety of new innovative funding mechanisms, including, but not limited to:

i. Collaborate with utilities and other groups to encourage schools to fully use existing incentive and rebate programs being offered, such as Savings by Design, California Solar Initiative (CSI), and California Energy Commission (CEC) loans, among others.

ii. Streamline, strengthen, and expand eligibility for the existing High Performance Incentive (HPI) Grant Program to ensure existing authorized funds get used by more schools.

iii. Increase the per-pupil grant basis for the State Allocation Board (SAB) modernization funding.

iv. Ensure all SAB funded projects meet minimum level of existing high performance schools criteria and allow use of state funds to be expended for any high performance school criteria.

v. Require the use of high performance design criteria in future state and local school bond initiatives. This could include all future state bonds incorporate language on high performance criteria; a significant set-aside in future state bonds to replenish the HPI Grants; a set-aside to fund low energy retrofits of existing facilities (as described in Recommendation 4, and modeled after Washington state's Energy Operating Cost Savings program); and encourage districts to include high performance criteria in their local bond measures. The CDE could create sample language to include in local school bond initiatives.

vi. Develop Revolving Green Loan Fund programs at state and/or local levels, building on models like UC Santa Barbara's "The Green Initiative Fund" (TGIF), Harvard's "Green Campus Loan Fund", and UC Berkeley's TGIF and Chancellor's "Green Campus Fund".

vii. Explore innovative financial arrangements, similar to existing measures like the Integrated Project Delivery method or the lease-leaseback alternative delivery method for school facilities built and leased by private entities, or other turnkey construction, retrofit, and maintenance contracts and arrangements.

Timeline: Mix of short-term (i – iv) and long-term (v-vii).

5B. The sub-committee recommends that the CDE better publicize the business case for the triple bottom line benefits of high efficiency sustainable school facilities and operations, based on existing research and evidence, as well as assess the potential financial, resource, pollution, health, attendance, and carbon savings from improvements in California's existing school facilities, and improve tracking the results of school sustainability efforts. This initiative will:

- Raise awareness among the education sector of the business case.
- Enhance existing and newly developed funding mechanisms through a better promotional campaign designed to educate schools via a one stop shopping information clearinghouse, where funding information is readily accessible and that could be modeled on the existing Energy Upgrade California Web site developed by diverse public and private partners, the Database for State Incentives for Renewable Energy (DSIRE), or the forthcoming COOL California.org Local Government Toolkit Funding Wizard.

Timeline: 6-12 months to develop information clearinghouse Web site and funding wizard.

Context and Problem Analysis:

California has many funding programs for school facilities, and in recent years some funds have been allocated towards incentivizing high performance and energy efficient schools. Ultimately, however, the goal is to transform all schools to become high performance and efficient ones. This will require internalizing high performance criteria into all funding programs, leveraging existing funds, fully utilizing all existing rebate and incentive programs, and developing new and innovative funding mechanisms.

For example, California voters approved Proposition 1D in 2006, providing $100 million in incentive grants to promote the use of high performance attributes in new construction and modernization projects for K-12 schools, which include site, water, energy, materials, and indoor environmental quality as attributes. Yet, only approximately $25 million of the $100 million available has been used to date. This leaves $75 million available to districts if they go through the process of filing for the monies. Most districts that want to apply for the grant incur some up-front soft costs for design and energy modeling, day lighting analysis and acoustics consulting, in addition to perceived and/or real commitment to higher hard construction costs as well as commissioning and acoustical testing. And there are no guarantees that a design team will achieve targeted credits, nor that the funding will still be available.

As of April 2011, changes were made to the regulations that include addressing some of these up front costs and discrepancy between new construction and modernization levels of per-pupil grant funding. Schools can now receive more money, a base of $150,000 for new construction and $250,000 for modernization, as well as additional incentives. The CHPS and the DSA have signed a Memorandum of Understanding (MOU) that should streamline the process of having a building CHPS Verified. Under the MOU, the DSA will become the third party reviewer during the design/HPI review and the approval will result in both the HPI and CHPS Verified approval. This coordination will have only one scorecard, one online document package and one project review process. When completed the scorecard will automatically calculate a project's HPI points and confirm compliance with the mandatory measures of the new California Green Building Code, while reducing overall fees to reflect this streamlining. We recommend supporting this type of streamlining of the HPI Grant processes. In future refinements of the HPI, the DSA may consider other pathways to compliance, such as LEED. There are a variety of pathways in different states, like CO-CHPS Verified Leader or LEED Gold in Colorado or in

Massachusetts either MA-CHPS Verified Leader or LEED for Schools Silver+MA Stretch Energy Code, and various others in between.

California utilities also offer incentive programs to help school districts offset the incremental costs of installing high performance energy efficient equipment. These programs provide incentives to offset equipment costs and help districts quantify the long-term energy savings they will see on a monthly and yearly basis. By combining the initial incentives along with the expected long-term energy savings, school districts can see paybacks of less than three years. One program in particular, the Savings by Design (www.savingsbydesign.com) program has been instrumental in helping many districts receive incentives, design assistance and training for both new construction and major modernization projects (replacing two or more building systems). The program utilizes an integrated whole building approach, which helps achieve integrated design while optimizing energy solutions. However, it appears school districts' knowledge of the program is limited and they may not know who to contact in getting timely information which would allow them to fully participate in the program.

In the future, new bonds and funding mechanisms should incorporate High Performance criteria from the outset so as to internalize these goals into all funding programs, or at least have significant set-asides for such programs. There are many examples to build on, including California's own HPI grants, as well as Washington State's "Energy Operating Cost Savings" program that sets aside a portion of bonds for energy retrofits and building commissioning. In addition to bonds, there are revolving loan funds and sustainability grant funds. Examples include: UC Santa Barbara's The Green Initiative Fund (TGIF), Harvard's Green Campus Loan Fund, and UC Berkeley's TGIF and Chancellor's Green Campus Fund. The beauty of revolving loan funds is that the loans are repaid by savings achieved from the programs funded, such as energy savings due to retrofits. While initial capital and funds must be raised, the funds proceed indefinitely via the loan repayments. Some of the loan funds raise initial capital through fees, other through state or private sources.

Finally, there are also opportunities to explore ways of enhancing or expanding a variety of alternative delivery methods for construction, retrofits, and maintenance. There can be efficiency results from outsourcing certain tasks to the private sector, as well as shifting the burden for raising capital to private entities. The CDE and the DSA could further explore concepts similar to the existing lease-leaseback alternative delivery and integrated project delivery method. Furthermore, there are other turnkey approaches to construction, retrofits, and facility maintenance, including Project Frog, other green prefabricated modular buildings, and various energy services companies (ESCOs) and Power Purchase Agreements (PPAs).

Regardless of which funding mechanisms to pursue, there is a great need to better coordinate, promote, and publicize all the various funding mechanisms to schools. There is a myriad of existing research and evidence that proves the business case for high efficiency schools (see, for example, U.S. Green Building Council's Center for Green Schools' Web site, the CHPS Web site, National Research Council reports, and others). To better persuade decision-makers, the CDE should compile this information and make it available to school constituencies. In addition, there is a great need for a one stop shopping information clearinghouse to make it very easy for schools to learn about and access funding sources and sustainability resources to support high performance initiatives in their districts and at their schools, whether it be for school facilities, construction, modernization, retrofits, operations, or maintenance. There are numerous Web sites that are coming online that the CDE could easily build on and expand beyond information about energy efficiency or renewables to encompass the full range of sustainability topics and resources for schools. Models include: Energy Upgrade California Web site, Database for State Incentives for Renewable Energy (DSIRE), or the forthcoming COOL California.org Local Government Toolkit Funding Wizard.

Resources and References:

Collaborative for High Performance Schools – various technical resources, case studies - http://www.chps.net/dev/Drupal/node/27

Harvard University, Green Campus Loan Fund. http://green.harvard.edu/loan-fund

National Research Council, 2006. "Green Schools: Attributes for Health and Learning." http://www.nap.edu/catalog.php?record_id=11756

State of Washington, Office of State Superintendent of Public Instruction, 2010 Energy Operational Costs Savings Improvement Grants, http://www.k12.wa.us/SchFacilities/Programs/EnergyImprovement/default.aspx

UC Berkeley, Chancellor's Green Campus Fund, http://enviro.berkeley.edu/node/3087

UC Berkeley, TGIF: The Green Initiative Fund, http://asuc.berkeley.edu/asinside.aspx?uid=91

UC Santa Barbara, TGIF: The Green Initiative Fund. http://sustainability.ucsb.edu/tgif/index.php

US Green Building Council, Center for Green Schools – various publications and references with existing research on the business case: http://www.centerforgreenschools.org/guides.aspx

Renewable Energy
Policy Sub-committee Memo

I. Sub-committee Topic: Renewable Energy

Co-chairs

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- Bob Linscheid, California State University, Board of Trustees

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- Panama Bartholomy, California Energy Commission
- Gary Eberhart, Seward L. Schreder Construction, Inc.
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- Tom Kelly, KyotoUSA
- Bill Meehleis, Meehleis Modular Buildings
- Mikal Nicholls, San Diego County Office of Education (Energy JPA)
- William Owens, Resource Accords

Support Staff

- John Gordon, California Department of Education, School Facilities Planning

Sub-committee Charge

At the request of the State Superintendent of Public Instruction (SSPI), the Renewable Energy sub-committee examined impediments to schools implementing energy conservation and alternative energy programs and developed action items for the California Department of Education (CDE) implementation. The sub-committee is pleased to provide our best thoughts for incentivizing and incorporating renewable energy resources for California's schools and the construction of appropriate and accountable renewable projects for K-12 classrooms and other school facilities.

II. Context

Making use of renewable power for schools is essential to achieving the state Legislature's overarching goal of increasing our overall renewable energy use while giving our children the sense that we are doing something significant to address the impacts of climate change. Doing so will also help to reduce the amount of energy wasted and the rising cost of energy – a cost that school districts can no longer afford to ignore.

On March 29, 2011, the California Assembly passed Senate Bill (SB) X1-2, approving a 33% renewable portfolio standard (RPS) for the state. The bill requires both public and private load-serving entities to obtain 33% of their power from renewable energy by 2020. Governor Brown signed the bill on April 12, 2011.

School facilities throughout the state provide a logical host site for "distributed" or independent generation. There is an inherent benefit to installing photovoltaic (PV) panels on school rooftops and/or integrated into parking lot or shade structures.

The sub-committee estimates that if every school district in California installed 1 megawatt (MW) of solar capacity, the resulting clean renewable energy produced would conservatively represent 2% of the state's 33% RPS goal.

On the local level, many communities have adopted very aggressive goals for renewable energy usage that enables the state to reach its overall goals and supports school district clean power initiatives. These include major cities such as San Francisco and San Jose who have targets of 100% of the entire city's electricity usage from renewable sources by 2020 and 2022 respectively.

When coupled with better energy efficiency and energy conservation behaviors, renewable projects will generate savings for school districts and county offices of education, create green jobs, relieve pressure on the energy grid, lower carbon emissions, produce fewer toxic air contaminants, and reduce water consumption. In addition to these important energy, environmental, and economic benefits, expanding opportunities for schools to participate in the production and use of renewable energy can generate significant educational benefits.

These savings can be put back into the classroom to support student learning. An energy efficient school powered by renewable energy (whether or not the renewable energy is generated on site) becomes a living laboratory for sound resource stewardship, environmental protection, and fiscal responsibility. Such a school is a teaching tool for all students and a source of pride for the community.

Finally, schools actively engaged with renewable energy and other sustainable resource management practices are better positioned to help achieve career technical education and workplace readiness goals by providing training and support to the next generation of the greentech workforce.

Greater reliance on self-generation through renewables also means that schools will have to purchase less of their electricity from utilities. These "avoided costs" are often substantial over the life of the self-generation project and may be structured by the schools to produce immediate General Fund savings. In the last two years, a number of school districts have procured "self funding" solar projects (meaning that the total avoided costs plus rebates more than offset the cost of procuring and operating the solar project). The resulting savings represent dollars that may be used for other budgetary needs.

A big variable here, however, is how the renewable energy projects are funded/financed; Power Purchase Agreements (PPAs) generally offer only very modest General Fund savings, while projects funded through bond measures offer the greatest savings. Such bond measures may be difficult to pass over the next several years. Low-cost financing, such as what California could provide to school districts, could provide significantly greater General Fund savings than PPAs.

Therefore, the state can play a very significant role in accelerating renewable energy savings if it could provide low-cost financing support.

Regulatory Barriers

- Renewable Energy Incentive Cap is currently limited to 1 MW per customer meter. Can this be increased? California State University recommends an increase to 5 MW.

- Standby Charges and Stranded/Costs/Exit Fees should be reviewed and modified taking into account the performance of these systems, their reliability, and any duplicative costs that may be embedded in these fees.

- California Air Resources Board (CARB) rules for co-generation classify end use customers as "utility class" requiring them to pay costly emissions fees.

- Review of the Department of General Services (DGS) authority and role in forecasting, billing, and purchasing services.

- Lack of availability of Direct Access program hinders options for schools to find cost-effective renewable energy options from remote project development. Further expansion of this program in 2012 is recommended.

- Net metering is limited to generating meter at the district site instead of being applied across all district electrical accounts.

Our recommendations are provided in the next section. Additional information is provided in the following appendices:

- Appendix A – State Agencies with Energy Responsibility
- Appendix B – Legislative Actions
- Appendix C – Bibliography

III. Key Recommendations and Options

Each action item includes the following recommended timeframes:

- Short term (next six months)
- Intermediate (within one year)
- Long term (within three years)

Recommendation 1: Protecting Revenues – Support laws/initiatives that fund renewable energy projects while ensuring that revenue savings achieved from these projects are protected for school districts, such as encouraging districts to allow individual school sites to share in dollars generated through their better energy and conservation activities.

- Introduce legislation that will encourage greater interest and investment for renewable projects at the local level. Local educational agency (LEA) energy savings programs and initiatives should be protected by excluding their savings from revenue limit calculations. (Intermediate goal)
- Encourage the California Energy Commission (CEC) to amend RPS Guidelines to allow Tradable Renewable Energy Credits (TRECs) from qualifying renewable energy projects. (Short term goal)
- Encourage school districts to allow individual school sites to share in any savings achieved through better energy and resource conservation behaviors. (Intermediate goal)
- Support Senate Bill (SB) 585 (Kehoe) so that renewable energy projects have a greater chance of "penciling out". (Short term goal)

Recommendation 2: Partnerships – Support efforts to broaden opportunities for schools to participate in the generation and use of the full range of renewable energy options (such as legislation similar to the introduced language in SB 383, Wolk); and to create partnerships that enable schools to pursue these opportunities and secure their educational, economic and environmental benefits.

- Support original wording of SB 383 (Wolk) with changes to include school based Joint Powers Authorities (JPAs) and designation of "benefitting account" to include accounts outside of district geographic boundaries.
    - School districts can net meter across all of their electrical accounts. (Short term goal)
    - Ability to partner with other public/private entities for generation, facilities. (Intermediate goal)
    - Flexibility to generate energy on non-school sites. (Intermediate goal)
- Spearhead public power advocacy on behalf of schools' energy interests and investments. (Intermediate goal)
- Support virtual net metering and feed in-tariff (Assembly Bill (AB) 2466 (Smyth) (Short term goal)
- Work with the California Public Utilities Commission (CPUC) to allow schools the ability to sell excess energy at a fair price (AB 920 (Huffman) (Short term goal)

Recommendation 3: Program Flexibility (Legislative/Regulatory Policy) – Examine and find ways to change existing review/approval and contracting processes and reauthorize state funding opportunities (i.e. Bright Schools) that would allow renewable energy construction projects to be completed in a more timely manner.

- Actively monitor the CPUC's implementation of AB 920 (Huffman) and advocate for rules that benefit school districts regarding:
    - Selling excess energy at a fair price.
    - Virtual net metering and feed-in tariff .
    - Support passage and implementation of SB 383 that:
        - Eliminates the 1 MW ceiling threshold for generation making schools eligible for utilities purchase.
        - Provides flexibility to allow one site to serve multiple school sites.
        - Provides flexibility to generate energy on non-school sites owned by districts (unused school sites, remote/TREC) and sell surplus from school sites and remote locations to utilities at fair market price. (Intermediate Goal)
- Implement a partnership with the DGS/DSA to independently review formulas and standards for renewable project life-cycle costs and projected savings. (Intermediate Goal)
- Authorize additional budget expenditures to allow for the reauthorization of the CEC Bright Schools program to assist districts in upfront baseline assessment financing. (Intermediate Goal)
- Maintain flexibility to use alternative methods to contract for energy service contracts and projects. (Intermediate Goal)

Recommendation 4: Procurement and Delivery – Develop standardized policies and processes to help local educational agencies address issues with the evaluation, procurement, financing and construction of renewable energy systems across their facilities.

- Preserve flexibility to use alternative methods to contract services (RFQ). (Short term goal)
- Develop a statewide template/best practices for energy project procurement steps endorsed by the California Department of Education (CDE). (Intermediate Goal)

- Create options for LEA financing and ownership of renewable energy project. (Long term goal)
    - Ownership
    - PPA
    - Leasing

<u>Recommendation 5: Local Training and Leadership Education – The CDE should take steps to ensure that school district decision makers have access to training and resources that will help them reduce energy and water consumption in their schools and navigate the evolving renewable energy marketplace, for example the development or sponsorship of an energy schools academy.</u>

- Provide resources, training, and recognition opportunities to key decision makers across all school districts for: (Short term goal)
    - Understanding various renewable energy options, including their costs and applicability.
    - Accessing external resources including federal, state, local case studies, and examples.
    - Site evaluation and renewable project planning.
    - Vendor and technology procurement and selection.
    - Project financing and contracting.
    - System commissioning and operations.
- Benchmark energy use for effectiveness. (Short term goal)
    - Establish independent review/baseline.
    - Assessment of generation and offsets. (Verify results)
    - Portfolio Manager (provided by the CEC) or other low to no cost Web sites that allow school districts to benchmark energy usage.
- Champion energy conservation efforts and funding opportunities for California school districts. (Intermediate goal)
    - Create an Energy Liaison position at the CDE.
        - Represent school districts at legislative and CPUC hearings.

    - Update school districts of regulatory/legislative changes and funding opportunities related to energy conservation.

- Develop a resource library for school energy conservation.

    - Quick and seamless method for allowing school districts to post RFPs for energy projects.

- Coordinate with the U.S. Department of Education to highlight best practices/demonstration projects that save money (i.e. Green Ribbon School program.)

Appendix A
State Agencies with Energy Responsibility

Policy and regulatory actions related to energy come from a number of agencies such as the California Public Utilities Commission (CPUC), the California Air Resources Board (CARB) and the California Energy Commission (CEC). The Department of General Services (DGS) approves facility projects and determines feasibility through formulas related to savings and lifecycle costs. The Division of the State Architect (DSA) reviews and approves most renewable energy system designs and installations.

The CPUC regulates rates and tariffs and will be instrumental in shaping the economics for renewable generation for schools. The CEC determines the rules and constraints relating to the RPS system. The CEC also manages certain loan and grant programs funded by Federal Recovery Act legislation (and other sources) that supports renewable energy generation and energy efficiency. Such programs offer funds and/or technical assistance that may benefit schools contemplating renewable energy projects. Therefore, it is essential that there are linkages among the three agencies that allow for useful input between the CDE, the CEC, and the CPUC on school energy needs and facilities.

The CARB is also developing a market for carbon credits that could provide more resource dollars for entities that are proactive in producing electricity from a renewable source (Tradable Renewable Energy Credits) or in reducing greenhouse gases (Offsets).

All of these organizations make decisions that may impact how renewable projects are sited and how the electricity generated may be used and paid for.

Appendix B
Legislative Actions

The Legislature also has had a key interest in renewable public projects and they currently have a number of bills that could change the way renewable projects are treated.

Current Law:

AB 920 (Huffman) (Chapter 376, Statutes of 2009)

This applies to Southern California Edison Company (SCE), Pacific Gas and Electric Company (PG&E) and San Diego Gas and Electric Company (SDG&E) Net Energy Metering (NEM) customers. Requires utilities to offer compensation to customers for any net surplus electricity they generate over a 12-month period. The provisions of the new law will be implemented in 2011 (the compensation provision became effective in 2010). Payback rates are determined by the CPUC and effective on January 1, 2010, to be paid out the following year.

Discussion: This bill was passed and required the CPUC to establish rates by January 2011. This hasn't happened yet. Good fiscal decisions on buying or leasing alternative energy capital cannot be made until the rates are known.

In addition, this bill only provides compensation for physical over-generation on a given account, whereas on a time of use (TOU) tariff the system starts "giving away" kWhs when it is producing as little as 70-80% of the on-site load. Under AB 920, the customer would receive nothing for this 20-30% "deadband.". This should be changed.

AB 2466 (Smyth) (Chapter 540, Statutes of 2008)
Effective January 1, 2009: Authorizes a local government entity to receive a credit on their electric bill for power generated from a renewable energy facility that generates more energy than is needed to serve the electrical load of a governmental entity owned or controlled site where the facility is located.

Discussion: The Renewable Energy Self-Generation Bill Credit Transfer Program (RES-BCT) tariff is now active at all three investor owned utilities (IOUs). The low valuation of the energy available for the credits are about half as much as one would achieve with net metering. The tariff rules on this law are so restrictive than no customer has yet employed it – this law needs to be liberalized.

SB 383 (Wolk) would have addressed this, however, it is currently an intent bill and we are awaiting new language in the bill that may resolve these issues.

Legislative Session 2011-2012 Current Bills:

SB 118 (Yee)
This bill makes changes to *Government Code* (*GC*) Section 4217 to require local public agencies, including schools, to provide public notice for energy service contracts and related facility leases. The bill language is expected to be amended per agreement with the author to

allow for maximum flexibility to the local agency following the code's stated intent in *GC* Section 4217.12.

Discussion: As originally drafted, the bill would have required competitive bidding which would have had a prohibitive effect on these energy contracts and projects. The State Superintendent of Public Instruction (SSPI) should continue to monitor the bill to allow for maximum flexibility to schools so that these projects continue to move forward with appropriate transparency and flexibility for schools.

SB 383 (Wolk)
Effective January 1, 2009: Authorizes a local government entity to receive a credit on their electric bill for power generated from a renewable energy facility that generates more energy than is needed to serve the electrical load of governmental entity owned or controlled site where the facility is located.

Discussion: The RES-BCT tariff is now active at all three IOUs. The low valuation of the energy available for the credits are about half as much as one would achieve with net metering. The tariff rules on this law are so restrictive than no customer has yet employed it – this law needs to be liberalized.

SB 383 (Wolk) would have addressed this, however, it is currently an intent bill and new language in the bill may resolve these issues.

SB 585 (Kehoe)
Amends an existing law that requires the CPUC, in implementing the renewable energy funding programs, to ensure that the total cost over the duration of the program does not exceed a specified sum, and that imposes monetary limits on programs funded by charges collected from electrical corporations. This bill imposes the total amount as a limit on the amount of moneys collected through charges on electric utility customers.

Discussion: Kehoe's bill would replenish the shortfall in the California Solar Initiative (CSI) and provide some amount of rebate to nonresidential electricity customers for all 10 steps in the CSI program. The CSI has been well-used by many school districts and its funds have been depleted faster than envisioned. This bill allows more dollars to be put into the program.

The CSI program should be expanded to include other renewables, not just solar.

This bill should also consider refunding with greater dollars and higher standards that have been previously used and proven viable as incentives to stimulate the growth of renewables.

Appendix C
Bibliography

1) AB 512 (Gordon) – This bill modifies *Public Utilities Code* (*PU Code*) Section 2830 to expand the maximum size for renewable generating systems eligible for the RES-BCT Program from 1 MW to 5 MW. The Office of Governmental Affairs SUPPORTS this bill. See: http://docs.cpuc.ca.gov/PUBLISHED/REPORT/133626.htm

2) AB 920 (Huffman) was heard at the CPUC on May 5, 2011. See this summary from Vote Solar: http://votesolar.org/2011/04/ab-920-payment-for-net-surplus-compensation/ FAQ from PG&E on AB 920 – http://www.pge.com/myhome/saveenergymoney/solarenergy/nembilling/faq

3) A good summary of California's Net Metering rules (with links to the State's Web site with additional information) and how the bills discussed alter the original rules. See: http://en.openei.org/wiki/California_-_Net_Metering_(California)

4) Department of Energy's (DOE's) *Solar America Communities Solar Powering your Community – A Guide for Local Governments* (http://solaramericacommunities.energy.gov/resources/guide_for_local_governments/) – while it does not address California public schools specifically, it has a wealth of information on many of the same issues that cities confront when planning for solar.

5) Benchmarking - the ongoing monthly review of energy performance to determine if a building is getting better or worse in comparison to itself, other buildings in the portfolio, and/or peers.

   Portfolio Manager is an interactive energy management tool that allows you to track and assess energy and water consumption across your entire portfolio of buildings in a secure online environment. Whether you own, manage, or hold properties for investment, Portfolio Manager can help you set investment priorities, identify under-performing buildings, verify efficiency improvements, and receive EPA recognition for superior energy performance.
   http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager

Grid Neutral Schools
Policy Sub-committee Memo

I. Sub-committee Topic: Grid Neutral Schools

Chair

- Randy Britt, Parsons

Members

- Nicole Anderson, California State University
- Laura Battise, Chevron Energy Solutions
- Margarita H. Colmenares, Think Verde
- David Gomez, NECA/IBEW Local 11
- Enrique Palacios, Pittsburg Unified School District
- Jason Retterer, Lombardo & Gilles, LLP

Support Staff

- Diane Waters, California Department of Education, School Facilities Planning

Sub-committee Charge:
The sub-committee was charged with making recommendations on how the number of grid neutral schools can be increased. Work included recommendations to eliminate legislative and regulatory obstacles to grid neutral schools.

II. Context

Educational Context

- Grid-neutral schools offer technologies that represent a potential hands-on learning tool which may be incorporated into the educational science curriculum.

- Instead of being an abstract term, "going green" can become a tangible reality for students by engaging them in student-led projects and programs across all sustainable technologies. These students will be empowered to create a social shift for future generations to have a deeper understanding and relationship with the term.

- Faculty will have a new tool for instruction that will not only help students in their learning pathway, but will become a cost-saving mechanism for the schools.

Legislative/Policy Context

- Regulatory changes are needed to allow for more cost effective solar installations on school buildings.

State incentives to promote solar installation at existing and new schools are gone.

Political/Fiscal Context

- School funding from the state has been severely cut in recent years, impacting preventive maintenance, repairs, capital improvements, and expense savings projects.
- Schools need immediate assistance to mitigate the impacts of rising utility costs.
- Projects that would generate utility savings would not only pay for the investment, but could also be used to offset other operational and payroll expenses.

III. Key Recommendations and Options

Recommendation 1: Make regulatory changes to allow for more cost effective solar installations on school rooftops.

- **Analysis of the Problem:** Although it is relatively easy to install solar installations on shade structures for schools, and the Division of State Architect (DSA) has a predetermined method for approving those types of installations, it is very difficult to meet the *California Building Code* (*CBC*) standards in effect for solar installations, particularly for rooftop installations which are not specifically designed to be applicable to solar installations, and do not allow self-ballasted photovoltaic solar installations on rooftops.
- **Proposed Solutions and Strategies:**
  - Promote revisions to the *CBC* that would allow for self-ballasted photovoltaic solar installations on rooftops. (Intermediate Term)
  - Update DSA standards to meet emerging technologies. (Intermediate Term)
  - Continue to support shade structure installations for solar projects in schools. (Short Term)
  - Update California Public Utility Commission (CPUC) and municipal utility regulations to allow for one utility account per district for energy generation that would facilitate district-wide grid neutrality. (Short Term)

Recommendation 2: Provide sufficient funding capability for schools to implement renewable energy conservation measures.

- **Analysis of the Problem:** State budget cuts, bond capacity limitations, and lack of available general fund sources, combined with the evaporation of California Solar Initiative (CSI) incentives have made for a very difficult environment to support the financial case for solar installations. Traditional Energy Services Company (ESCO) solutions are too costly and time consuming for timely execution.

- **Proposed solutions and strategies:**
    - Create energy conservation and renewable energy rebates dedicated to schools. (Intermediate Term)
    - Create a dedicated category for statewide school construction bond for renewable energy projects. (Intermediate Term)
    - Work with the CPUC to extend net metering benefits indefinitely. (Short Term)
    - Work with the California Energy Commission (CEC) and CPUC to extend CSI benefits or provide for improved feed-in tariff. (Short Term)
    - Carve out an allocation of Proposition 1D funds that would provide for a 75/25 split for schools that achieve grid neutral status for both new schools and modernizations. (Short Term)

Recommendation 3: Develop and implement effective energy efficiency programs for existing schools. First and foremost, energy audits need to be done that would create benchmark data.

- **Analysis of the Problem:** Most schools have not developed effective energy efficiency programs, don't know what their Key Performance Indicators (KPIs) are, and have not had energy assessments done to benchmark their current operating data from which to determine what can be done to minimize energy usage and install sufficient renewable energy resources to achieve grid-neutral status.

- **Proposed solutions and strategies:**
    - Create a statewide template for energy audits and energy efficiency strategies. (Short Term)
    - Conduct statewide energy audits and create a central repository with the state for the data. (Intermediate Term)
    - Work with the CPUC, the investor-owned utilities, and municipal utilities to make electricity metered data available to all schools at no cost. (Intermediate Term)
    - Provide energy efficiency education for users and administrative staff; that is, develop a statewide energy education program. (Intermediate Term)

Recommendation 4: Encourage new school construction projects and major modernization projects to be designed for true grid neutral operations.

- **Analysis of the Problem:** New schools are being designed with small area rooftops populated with high numbers of rooftop air conditioning and other mechanical systems preventing the best available use for rooftop solar installations.

- **Proposed solutions and strategies:**
    - Work with the DSA to better understand how grid neutral schools can be achieved through both new construction and modernization projects. (Intermediate Term)
    - Utilize the DSA resources to create design templates for schools that allow for greater renewable energy installation capacity with the lowest energy usage. (Intermediate Term)
    - Encourage design teams to utilize best available technologies and design with future renewable energy and the capacity for emerging technologies in networked energy storage systems in mind. (Intermediate Term)
    - Create a centralized best practices repository with the state to share how grid-neutral schools were realized within other districts (Intermediate Term)

Financing of High Performance Schools
Policy Sub-committee Memo

I. Sub-committee Topic: Financing

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Members
- Bill Kelly, Sunpower Corporation
- Bernie Kotlier, NECA/IBEW Joint Labor Management Cooperation
- Philip Kranenburg, College of Marin
- Jody London, Oakland Unified School District, Board of Trustees
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- Shannon Farrell-Hart, California Department of Education, School Facilities Planning

Sub-committee Charge
The sub-committee was charged with reviewing and making recommendations regarding how existing sources of funds can be maximized for local educational agencies (LEAs) to make buildings more energy efficient and generate renewable energy at school facilities. Work included recommendations to eliminate legislative and regulatory obstacles.

II. Context

California has some of the highest energy costs in the United States. These costs are both a burden and an opportunity. The burden is that scarce education funds must be used to pay facility heating, cooling, and lighting costs. The opportunity is that California can reduce demand for energy by better managing energy use and installing energy efficiency technology, and California has significant solar, geothermal, wind, and other renewable energy resources that can be used to offset remaining energy demand.

California's *Energy Action Plan*, adopted in 2003 and updated in 2005 and 2008, by the California Public Utilities Commission (CPUC) and the California Energy Commission (CEC), directs that new electricity resources be added in the following order:

1. Energy efficiency
2. Renewable energy
3. Clean fossil fuel

Recognizing the opportunity for California to increase its use of renewable energy to meet its energy needs, Governor Brown signed into law a requirement that 33% of the electrical energy used in the state is provided from renewable resources by 2020 Senate Bill (SB) 1X2, (Chapter 1, Statutes of 2011). California's public school facilities provide a great resource to support the state in this mission to significantly increase its use of energy efficiency and renewable energy.

In addition to generating clean electricity, investments in energy efficiency and renewable energy installations at public schools provide an opportunity to enhance the learning environment, and prepare students for opportunities in emerging clean technology industries. California public schools can train students in new careers, while 1) meeting the state and federal government's policy goals to reduce greenhouse gas emissions; and 2) reducing dependence on imported petroleum products.

California's public schools, however, face operational and financial barriers to accomplishing these goals. Operational barriers exist, such as a local school district generating energy in excess of its needs at one school site and are being limited in selling its excess back to the grid or transmitting that excess to another school across town, or to a different district's facility across district boundaries. Also, even for the largest school districts, there are barriers in economies of scale, scope, and access to financing to overcome the economies of scale required for energy resource poor school districts compared to energy resource rich school districts. Removing the operational barriers will require both regulatory and legislative action. Addressing the financial barriers will require access to new financial tools and capital funds.

III. Key Recommendations and Options

There are many policy issues the sub-committee considered, such as, should the financing and capital access be available based on need or based on the most efficient use of capital to be effective – i.e. "What pencils out best?" The allocation also should be based on a loading order action plan of: 1) energy audits by qualified auditors; 2) increase site efficiency by reducing building energy loads; and 3) new energy generation. The sub-committee discussed other policy issues, including the tension between public benefits (greenhouse gas reductions, less energy use, etc.) versus private good (school district general fund savings or revenue) that stay with the district.

The sub-committee concludes that the state should not limit new financial tools and access to capital for schools based on the school's energy needs, but instead should create financial tools and incentives that result in the maximum energy efficiency and renewable generation by public schools. The sub-committee suggests the political process should determine the public versus the private benefit issues.

The sub-committee has adopted five recommendations. While the recommendations will be presented individually, they have significant overlap and interaction. The sub-committee did not adopt separate recommendations simply related to energy efficiency or simply to energy generation. Rather, most of the recommendations would apply to both efficiency and generation. For example, Recommendation 1 regarding new and expanded funding sources could be used for either energy efficiency, energy generation, or both. On the other hand, Recommendation 2, to maximize production at a school site and Recommendation 3 for Joint Powers Authorities (JPAs) are more directed toward regulatory issues that are related to generation and transmission of generated energy than efficiency at a particular site.

Recommendation 1: New and expanded funding sources.

The sub-committee recommends that the state investigate the use of multiple new and expanded revenue sources such as expanding the Public Goods Charge on utility bills, utility surcharges dedicated to a revolving loan fund for school energy efficiency projects, revenue bonds, State General Obligation (GO) bonds, private investment funds, and authorizing school districts or local JPAs to issue local revenue bonds. The sub-committee also recommends that the state consider state revenue bonds, as well as State GO bonds targeted for providing loans to fund school districts for energy efficiency and generation projects.

- **Rationale:** School districts have limited access to their assessed valuation for bonding purposes. That limited access is currently being used for new construction or modernization of existing school facilities. The local assessed valuation is directed toward the matching state funds for those purposes.

- **Analysis of the Source of the Problem:** Current statutory law contains a limitation on the amount of assessed valuation that is available for bonding capacity at school districts.

- **Description and Analysis of the Proposed Solution:** The sub-committee discussed and recommends that because of the limitations on local access to property tax backed bonding, additional funding through state and local revenue bonds, as well as GO bonds, is necessary.

  The sub-committee proposes increasing the local bonded debt capacity for bonding restricted solely for energy efficiency and generation projects. The current bond capacity cap is 1.25% of assessed valuation for elementary and high school districts and 2.5% for unified school districts. The sub-committee suggests that the percentage be increased by .25%, for elementary and high school districts up to 1.5% and unified districts from 2.5% to 3.0%.

  Authorizing local revenue bonds for school districts, as well as issuing state and local revenue bonds and state GO bonds, would require legislative action. Both the local revenue bond authority and the assessed valuation bond capacity increase would be short-term actions that have long-term effects.

  School districts should be encouraged to collaborate with one another and with other local government entities to take advantage of economies of scale and pool scarce technical and financial resources.[1]

  The California Solar Initiative and Public Goods Charge funded initiatives should be continued and expanded with specific guaranteed funds for school projects.

[1] One example of this is the Leadership in Energy Efficiency Program operated by the Alameda County Office of Education (ACOE). Under this pilot program sponsored by PG&E using public goods charge funds, ACOE is offering energy management services to local districts. Similarly, the San Diego County Office of Education (SDCOE) sponsors an Energy Joint Powers Authority whose goals include: all schools are off the grid; schools have lower baseline energy usage, and schools are able to scale up alternative energy production to support expected increase in technology in the classroom.

Utilities should be required to purchase at peak load prices for a guaranteed term the excess energy provided through state approved or funded school energy projects. The state approved or funded projects would be required to meet eligibility requirements based on CEC loading standards.

- **Strategy:** The strategy is to include within the state's 2012 GO bond provisions for matching grants to school districts based upon energy efficiency and renewable generation at the same time as a state revenue bond would provide local incentives for energy efficiency and generation through no cost and discounted state loans. This would build upon the incentives included in Proposition 1D (2006) for designing new schools to meet the green building criteria in the Collaborative for High Performance Schools (CHPS).

  Part of this strategy is to conduct polling to determine the public's willingness to provide grants and loans, as well as buyouts of low principal and interest loans to encourage school district energy efficiency and production.

Recommendation 2: Maximize production at school sites.

The sub-committee recommends that net metering caps be eliminated so that energy generated at one site can be shared and credited to other sites and allow the surplus to be distributed to within a school district.

To ensure a source of private capital, energy generated on or off-site must be purchased under long term contracts as a renewable energy by the utility serving the district, with under feed-in tariff requirements.

- **Rationale:** The sub-committee believes that these actions would maximize renewable generation, as well as reward the combination of efficiency and excess generation at school sites following if the *Energy Action Plan* loading order is required.

- **Analysis of the Source of the Problem:** The sub-committee discussed the barriers to selling energy that are created at a site if that energy is greater than the amount needed by the site. Current barriers, particularly in the limitations on being able to sell back to investor-owned utilities excess power, result in inefficient allocation of energy resources. A site may be able to generate two or three times the amount of energy needed to be grid neutral, but it would not make the investment in excess energy generation because the investment could not be funded by selling the excess energy production. The second barrier is that, even if the school could fully sell all excess generation to the utility, there is no assurance the utility would buy the excess. Current law and regulation would need to be changed to require the long term purchase of that excess at a rate of return on investment that is equal to the cost of that excess generation.[2]

[2] The California Public Utilities Commission in June 2011 adopted a methodology for compensating customers for excess electricity they produce when taking service under net energy metering tariffs (Decision 11-06-016).

The sub-committee also discussed the alternative of allowing the excess generation to be transmitted and used at other sites within the school district or adjacent school districts or other government entities. This would require the owners of distribution and transmission lines to provide low or no-cost open access to their distribution and transmission lines for the excess generation.

- **Strategy:** The recommendation requires significant changes in law and regulations. Because there have been a considerable number of bills introduced in the current legislative session to improve the net metering laws in California, we recommend gathering support for those bills that will improve state laws (see attached list of net energy metering bills under consideration).

<u>Recommendation 3: Joint Powers Authorities (JPAs) and other combinations.</u>

The sub-committee recommends that school districts be given the authority to create energy JPAs and allow those JPAs to engage in energy management activities, including energy efficiency, renewable energy, and related activities.

- **Rationale:** The sub-committee discussed and concluded that regional energy efficiency and generation opportunities would maximize efficiency and generation better than school district by school district. Funds could be leveraged in a way where a school district that was energy resource poor could provide financial support and receive energy from school districts that were energy resource rich. Pooling the finances and the resource excess capacity would maximize generation and result in more schools becoming grid neutral.

- **Description and Analysis of the Proposed Solution:** *Government Code* § 52000-52012, the Community Energy Authority Act, allows cities or counties, individually or joining together in Joint Powers Authorities, to plan and implement comprehensive energy management strategies to encourage energy efficiency and conservation and minimize the impacts of future price increases. School districts should be encouraged to form and/or participate in existing JPAs with this purpose. This should provide districts that install generation resources in excess of their own demand with greater access to existing transmission facilities and would provide better opportunities for sale of excess energy generation to other governmental entities within the geographic area of the school JPA or school district.

  This recommendation is a mid-term (incentives for the creation of or participation in a JPA) and potentially long-term recommendation (creating greater opportunities for districts that so desire to participate in energy markets).

<u>Recommendation 4: Incentivize local financing.</u>

The sub-committee recommends creating opportunities for expanding public/private partnerships and creating tax incentives for corporations to invest in school energy generation to provide more access to capital.

- **Description and Analysis of the Proposed Solution:** Currently school districts have few incentives to make significant investments in excess generation capacity. There is incentive for energy efficiency and generation but only on a site-by-site basis and only to the extent of what is anticipated to be needed by that site, and finally, only if adequate financing can be found that does not put pressure on the school district's general fund.

One limitation for local funding is that school districts are not eligible to receive renewable energy credits and do not have the opportunity to sell or trade credits in a primary or secondary market. The sub-committee believes that incentivizing local funding should include the ability for schools to receive and sell renewable energy credits.

The sub-committee believes school districts must have energy audits to access state energy project funds. Districts should have access to the California Department of Education (CDE), California Energy Commission (CEC), and California Public Utilities Commission (CPUC) energy audits along with a certification program for private providers of energy audits. The CDE and CEC should provide energy project analysis for local funded projects and private funded projects to ensure that best practices and maximum cost effective energy efficiency and generation practices are used for school district projects.

- **Rationale:** These opportunities, in combination with local revenue bond authority, would provide funding to be: 1) part of a district match in accessing state grant or loan funds; 2) resources for funding offsite energy generation; or 3) supplements for local GO bonds.
- **Strategy:** Some of these strategies are in law, such as the public/private partnerships and the third party investors. Tax incentives for corporations are partially in law, but they are not well integrated or incorporated with the ability for local sharing through revenue bonds and expanded access to local GO bonds.

Recommendation 5: Incentivize the creation of Renewable Energy Credits (REC) marketplace.

Currently, the market for renewable energy credits (RECs) is illiquid in California, limiting the ability for schools who invest in renewable energy projects to capitalize on the environmental impacts of these investments. With Governor Brown's signing of SB 1X2 on April 12, 2011, there is a great opportunity to utilize renewable energy investments on public school properties in support of meeting the state's renewable energy goals while enabling districts to receive REC payments for their solar investments. To facilitate this benefit, the CPUC must modify its guidelines under the California Solar Initiative (CSI) to facilitate the sale of RECs from solar projects completed under the CSI. This modification is currently under consideration by the CPUC.

Attachment 1

2011 Legislative Session – The following is a list of proposed legislation that may influence LEAs' abilities to build energy efficient and energy generation projects.

AB 204 – Author Halderman, Sales and Use Taxes: Exemptions: Biomass Energy

AB 436 – Author Solorio, Public Works Prevailing Wage

AB 512 – Author Gordon, Local Government Renewable Energy Self-Generation Program

AB 603 – Author Perez, Energy: Renewable Resources

AB 631 – Author Ma, Public Utilities: Electric Vehicle Charging Stations

AB 721 – Author Bradford, Renewable Energy Resources: Solar Energy Systems

AB 722 – Author Bradford, Utility Rates: Costs and Rate Increases

AB 723 – Author Bradford, Energy: Public Goods Charge

AB 725 – Author Bradford, Utility Service: Undergrounding of Facilities

AB 796 – Author Blumenfield, Energy: Clean Energy Economy

AB 850 – Author Gordon, State buildings: Efficiency

AB 864 – Author Huffman, Electricity: Self-Generation Incentive Program

AB 865 – Author Nestande, Property Tax: Exclusion: Active Solar Energy System

AB 904 – Author Skinner, Energy Efficiency

AB 915 – Author Fletcher, California Solar Initiative

AB 932 – Author Blumenfield, Renewable Energy Resources: Renewable Transition Funding

AB 940 – Author Bradford, Public Utilities Commission Report

AB 982 – Author Skinner, Energy: Solar Energy Parks Program

AB 1054 – Author Skinner, Energy: Clean Energy Financing

AB 1073 – Author Fuentes, Electrical Corporations Energy Efficiency Programs: Application Requirements

AB 1150 – Author Perez, Self-Generation Incentive Program

AB 1186 – Author Skinner, Electrical Generation: Source Disclosures

AB 1261 – Author Fletcher, Local Government Renewable Energy Self Generation Program

AB 1302 – Author Williams, Electricity Distribution Grid Upgrade

AB 1303 – Author Williams, Energy Programs

AB 1361 – Author Perea, Electricity: Net Metering

AB 1376 – Author Nestande, Sales and Use Tax Exemption: Production of Electrical Energy

AB 1385 – Author Bradford, Electricity

AB 1391 – Author Committee on Utility and Commerce, Electricity: Net Energy Metering: Report

SB 128 – Author Lowenthal, School Facilities Funding: High Performance Schools

SB 132 – Author Lowenthal, School Facilities: State Planning Priorities

SB 142 – Author Rubio, Electrical Rates

SB 343 – Author DeLeon, Energy: Efficiency

SB 370 – Author Blakeslee, Energy: Net Energy Metering

SB 371 – Author Blakeslee, Electrical Corporations

SB 372 – Author Blakeslee, Distributed Generation

SB 383 – Author Wolk, Renewable Energy

SB 410 – Author Wright, Public Interest Research, Development and Demonstration

SB 454 – Author Pavley, Energy Efficiency Standards: Energy Commission

SB 489 – Author Wolk, Electricity: Net Energy Metering

SB 536 – Author DeSaulnier, Property Tax Revenue Allocations: Public Utilities

SB 555 – Author Hancock, Local Government: Community Facilities Districts

SB 564 – Author Evans, Energy Efficiency

SB 569 – Author Kehoe, Alternative and Renewable Fuel and Vehicle Technology

SB 585 – Author Kehoe, Energy: Solar Energy Systems: Funding

SB 771 – Author Kehoe, California Alternative Energy and Advanced Transportation Financing Authority

SB 790 – Author Leno, Electricity: Community Choice Aggregation

SB 854 – Author Blakeslee, Renewable Energy Resources

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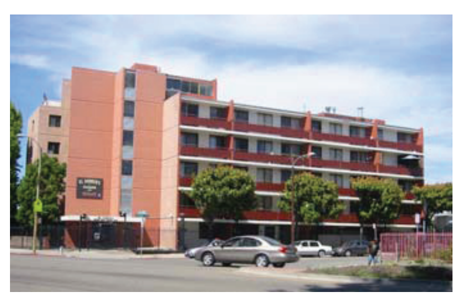
EXHIBIT 7

Improving California's Multifamily Buildings: Opportunities and Recommendations for Green Retrofit & Rehab Programs

Findings from the Multifamily Subcommittee of the California Home Energy Retrofit Coordinating Committee

Final Report
April 11, 2011



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EXECUTIVE SUMMARY

In California, the single-family home weatherization and whole-house performance sector is very active, with many programs already in place and new ones that began rolling out in the fall of 2010. While these programs have the potential to achieve impressive energy savings, their approaches do not neatly carry over into the multifamily and affordable housing sector.

The multifamily and affordable housing sector is different from the single-family sector in many fundamental ways, and optimal energy improvements at the whole-building level cannot be accomplished by merely modifying or expanding the single-family programs. The opportunities and challenges unique to the multifamily sector can only be met if there are well-designed and well-coordinated programs and policies that address this sector's specific infrastructure.

In recent decades, California's building energy efficiency standards, the California Home Energy Rating System (HERS), utility incentives and local government programs have made major strides in improving the energy efficiency of the state's building stock. However, neither single-family nor commercial building energy upgrade programs fully address the unique aspects of the multifamily sector and its subsectors. Multifamily developer/owners find it time consuming and daunting to sort through the range of individual measure and targeted programs that might apply to their properties, and to make sense of the varying application procedures and requirements associated with each program.

The Multifamily Subcommittee of the California Home Energy Coordinating Committee (MF HERCC) is working to address these challenges by coordinating development of standards, professional qualifications, verification procedures, and energy savings quantification and tracking tools. The California Home Energy Retrofit Coordinating Committee was convened by U.S. EPA Region 9 to develop consistent recommendations and standards for statewide home energy retrofit programs.

This report summarizes the MF HERCC's recommendations and analysis in six specific areas:

1. Program delivery
2. Professional qualification and training
3. Whole-building performance approach
4. Energy analysis software
5. Performance measurement, tracking and benchmarking
6. Low-income and energy efficiency program access and coordination

Summary of Recommendations

1. Program Delivery

a. ***Use raters/verifiers and energy consultants to deliver multifamily incentive program services.***
b. ***Give developer/owners the flexibility to hire and manage the construction and verification team.***
c. ***Design individual measure-based incentive programs[1] and whole-building performance-based programs to be complementary and parallel offerings.***
    - Utilize a rater/verifier and energy consultant delivery model for whole-building performance programs and continue to utilize a contractor delivery model for individual measure programs.
    - Take into account the conditions under which a contractor-delivery approach may be appropriate for whole-building performance programs.
d. ***Provide a single point of customer interface for multifamily property owners to streamline their participation.***

Incentive programs that deliver energy and green upgrade services for single-family homes, as well as individual measure-based programs for multifamily buildings, typically rely on pre-approved contractors. These contractors serve as the conduit for participating in the program and provide services such as diagnostics, verification and documentation. This contractor-list delivery approach, however, is unlikely to be successful for California's diverse and professionalized multifamily and affordable housing sector, for a number of reasons. Developer/owners typically have long-established relationships with a variety of specialized sub-trade contractors whom they may be contractually obligated to use, making it problematic to use program-designated contractors. Using raters/verifiers instead of contractors to delivery multifamily incentive program services also aligns with the HERS program model. California already has a well-established network of professional HERS raters, and existing multifamily programs already successfully use a rater model for program delivery. To support program delivery by raters, the MF HERCC has already developed whole-building audit protocols for use by raters/verifiers who are auditing multifamily buildings. There are circumstances, however, where a contractor-delivery approach may be appropriate; these should be considered when coordinating the offerings of individual measure-based incentive programs and whole-building performance programs.

When multiple programs (e.g. individual measure programs and whole-building performance programs as parallel offerings, or different offerings for low-income and market rate properties) are offered to the multifamily sector and sub-sectors, providing a single point of customer interface for multifamily property owners will reduce consumer confusion and improve program participation rates.

[1] Primary multifamily individual measure programs currently offered in California include the DOE Weatherization Assistance Program (WAP) administered by CSD, the CA Utility Rate-payer funded Statewide IOU Multifamily Energy Efficiency Rebate (MFEER) program, and the low-income Energy Efficiency (LIEE). See the CPUC matrix of MF programs included as an appendix to this report for examples of individual measure programs currently offered by IOUs.

2. Professional Qualification and Training

a. ***Focus on qualifications of rater/verifier and add specialized expertise to audit team based on scope of upgrade.***
b. ***Develop targeted training curricula and require completion of training by participating raters/verifiers, building operators, central systems contractors and users of energy analysis software.***
c. ***Consolidate required qualifications and training for participating building professionals. Build the capacity for partners who deliver individual measures to become whole-building raters/verifiers or to install individual measures as part of a whole-building program***.

The MF HERCC recommends targeting specialized training at four types of professionals who work on multifamily buildings: rater/verifiers, building operators, central water heating system contractors, and energy analysts. Each of these training courses focuses on making sure that key professionals working on multifamily building upgrades have the knowledge and expertise to make effective decisions about building improvements, program participation and ongoing operational savings. Minimum professional qualifications have been established for the verification/audit team.

The minimum professional qualifications and associated training required for various programs statewide should be consolidated to maximize the programs' ability to share trained workforces, and to limit the number of trainings and certifications required of participating building professionals.

The recommended Property Manager/Building Operator Training includes content to empower the entities who operate multifamily buildings to provide education and outreach to building residents. Residents need information and tools to make smart decisions about using energy efficiently and keeping their homes healthy. A home environmental education component can increase behavior-based conservation, improve the lives of residents (especially low-income renters who may not have ready access to this information) and enhance relationships between property owners, tenants and the broader community.

3. Whole-Building Performance Approach

a. ***Offer funding programs based on a whole-building performance approach for multifamily energy efficiency improvements, rather than a prescriptive approach. This performance approach should be based on Title 24 and HERS II protocols for multifamily residential buildings that consider the energy end-uses of heating, cooling, water heating (including solar pre-heat), appliances and lighting.***

b. ***Require a minimum of 10 percent energy efficiency performance improvement for all projects, with additional targets for projects to reach 15 percent and 20 percent improvement.***

c. ***Ensure that program total resource costs are minimized by eliminating administrative inefficiencies and optimizing leveraging among programs.***

d. ***Provide utility-funded incentives for the whole-building performance approach to stimulate demand for comprehensive energy upgrades.***

Single-family upgrade programs have traditionally taken a prescriptive approach, allowing for specific, clearly defined packages of improvements to be made to participating buildings as an option in parallel to the whole-building performance approach. This prescriptive path is seen as a “ramp-up” for increasing workforce capacity. After extensive analysis, the MF HERCC has concluded that this type of whole-building prescriptive approach is not feasible for the multifamily sector. Because of the diversity of building types, system types and other factors discussed throughout this document that distinguish multifamily buildings from single-family homes, a statewide whole-building prescriptive approach to multifamily upgrades would require 16 or more distinct packages of measures. This would likely create a huge administrative burden, confuse the market and drive up program costs.

For multifamily whole-building programs, the MF HERCC recommends a performance approach to energy savings analysis and upgrades. Minimum performance improvement targets ranging from 10 percent to 20 percent are recommended based on the building’s vintage. Individual programs need to conduct their own cost-effectiveness analysis based on the program’s specific parameters. Utility-funded incentives to developer/owners will drive demand for energy and green upgrades.

4. Energy Analysis Software

a. ***Use code compliance software as the standard baseline reference for energy savings reporting in programs funded by the American Recovery and Reinvestment Act (ARRA) or investor-owned utilities (IOUs).***

b. ***Use supplemental software programs where necessary to optimize analysis of energy savings opportunities.***

c. ***Apply California Energy Commission (CEC) HERS II-type residential multifamily low-rise protocols to high-rise multifamily in the code compliance software.***

d. ***Align funding programs' use of various software platforms for compliance to reduce administrative barriers to program participation.***

For multifamily developer/owners, a major barrier to carrying out energy performance upgrades is the complex and sometimes conflicting requirements of incentive and funding programs. Using standardized Title 24 code compliance software is an important step toward streamlining program requirements. That said, there must be some flexibility to use other software programs when needed to analyze certain types of improvements not well addressed by the Title 24 compliance software. The MF HERCC also recommends modifying HERS II code compliance software to address multifamily buildings including high-rise residential buildings (it currently applies to single-family and low-rise multifamily buildings, and was designed primarily with single-family assumptions), and coordinating requirements of funding programs to reduce duplication of energy modeling and analysis efforts.

5. Performance Measurement, Tracking and Benchmarking

a. ***Develop technical infrastructure for consistent building performance data analysis and tracking.***

To ensure that projects are achieving the predicted energy savings, and to inform improvements to building energy savings estimates, the MF HERCC recommends that programs require a verification of achievement of performance improvement following the completion of the project, ideally based on bill analysis that accounts for external influences on usage during the period of evaluation. This performance feedback would help to evolve performance program guidelines and goals to reflect realized savings. However, in order to actualize this recommendation, the MF HERCC recommends development of the technical infrastructure—including consistent protocols, policies and tools—for multifamily building owners and asset managers to:

- Track, analyze, and evaluate their buildings on a portfolio level,
- Track building performance and plan improvements over time, and
- Receive Automated Benchmarking Service (ABS) for multifamily properties through their local utility.

6. Low-Income and Energy Efficiency Program Access and Coordination

a. ***Coordinate and integrate energy efficiency retrofit and weatherization programs serving the low-income sector by developing consistent program requirements, standards and audit protocols; modifying program structures to provide more flexibility for multifamily building owners; and supplementing prescriptive approaches with whole-building performance approaches.***
b. ***Improve accessibility of low-income energy efficiency and weatherization programs to rent-restricted rental housing providers, thereby achieving additional market penetration and deeper energy savings by streamlining eligibility and administrative procedures.***
c. ***Build capacity in the affordable housing industry for use of energy efficiency-based utility allowances and project specific utility allowance calculators.***

Unless otherwise stated, the recommendations in Sections 1 through 5 above pertain equally to low-income and market rate properties. Additional recommendations that are entirely specific to low-income and weatherization programs are found here in Section 6.

For the multifamily housing sector, one of the major barriers to upgrading a building's energy performance is the plethora of sometimes confusing and often overlapping program requirements, incentives, financing sources, protocols and compliance software requirements. While this situation is a challenge for market-rate developers, it is even more challenging for developer/owners of income-restricted properties, who face additional complicated program and funding requirements. In addition, low-income energy efficiency (LIEE)[2] programs funded by California Public Utilities Commission (CPUC) ratepayers and Weatherization Assistance Programs (WAP) funded by the U.S. Departments of Energy (DOE) utilize a single-family program delivery model and have other barriers that make them difficult for multifamily properties to participate. As a result of these factors, most of the apartments which house low-income residents in California have not benefitted from or have been underserved by energy upgrade programs. To reduce barriers to participation, improved access to these programs and coordination of their requirements is essential.

Adoption of the recommendations in these six areas will allow California's energy and green upgrade programs to more effectively and quickly serve the multifamily building sector.

[2] Since these recommendations were initiated the CPUC/IOU Low Income Energy Efficiency (LIEE) program has been re-named Energy Savings Assistance Program (ESAP). Because these recommendations pertain to the program as it has been operated under the LIEE version, the term LIEE is used throughout the document for consistency.

INTRODUCTION

Challenges and Opportunities in the Multifamily Retrofit & Rehab Sector

In California, the single-family home weatherization and whole-house performance sector is very active, with many programs already in place and new ones rolling out in the fall of 2010. While these programs have the potential to achieve impressive energy savings, their approaches do not neatly carry over into the multifamily and affordable housing sector.

The multifamily and affordable housing sector is different from the single-family sector in many fundamental ways, and optimal energy improvements cannot be accomplished by merely modifying or expanding the single-family programs. The opportunities and challenges unique to the multifamily sector can only be met if there are well-designed and well-coordinated programs and policies that address this sector's specific infrastructure.

In California, approximately one-third of households reside in multifamily buildings (Figure 1).[3] Nationwide, more than 70 percent of multifamily housing units were constructed before building energy efficiency codes were established.[4] Although multifamily buildings inherently tend to be more efficient on a per capita basis compared to single-family homes, the large population living in multifamily buildings combined with the age of these buildings means that the potential for energy savings in this sector is enormous.[5]

Figure 1. Distribution of California Households by Dwelling Type
(Source: CPUC Strategic Plan, 2008)

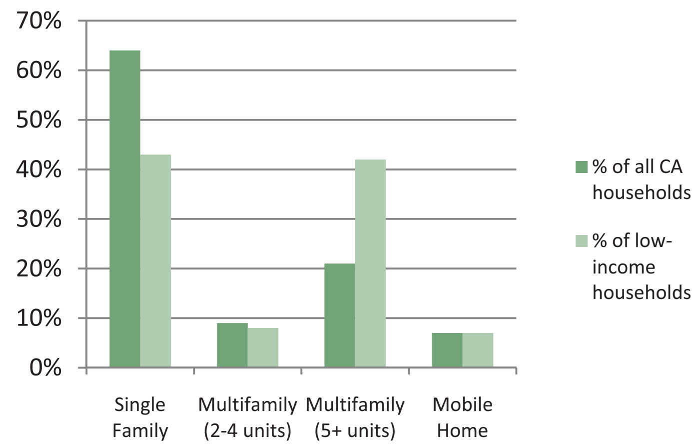
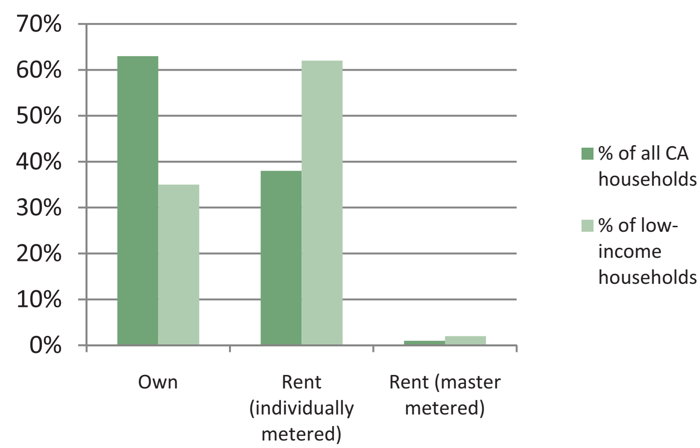


Figure 2. Distribution of California Households by Home Ownership
(Source: CPUC Strategic Plan, 2008)



[3] California Public Utilities Commission, "California Long-Term Energy Efficiency Strategic Plan," September 2008.
[4] Energy Foundation, "U.S. Multifamily Energy Efficiency Potential by 2020," October 19, 2009, prepared by The Benningfield Group, Inc.
[5] There are more than 2.4 million existing multifamily dwelling units in California. If 14 percent of those units were upgraded to improve energy performance by 25 percent, it would reduce annual energy consumption by 533,971 megawatt-hours (MWh) of electricity and 37 million therms of natural gas. Avoided greenhouse gas emissions

In the multifamily sector, energy savings and social equity are intertwined challenges. According to the California Public Utilities Commission, 42 percent of California households are renters rather than owners, and about one-third of these households qualify for low-income energy efficiency (LIEE) programs.[6] Figure 1 and Figure 2 show dwelling types and home ownership rates for California households in general and for low-income households.

Compared to higher income homeowners, lower income renters spend a disproportionate amount of their income on energy, and yet they typically do not have the financial resources or ownership rights to make energy efficiency investments in their homes. Well-coordinated upgrade programs targeted at the multifamily and affordable housing sector can make a big difference in individual's lives while supporting the state's ambitious energy and climate change goals.

A central challenge to the successful implementation of market transformation strategies arises from the fact that the multifamily and affordable housing sector actually consists of a number of subsectors. These are shown in Figure 3 and discussed in greater detail in the "Understanding California's Retrofit & Rehab Market" section later in this report.

Figure 3. Multifamily Subsectors

Physical configuration: **High Rise/Low Rise**	• Reference codes and standards for design, construction and energy savings analysis is different for low-rise vs. high-rise structures. • High-rise buildings are commonly classified as non-residential structures, and in California their specifications span residential and non-residential codes.
Building ownership: **Affordable/ Market Rate**	• Low-income multifamily sector faces unique financing structures and regulatory restrictions.
Unit ownership: **Rental/Condo**	• Owners and tenants have different economic motivations to invest in improvements.
Ownership & physical configuration: **Residential/Common Areas/Mixed Use**	• Different reference standards apply to residential and non-residential spaces. • Residential programs often miss savings opportunities in commercial and common areas, while commercial programs often miss opportunities in residential dwelling units.
Ownership & physical configuration: **Central/Individual Systems**	• Building may have individual or central heating, ventilation and air conditioning (HVAC) and domestic hot water (DHW) systems. • Upgrade decisions are affected by type of system, who owns it and who pays utility bills.

would be 430,245 MTCO2E annually. (Calculations done using methodology from the California Air Resources Board (CARB) AB 32 scoping plan.) On a national basis, estimates of achievable potential for energy efficiency improvements in existing multifamily housing by 2020 would save more than 51,000 gigawatt-hours (GWH) of electricity and more than 2,800 million therms of natural gas. Avoided CO2 emissions are estimated from at least 50 million tons to more than 100 million tons per year (Energy Foundation, op. cit.).

[6] CPUC, op. cit.

The various building configuration and ownership variables shown in Figure 3 influence:

- Which reference standards apply,
- Who is the decision maker and therefore which measures will be selected for energy investments and associated payback,
- What is the financing and regulatory structure of the project and how that might constrain energy efficiency decisions, and
- Whether the common areas, the dwelling units or both are the focus of the improvements.

In recent decades, California's building energy efficiency standards, California's Home Energy Rating System (HERS), utility incentives and local government programs have made major strides in improving the energy efficiency of the state's building stock. However, energy efficiency programs often do not fully recognize the unique characteristics—and potential for energy savings—of the multifamily industry's subsectors. In some cases, multifamily buildings are treated generically as housing and lumped together with single-family residential programs, standards and policies. In other cases, multifamily buildings are treated as if they were commercial buildings—in other words, large structures with complex ownership, financing, development and management.[7]

Neither this nor that

In California's Building Energy Efficiency Standards, commonly known as Title 24, low-rise multifamily buildings are covered by the residential section of the code. The nonresidential code addresses envelope and HVAC in high-rise multifamily buildings, but the residential code addresses water heating, lighting and appliance energy use in high rises.

In this case and many others, the multifamily sector has to straddle the requirements of programs and standards designed for either single-family homes or commercial buildings. Deciphering which programs and reference standards apply requires the intervention of experts. As a result, too often multifamily retrofit projects wind up falling between the cracks, leaving substantial energy savings and other benefits on the table.

Neither single-family nor commercial building upgrade programs fully address the unique aspects of the multifamily sector and its subsectors. Multifamily developer/owners find it time consuming and daunting to sort through the range of individual measure and targeted programs that might apply to their properties, and to make sense of the varying application procedures and requirements associated with each program. They would be more inclined to participate if programs, protocols and resources were better coordinated.

Fortunately, there is an opportunity for this systemic issue to be addressed in California today. Federal stimulus funds targeted at improving building energy efficiency, combined with ongoing programs such as those funded by utility ratepayers, are creating unprecedented opportunities for policymakers and program implementers to develop definitions, protocols and resources that are fine-tuned to the needs

[7] For some multifamily properties, the developer and owner are the same entity. In other cases, the property owner may not be a developer. In this report, the term "developer/owner" refers to a developer and/or owner, and is used to distinguish the more complex multifamily ownership structure from single-family home ownership.

of the multifamily sector and that are coordinated to reduce administrative inefficiencies and eliminate unnecessary costs and barriers to participation.

About the Multifamily Home Energy Retrofit Coordinating Committee (MF HERCC)

Dozens of entities across the state are actively involved in rolling out residential building upgrade programs. To coordinate their efforts and accelerate the rate at which California's buildings undergo energy and green building improvements, many of these entities came together in early 2009 to form an ad hoc group—the California Home Energy Retrofit Coordinating Committee (HERCC).

Convened by the U.S. EPA's Region 9, this collaborative of utilities, government agencies, building experts and others is working together to develop consistent recommendations and standards for statewide home energy retrofit programs. In its first year, the HERCC focused on single-family programs. Starting in January 2010, a Multifamily Subcommittee (MF HERCC) was formed to address the application of residential energy and green building programs to the unique needs of the multifamily and affordable housing sectors.

The MF HERCC's goal is to minimize administrative barriers to participation in multifamily retrofit and rehab programs emerging as part of Energy Upgrade California.[8] It is doing this by coordinating development of standards, professional qualifications, verification procedures, and energy savings quantification and tracking tools. Within the MF HERCC, Task Groups address specific tasks such as audit protocols, IT systems and weatherization programs. The MF HERCC is chaired by StopWaste.Org; the Acknowledgments section in this document includes a list of participants.

Purpose of This Report

This report is intended for people involved in developing and implementing multifamily building upgrade policies, programs and incentive structures in California. The report summarizes the MF HERCC's recommendations for:

1. Program delivery
2. Professional qualification and training
3. Whole-building performance approach
4. Energy analysis software
5. Performance measurement, tracking and benchmarking
6. Low-income and energy efficiency program access and coordination

The following background information about California's multifamily building sector provides critical context for these recommendations and analyses.

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[8] Energy Upgrade California is a new statewide program that promotes improvement of California's building stock using funding from sources including utility ratepayers, local government and the American Recovery and Reinvestment Act (ARRA). Energy Upgrade California multifamily program elements and tools are scheduled to launch in 2011.

Understanding California's Multifamily Retrofit & Rehab Market

The State of California, as well as local governments, regional agencies and many entities in the private sector, have established ambitious goals for reducing building energy use and related greenhouse gas emissions. To achieve these goals, building upgrade programs must be quickly and effectively ramped up. But if these efforts are to succeed, multifamily buildings cannot be shoehorned into programs designed for single-family or commercial buildings. Instead, California needs well-coordinated programs tailored to the unique opportunities and market barriers faced by the multifamily sector. The following key issues are discussed below:

Multifamily buildings cannot be shoehorned into programs designed for single-family or commercial buildings.

- **Building types:** The diversity of multifamily building types makes it highly challenging to develop program delivery models, incentive programs and consistent packages of building upgrade measures that meet the needs of every situation.
- **Financing:** Programs that fund multifamily energy upgrades need to be coordinated with traditional sources of financing so that they serve as a stimulus rather than a barrier to building upgrade activities.
- **Split incentives:** Upgrade programs need to take into account the divergent economic motivations of multifamily building owners and occupants, as well as the different ways in which energy is used and paid for by tenants and owners in multifamily buildings.
- **Trigger events:** During a multifamily building's lifecycle, there are specific times when it is most cost effective and convenient for the developer/owners to make energy and green upgrades. Building upgrade programs should tailor their services to take advantage of these entry points.
- **Cost-effective energy savings measures:** There are many cost-effective energy savings measures that are unique to multifamily properties. These measures need to be taken into account when designing building upgrade programs and incentives and conducting outreach to multifamily developer/owners.

Building Types

The multifamily sector encompasses a range of building sizes, system types and configurations of dwelling units and nonresidential areas. These configurations generally fall into the categories shown in Figure 4, and are consistent with Title 24 building code definitions.[9] When multifamily buildings undergo energy efficiency and green upgrades, these occupancy mixes and physical configurations affect how technical protocols and codes and standards (such as the residential vs. commercial versions of Title 24) are applied.

Figure 4. Multifamily Building Types

Low-rise Multifamily	• Three or more attached dwelling units with less than four habitable stories.
High-rise Multifamily	• Three or more attached dwelling units with four or more habitable stories. A mid-rise multifamily category is not defined separately from high-rise multifamily in Title 24 but it is generally accepted in the industry to refer to multifamily buildings of four to six stories.
Mixed-use Multifamily	• Three or more attached dwelling units as well as nonresidential spaces within one building envelope. Commercial spaces follow non-residential code; residential common area and corridors follow residential code unless they exceed 20 percent of total floor area.
Small Multifamily	• Three to five attached dwelling units that are in the configuration of a single-family home, such as a Victorian house converted into apartments, to which single-family protocols can be applied on a case-by case basis.
Multifamily Central Systems	• Three or more attached dwelling units that share common water heating or space conditioning equipment.

Smaller multifamily buildings present a special case. In some jurisdictions in California, such as the cities of San Francisco and Berkeley, multifamily buildings with three to five dwelling units constitute a significant portion of their multifamily housing stock. Although these buildings may technically meet the multifamily definition of three or more attached dwelling units, they do not always have other defining characteristics of multifamily properties such as central mechanical systems, multistory construction

[9] Title 24 defines multifamily housing as three or more attached dwelling units. However, various programs define multifamily housing differently; for instance some IOU programs consider buildings with two or more units, including duplexes, to be multifamily.

with high framing factors, or less overall exterior surface area per dwelling unit than a single-family home.

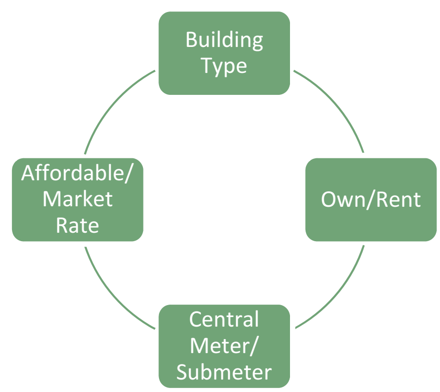
These smaller multifamily buildings are currently not well served by either single-family or multifamily programs. Pilot energy upgrade programs for small to medium multifamily buildings are currently underway in San Francisco and Maine. These programs will likely shed light on successful program design and implementation strategies for this subsector.

Until then, program administrators should take a case-by-case approach to determining whether these buildings fall under single-family or multifamily programs.[10] Program administrators should also consider offering specialized incentives for this market subsector since they do not experience the economies of scale of larger multifamily buildings and they tend to be too small to be targeted for participation by multifamily incentive programs.

In addition, the building upgrade decision-making process and potential for improving the energy efficiency of these building types is further influenced by other factors, including whether the building is an affordable or market rate property, whether the units are rented or owned, and the type of utility metering and billing configurations in place (Figure 5).

Because multifamily building types are so diverse, it is highly challenging to develop program delivery models, incentive programs and consistent packages of building upgrade measures that meet the needs of every situation.

Figure 5. Factors Influencing the Multifamily Building Upgrade Decision-Making Process



Financing

A variety of incentives and financing options are available to property owners and developers interested in making green improvements to their buildings. In addition to conventional sources of multifamily and affordable housing upgrade financing, Energy Upgrade California will facilitate access to the following sources of technical assistance and funding to undertake green building improvements:

- Investor-owned utility energy efficiency and low-income programs

[10] Case-by-case analysis can be defined by parameters other than number of dwelling units, such as shared attic and crawl spaces, original building configuration (e.g., if the building was originally a large single-family home that has been converted into separate units), and utility metering configurations. Technical criteria to be used to refine the definition of small multifamily might include number of dwelling units, square feet, ownership access to all or part of building and presence of central mechanical systems.

- Energy efficiency programs funded by the State Energy Program
- U.S. Department of Energy's Better Buildings Program
- Local government and private sector funding programs
- Federal and state housing programs[11]

Out of necessity, experienced multifamily housing owners and developers are adept at pulling together and layering myriad resources to complete a major construction, rehab or retrofit project. However, the decision to access incentive program resources is more complex for multifamily building owners than for single-family building owners. That's because:

- Construction in the multifamily and affordable housing industry is driven by multiple financing sources. These funding sources often have unique criteria that may limit the scope of a retrofit and supersede any requirements of an incentive program.
- Complex retrofit and rehab projects involve budgets ranging from tens of thousands to millions of dollars. For larger projects, it can take several years to line up capital. By the time a project is fully funded, design has advanced and opportunities to influence the scope are limited.
- Processes for permitting, insurance, general contractor and subcontractor arrangements, and ongoing building management bear more resemblance to the professionalized services in the commercial building sector than the single-family home sector.

The type of building ownership also has a direct impact on the economics of energy and green upgrades. As a recent report written by the Benningfield Group for the Energy Foundation explains,[12] single-family homes "are typically built to sell," while multifamily buildings are built to be held and to produce income, or in the case of affordable housing, "to show a positive monthly cash position." The report makes clear that owners of these buildings are "very different groups with very different motivations, financial considerations, and costing horizons." Programs intended to incentivize developer/owners to upgrade their properties must take these differences into account.

Despite the complexity of multifamily retrofit and rehab financing and economics, the multifamily sector presents significant opportunities for green and energy efficiency programs because:

- It is often more cost effective to perform efficiency upgrades on larger properties that have lower administrative and transaction costs per dwelling unit because of economies of scale.[13]
- Major rehabilitation projects are common in the multifamily sector. These projects typically have large construction budgets and may involve everything from replacing finishes and fixtures

[11] These include the California Tax Credit Allocation Committee (CTCAC), which administers federal and state low-income housing tax credit programs; California Debt Limit Allocation Committee (CDLAC), which allocates bond issuance authority to housing projects and programs; California Department of Housing and Community Development (HCD) programs; U.S. Department of Housing and Urban Development's (HUD) Green Retrofit Program (GRP) for multifamily housing; and U.S. Department of Energy's Weatherization Assistance Program (WAP) for low-income households.

[12] Energy Foundation, op. cit.

[13] A single-family program might deliver savings of approximately 2,000 kWh per home. A multifamily program might deliver savings of approximately 650 kWh per dwelling unit. Accordingly, a 100-unit multifamily building would deliver 65,000 kWh per program participant, hence increasing the energy savings per program transaction.

to installing new building systems to reconfiguring dwelling units. It is cost effective and efficient to include energy efficiency upgrades at the time of these renovation projects.

- Standards and verification procedures developed by regulated retrofit and rehab incentive programs can provide quality assurance to financing sources that have green building criteria.
- Multifamily properties tend to be operated and maintained by professional building staff. Providing training and other resources to these people increases the odds that the building will be operated efficiently after energy upgrades are installed, and that persistent savings will be achieved.

To capitalize on these opportunities, it is important that the standards, verification and administrative requirements of newer energy funding programs be as complementary as possible with traditional sources of financing to help trigger more building upgrade activities rather than creating barriers to participation.

Split Incentives

The multifamily sector provides a textbook case of the economic barrier often referred to as "split incentives." When occupants pay their own energy and water bills, a multifamily building's developer/owner has little incentive to invest in upgrades such as more efficient water heaters, higher levels of insulation or more efficient lighting. This obstacle to energy improvements is particularly acute in the affordable rental housing sector. In the cases where occupants pay their own utilities, tenants would greatly benefit from efficiency upgrades but may not have the authority (as non-owner occupants) or financial resources to carry them out.

As illustrated in Figure 6, among multifamily households, approximately 88 percent are renters. Household income in renter households is roughly half the income of households where the occupants own their home. Renters "pay a higher share of their monthly income for utilities, and yet they are less able to affect the efficiency of their homes," according to the Energy Foundation/Benningfield Group report. Among low-income renters, the need for energy efficiency is particularly evident: nearly 20 percent of their monthly income goes to energy bills, compared to roughly 4 percent for the average household. For the more than 790,000 California households at or below 50 percent of the federal poverty level,[14] an average of 38 percent of their monthly income goes to paying utility bills.[15]

[14] U.S. Census Bureau.
[15] U.S. Energy Information Administration, 2005.

Although there is a great need to address energy efficiency in the multifamily sector, the split incentive issue creates a barrier to progress. Appliances such as refrigerators and clothes washers and dryers, for example, are often owned by the building developer/owner, who has little economic incentive to upgrade them to more efficient models. This is particularly true in markets where vacancy rates are low and the owner doesn't have to compete for tenants. Even when renters own their appliances, they may not be able to afford to replace them since renter-household incomes are typically about half that of owner-household incomes (Figure 6).

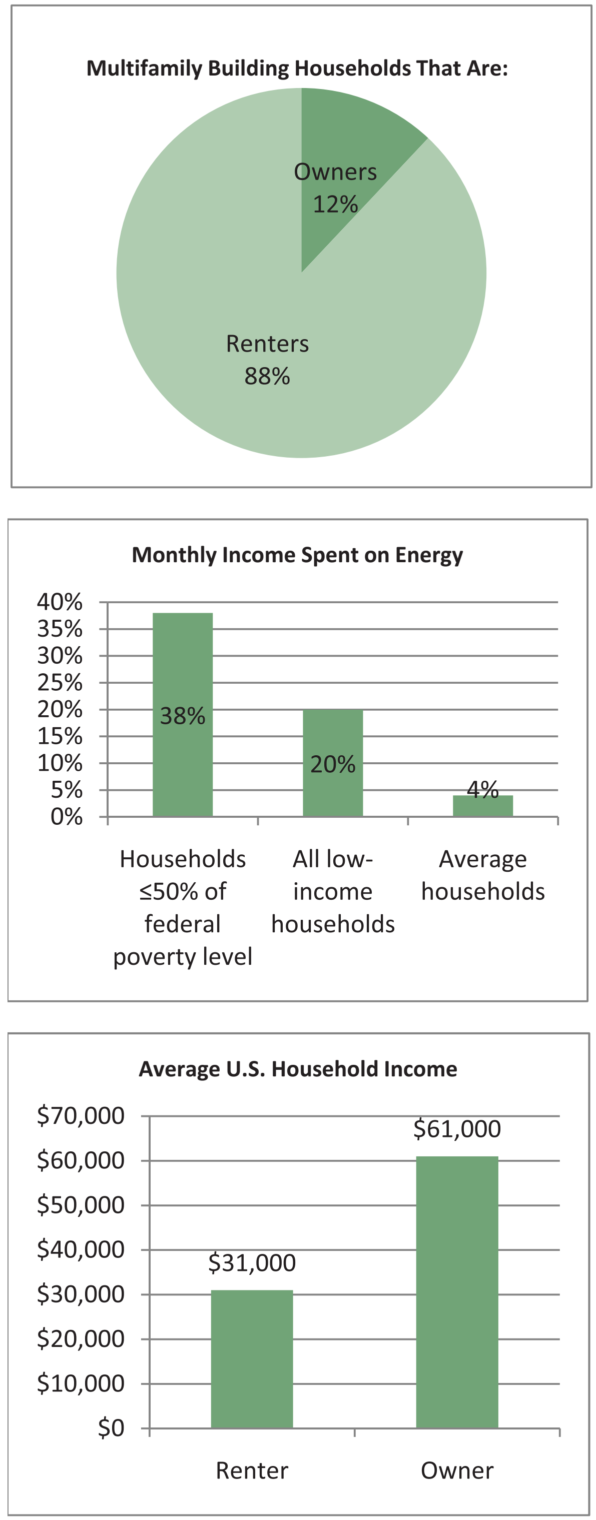
The predominance of central systems, particularly central water heating systems, in multifamily buildings often skews the split incentive: the developer might pay for central utility bills and therefore only be interested in upgrading the systems for which they will see a financial payback. This tends to make central system upgrades the "easiest sell" in a multifamily building upgrade. However, the opportunity associated with central systems is often offset by lack of a price signal to tenants, which in turn limits behavior-based conservation.

It is critical that building upgrade programs involve residents, managers and landlords alike to take into account these energy-use differences in the multifamily sector, as well as the "disincentives" caused by split incentives. The more that residents are educated and engaged in the upgrade process, the more reductions in energy use will occur.

Trigger Events

There are many discrete economic, financial and even regulatory events that may prompt a developer/ owner to upgrade a multifamily building. However, in general, there are a few specific points in a multifamily building's lifecycle when it is typically more cost effective, convenient and efficient to make green and energy improvements. To maximize effectiveness, building energy upgrade tools,

Figure 6. U.S. Household Demographics



Sources: Energy Foundation, "U.S. Multifamily Energy Efficiency Potential by 2020," October 19, 2009, prepared by The Benningfield Group, Inc.; U.S. Energy Information Administration, 2005; U.S. Census Bureau.

resources and incentives need to be aligned with these "trigger events" so that developer/owners are motivated to incorporate energy efficiency and other green improvements into their overall upgrade plans.

Figure 7 lists the most common trigger events; all of these are excellent entry points for energy and green upgrade programs. The scope varies greatly depending on factors such as the age of the building, its condition, the type of occupancy, the history of previous improvements, and whether the building is an affordable or market rate property.

Figure 7. Events That Trigger Energy and Green Upgrades

Trigger Event	Scope of Upgrade
Tune-up/ Spruce-up	Ongoing maintenance of mechanical equipment or lower cost, easier-to-implement measures that spruce up a property at time of sale or purchase such as servicing mechanical equipment, repainting common areas, or making landscape and irrigation improvements.
Replacement	Replacement of specific central or individual equipment that is broken or aging, including water heaters, boilers, furnaces, air conditioners, appliances, lighting and irrigation systems.
Unit turnover	Unit-specific improvements made when occupants vacate. Upon vacancy, it is common practice to paint units, replace carpets, address moisture intrusion and other minor repairs, replace appliances, and make accessibility improvements.
Retrofit	Usually more limited in scope than a whole-building rehab, retrofits typically consist of a package of coordinated improvements designed to achieve a specific goal, such as seismic safety or energy efficiency.
Rehab	Building-wide overhaul may include remodeling common areas, upgrading structural elements, installing new electrical, plumbing and mechanical equipment, and more.

Current programs tend to recognize and capture savings from only one of these entry points—typically either replacement or full rehab. Because programs don't focus on the full spectrum of entry points, owners will typically either carry out limited energy improvements that don't optimize whole-building performance, or they postpone energy upgrades until they are ready for a full-building rehab, which may entail years of raising funds.

Energy upgrade programs that recognize these entry points and tailor their outreach and services to these opportunities will increase their likelihood of success.

Cost-Effective Energy Savings Measures

The approach to selecting energy savings measures is different for multifamily than other building types. Although there are opportunities (depending on the climate zone) to save space-conditioning energy, the shared wall geometry of dwelling units and reduced external surface area in multifamily buildings means that less heating and cooling energy is lost to the exterior. Therefore in multifamily buildings, less of the savings will come from building envelope and heating, ventilation and air conditioning (HVAC) measures, and more will come from water heating efficiency gains and appliances. The predominance of water heating as the primary energy use is exaggerated in coastal areas where there is little need for heating and cooling.

The single largest and most consistent opportunity in multifamily housing is reducing the energy consumed to heat domestic water.

The single largest and most consistent opportunity in multifamily housing is reducing the energy consumed to heat domestic water, particularly when central systems are present. It is common for multifamily buildings to have central water heaters, typically gas appliances with a large distribution system and recirculation loop. Increasing the AFUE[16] of the water heater, combining the water heater with solar pre-heat systems, and implementing distribution system strategies such as extra insulation, recirculation controls and high-efficiency recirculation pumps, represent significant opportunities for cost-effective savings. These savings are weighed against the limitations in hot water sub-metering of central systems.

There are many other ways in which multifamily savings opportunities diverge from single-family opportunities. For example:

- Common area and garage lighting in multifamily properties can use significant amounts of energy.
- There are operational efficiencies associated with ongoing equipment commissioning and professional energy management in multifamily properties.
- Multifamily properties may have fairly extensive irrigation and lighting of the exterior landscape and site.
- Compared to single-family homes, taller residential buildings have a smaller roof area relative to the overall building envelope area. As a result, measures such as attic insulation and radiant barriers will have less impact.
- Multifamily buildings often have limited roof or site area for installation of photovoltaic arrays.
- Air infiltration to the exterior of a multifamily building is of equal importance to heat and air transfer between dwelling units, and between dwelling units and common areas.
- Multifamily properties often have common ventilation systems utilized to exhaust kitchens, bathrooms and laundry rooms. These can contribute substantially to energy use.

[16] Annual fuel utilization efficiency (AFUE) is a measure of the thermal efficiency of combustion appliances such as gas-fired boilers, water heaters and furnaces. Various other efficiency ratings apply to specific water heating equipment, such as Energy Factor for small tank-type electric water heaters, and Thermal Efficiency or Recovery Efficiency for large water heating equipment.

- Cooking and refrigeration comprise a larger portion of the energy budget in multifamily homes. Appliances in single-family homes are almost always owned by the occupant, whereas in multifamily, appliance ownership is less common.
- Almost all single-family homes have a washer and dryer, while apartment buildings often have central laundry facilities or no on-premises laundry at all.

Each of these differences will impact energy efficiency decisions and need to be taken into account when designing building upgrade programs and incentives and conducting outreach to multifamily property owners.

MF HERCC RECOMMENDATIONS FOR PROGRAM DESIGN AND IMPLEMENTATION

Since the beginning of 2010, the MF HERCC has focused on coordinating development of standards, professional qualifications, verification procedures, and energy savings quantification and tracking tools for the multifamily building upgrade sector. This report presents the subcommittee's recommendations and analysis in six specific areas:

1. Program delivery
2. Professional qualification and training
3. Whole-building performance approach
4. Energy analysis software
5. Performance measurement, tracking and benchmarking
6. Low-income and energy efficiency program access and coordination

1. Program Delivery

Recommendation

a. ***Use raters/verifiers and energy consultants to delivery multifamily incentive program services.***
b. ***Give developer/owners the flexibility to hire and manage the construction and verification team.***
c. ***Design individual measure-based and whole-building performance-based programs to be complementary and parallel offerings.***
    - **Utilize a rater/verifier and energy consultant delivery model for whole-building performance programs and continue to utilize a contractor delivery model for individual measure programs.**
    - **Take into account the conditions under which a contractor-delivery approach may be appropriate for whole-building performance programs.**
d. ***Provide a single point of customer interface for multifamily property owners to streamline their participation.***

Background and Analysis

Incentive programs that deliver energy and green upgrade services for single-family homes, as well as individual measure-based programs for multifamily buildings, typically rely on pre-approved contractors. These contractors serve as the conduit for participating in the program and provide services such as diagnostics, verification and documentation. This contractor-list delivery approach, however, is unlikely to be successful for California's diverse and professionalized multifamily and affordable housing sector, for the reasons described below. Instead, the MF HERCC recommends a rater delivery model.

A significant problem with using a contractor-delivery model for whole-building performance programs is that the developer will be limited to using only program-approved contractors; if the developer's other sources of construction funding are much larger than the energy efficiency rebates, the developer may have a strong motivation to not participate in the performance program. Often times the level of rehab work being done in conjunction with the energy efficiency work necessitates using an experienced general contractor. Having to layer/stage the use of two contractors on one project is onerous, inefficient, and can cause on-site problems.

a. Rater Delivery Model

- **HERS has an established network of professional raters.** Using raters/verifiers and energy consultants to delivery multifamily incentive program services aligns with the HERS program model, which uses raters and energy consultants to prepare compliance documentation, conduct audits and diagnostics, and verify project installation. For new construction, the robust statewide HERS system has succeeded in building a large workforce of professional raters with expertise in building energy standards, auditing, energy analysis and diagnostic testing proficiency for both single-family homes and multifamily low-rise buildings. Given this well-established HERS network and protocols, it is practical and logical to continue to refine the HERS program to apply to multifamily retrofits and rehabs.
- **Existing multifamily programs already use successful rater/energy consultant models.** Performance-based incentive programs[17] for multifamily building upgrades already successfully utilize a program delivery model in which an energy consultant or rater, not a contractor, is the primary conduit for accessing program services.
- **Multifamily owners need to integrate incentives with multiple funding sources.** Since the developer/owner makes the purchasing decisions and is responsible for completing the project, it is important that the incentives and services go directly to the developer/owner so they can integrate them with the overall project financing.

b. Hiring Flexibility

- **Multifamily owners will resist being limited to program-approved contractors.** Given the market factors discussed in this report's Introduction, it is important that multifamily developer/owners not be limited to using contractors approved by the incentive program. Developer/owners tend to have relationships with general contractors and trade contractors they trust, which is very different from single-family homeowners who don’t typically have a suite of construction professionals under contract to them. Structuring incentive programs to deliver verification services via an energy consultant/rater/verifier team rather than a contractor gives multifamily developer/owners the flexibility and control to include energy and green building experts among the multitude of professionals they will hire in the overall design and development process.

To streamline program delivery across regions and project types, the MF HERCC has already developed whole-building audit protocols for multifamily building upgrade programs in California. These baseline

[17] Multifamily performance-based programs for new construction include the following: ENERGY STAR for Homes Multifamily (EPA/statewide IOUs), the California Advanced Homes Partnership (Sempra and SCE), California Multi-Family New Homes (PG&E), and Green Building programs such as LEED for Homes (national), GreenPoint Rated (statewide) and Green Communities (national). Multifamily performance-based programs for existing buildings include the following: the GreenPoint Rated Existing Home Multifamily Pilot Program and the affordable specific Green Communities (national) and the discontinued program, Designed for Comfort (statewide IOUs).

protocols are designed to be tailored to the needs of individual programs. Provided in the form of a template, the protocols describe best practices for conducting whole-house energy, water and green building audits of multifamily buildings. The document includes sample language that programs can use to create their own customized Audit Specifications or Audit Protocol document.

c. Complementary Individual Measure and Whole Building Programs

- **Design Individual measure-based and whole-building performance-based incentive programs to be complementary and parallel offerings.**
- **Utilize a rater/verifier and energy consultant delivery model for whole-building performance-based programs and continue to utilize a contractor delivery model for individual measure programs.**

The MF HERCC recommends offering parallel program pathways with two delivery models:

- Individual measures with predetermined contractors, or
- Whole-building performance model with cash incentive issued to the owner/developer and flexibility in hiring contractors.

Individual measure programs (and single-family upgrade programs) have developed an established network of professional who are experienced in their specific trade (such as lighting contractor, home performance contractor, and so on) and are effective at both marketing program availability to potential clients and installing the specific set of measures. This infrastructure should be maintained and utilized for the delivery of individual measure programs. Because of the factors described throughout this report this contractor delivery approach is less viable on a whole-building multifamily upgrade project.

The following table outlines the scenarios when an individual measure vs. a whole-building performance approach would likely apply.

Table 1. Trigger Events and Likely Upgrade Approach

Trigger Event	Likely Path
Tune-up / Spruce-up	Individual measures.
Replacement	Individual measures, as appropriate depending on which equipment is replaced.
Unit Turnover	Individual measures within units, or whole building if replacements are planned as part of comprehensive upgrade strategy and are applied consistently across enough units.
Retrofit	Individual measures or whole building, depending on scope of retrofit and how many systems/structural aspects are addressed.
Rehab	Whole building.

If multifamily projects have the option of pursuing individual measure incentives or whole-building incentives, the following principles should be observed in designing multifamily programs to be complementary:

- Make whole-building performance-based incentive amounts large enough to be more attractive than adding up individual measure incentives.
- Where low-income individual measure-based incentives pay for the full cost of the measure, integrate those incentive funding sources with the performance-based approach.[18]

- **Take into account the conditions under which a hybrid contractor-delivery approach ("construction management delivery model") may be appropriate for whole-building performance programs.**

In California, factors such as the lack of comprehensive funding from a single source to drive deep energy improvements and the variability in cost-effective measure approaches across program criteria, building types and climate zones favor the consultant approach to performance-based programs. A contractor-delivery approach seems best suited to the individual measures programs. There are exceptions to this general recommendation. A hybrid of a contractor delivery model and rater/consultant delivery model (a "construction management delivery model") might be appropriate for the performance approach in multifamily markets where the following conditions exist:

- The market consists of a limited geographic region with little variation in building types or climate conditions (e.g., similar measures tend to be cost-effective across all building types even using the performance approach);
- The program administrator has sufficient resources to train and provide quality assurance to various specialized multifamily sub-trade contractors involved in various aspects of a whole-building upgrade;
- Some entity involved in the process (such as a contractor or program administrator representative) is trained to provide necessary energy software analysis and building auditing, evaluation and verification for whole building performance approach; and/or
- A high level of integration exists among utilities, weatherization, local government and other funding programs to enable a turn-key program delivery. Under these circumstances, using the same set of professionals may allow for efficiency of quality assurance and leveraging of resources towards the cost of audits. This condition exists in

[18] A number of questions remain to be resolved. For example, if whole building and individual measure programs are allowed to be combined on a project, how would the direct-install contractors vs. whole-building owner-selected general contractors be coordinated? Would a whole-building contractor be allowed to perform all the work, and would the building owner be issued the incentives for both individual measure and performance programs?

certain markets, such as those addressed by NYSERDA's multifamily program, but it is not typical of California.

In addition to grappling with the layering of funding issue, whole-building performance programs that are considering a contractor-delivery model will need to resolve the following issues:

- Which contractors would need certification among the various sub-trades involved in multifamily projects?
- Which certifications would apply?
- Who would perform the audit, energy analysis and verification?
- What percentage of the job cost is being covered by the program rebate?
- Can the entire upgrade be completed without leveraging other sources of construction funding? If not, are developers subject to different contractor requirements from other construction funding sources?
- Can the program justify limiting the developers to using only program-approved contractors?
- Do program administrators have resources to provide quality assurance on construction management throughout the project?[19]

For the reasons listed above, nascent multifamily performance-based programs should rely on the existing HERS infrastructure to deliver performance-based verification for work done by owner-selected contractors, while at the same time moving towards a "construction management delivery model" by providing training and capacity for specialty contractors as the California multifamily retrofit and rehab market develops more capacity and consistency.

d. Single Point of Contact

Multifamily building owners and managers find it daunting to sort through the various programs, funding and incentive options, and program requirements. To reduce obstacles to participation, the MF HERCC recommends streamlining multifamily program offerings by providing building owners/managers with a single point of contact.

This point of contact could be provided by one of or a combination of the following: utility, local government, third-party consultant, certification entity (such as U.S. Green Building Council, Build It Green, CalCERTS), or an online interface.

Whether the online navigation tool currently under development serves this function, or whether another tool or entity is used, having a single point of contact will help alleviate the difficulty and confusion of navigating the various programs by:

[19] In NYSERDA's program, the "partner" (the consultant team) would be the point of contact to the owner, would perform the audit and produce the report, would be responsible to sign off at each stage of the construction including: design, bid documents, approval of winning contractor(s) documents, and an interim and final site inspection of construction. This is a large role but it makes the consultant the project manager and responsible for ensuring that predicted performance is realized through quality construction.

- Directing developers/owners to appropriate program(s) based on eligibility criteria and their likely approach to upgrading the building or buildings (e.g., individual measure vs. whole-building approach); and
- Directing participating developers/owners to a list of qualified contractors.

Stakeholders have also suggested that it might be helpful if this tool could eventually provide customized offerings and incentive calculations to projects if more than one program applies, and submit application materials to those programs on behalf of the property owner. Such an interface would reduce the burden and barrier to program entry for the owner.

In addition to connecting building owners and managers to appropriate programs and professionals, more robust single point of contact customer services may include customized technical assistance. The technical assistance provides preliminary guidance on determining the scope of the upgrade, and can be paired with the program and funding navigation services to ensure that the developer/owner is pursuing appropriate and feasible upgrades. Including technical assistance in the single point of contact will enable program participation and better decisions earlier in the design phase, however it can also add to program administrative costs and in order to “scale-up” services, initial program navigation would be more effective through a self service online web portal.

2. Professional Qualification and Training

Recommendations

a. ***Focus on qualifications of rater/verifier and add specialized expertise to audit team based on scope of upgrade.***
b. ***Develop targeted training curricula and require completion of training by participating raters/verifiers, building operators, central systems contractors and users of energy analysis software.***
c. ***Consolidate required qualifications and training for participating building professionals. Build the capacity for partners who deliver individual measures to become whole-building raters/verifiers or to install individual measures as part of a whole-building program.***

Background and Analysis

a. Verification Team Qualifications

In the recommended rater-based program delivery model, the rater/verifier (may also be the energy consultant) will be required to have minimum qualifications as specified in Table 2. To meet the qualification requirements for specific tasks, the rater can assemble multidisciplinary teams consisting of internal employees or contracted partners with complementary skill sets. Raters will be responsible for ensuring that their personnel and any contractors assigned to perform services have the necessary qualifications, licensing, bonding, insurance, competence, skill sets and experience required to fulfill their respective responsibilities. In this capacity, program administrators, QA providers and Raters share the construction management responsibilities.

Table 2. Required Minimum Qualifications for Audit/Verification Team

	Task	Minimum Qualification
Required for all multifamily projects	Energy Modeling and Utility Data Analysis	▪ California Home Energy Analyst ▪ California Association of Building Energy Consultants (CABEC) Certified Energy Plans Examiner (CEPE)
	Whole Building Energy Audit, Recommendations and Third-Party Verification	▪ HERS II Rater (CA Whole-House Home Energy Rater) ▪ CA Existing Building Multifamily Upgrade Training
Required depending on scope	HVAC system efficiency and balancing (including duct testing)	California Field Verification and Diagnostic Testing Rater
	▪ Central domestic water heating and distribution system efficiency ▪ Commissioning and retrocommissioning	▪ C-36 plumbing or C-4 boiler contractor license ▪ Multifamily Green Contractor Training
	▪ Water, IAQ and resources measures ▪ Whole-building retrofits over time o EnergyPro MF Module: Improvement over baseline o Dwelling unit turn-over ▪ High-rise multifamily proxy to HERS II ▪ Central systems operational efficiency (BPI)	GreenPoint Rated Existing Home Multifamily Rater
	Combustion appliance safety	BPI Analyst
	Feasibility of renewable energy installation	CSI Approved Contractor (C-46 Solar Contractor license)
	Energy audit and recommendations for non-residential spaces > 20% floor area	ASHRAE II Auditor
	Operations and maintenance	BPI Multifamily Building Operator or NAHMA Green Building Operator

b. Training

The recommended training consists of curricula targeted at four types of professionals who work on multifamily buildings: rater/verifiers, building operators, central water heating system contractors, and energy analysts. Each of these courses focuses on making sure that key professionals working on multifamily building upgrades have the knowledge and expertise to make effective decisions about building improvements, program participation and ongoing operational savings.

Rater/Verifier Training

To help ensure that multifamily upgrade programs are robust and lead to energy savings that persist over time, California needs third-party raters/verifiers who:

- Are well-versed in program and incentive requirements
- Have expertise in evaluating multifamily buildings and developing appropriate scopes of work for energy and green improvements
- Are skilled in verifying the quality of the completed work, including conducting post-installation verification tests

Training currently offered in conjunction with the California Whole-House Home Energy Rating System (HERS II) program addresses some of these areas. To build a market of raters/verifiers specially qualified to evaluate multifamily building upgrades, the MF HERCC has supported the development of a new training curriculum. This curriculum builds on the current HERS II curriculum and supplements it by training participants to rate multifamily buildings in various upgrade scenarios from replacements to unit turnovers, retrofits and comprehensive rehabs. Topics include:

- Central system (retro)commissioning
- Central domestic hot water (CDHW) controls
- Common area improvements (such as central system replacements)
- Tenant space improvements at unit turn-over
- High-rise multifamily protocols
- BPI operational efficiency and combustion safety protocols
- Water conservation
- Materials resource efficiency in rehabs
- Indoor air quality

The curriculum is intended to equip the multifamily rater with the broad range of skills necessary to act as the verification agent for various programs that provide incentives and financing to multifamily projects. To streamline delivery of the many upgrade programs available to multifamily building owners, the rater/verifier training should be coordinated with other available green upgrade programs. These include programs such as CPUC ratepayer-funded programs, the U.S. Department of Housing and Urban Development's Green Retrofit Program (GRP), the DOE Weatherization Assistance Program (WAP), Enterprise Green Communities, GreenPoint Rated Existing Home Multifamily, CA Low Income Housing Tax Credit program (LIHTC) and mandatory existing building upgrade policies referred to as Residential Energy Conservation Ordinances (RECO) and Commercial Energy Conservation Ordinances (CECO).

Property Management Staff and Building Operator Training

Because multifamily buildings have professional management and operations staff, training them in green operations and management will likely result in some persistence of conservation-based savings. For this training, the MF HERCC recommends building upon the Building Performance Institute (BPI) existing Multifamily Building Operator training.[20] The training includes technical content on:

- Energy-efficient building systems operations
- Concepts that would be included in any retrofit project's customized green building maintenance manuals
- Green product specifications
- Access to bulk procurement of ENERGY STAR equipment and green materials to bring down the cost premiums

[20] Longer term training plans should investigate coordination with other related training programs, such as Building Operator Certification (BOC) and National Affordable Housing Management Association (NAHMA) training programs.

- Materials they can use to educate residents about the building's green features and access to resident-oriented upgrade rebates (such as for compact fluorescent light bulbs, faucet aerators and appliance upgrades)
- Available incentive programs, particularly those applicable to trigger events such as unit turnover or equipment replacement (for example, IOU prescriptive rebate programs for refrigerators or other appliances or technologies owned by the resident)

As touched upon in the last bullet point above, part of the Property Management Staff/Building Operator Training participants should receive content regarding educating their residents on opportunities for energy saving upgrades in units and conservation behavior. Tenants need the information and tools to make smart decisions about energy use and promote healthy behaviors in their home. A home environmental education component can increase behavior based conservation, improve the lives of low income tenants and enhance the relationship between property owners, tenants and the community. Much of this consumer outreach and education is already taking place through Energy Upgrade California, but specific outreach to multifamily building residents should be considered.

Multifamily Central Water Heating Systems and Combustion Safety Training
Because of the sheer number of specialized subcontractors on any given comprehensive multifamily rehab project, it does not make sense to require a single contractor certification for all contractors and sub-trades. Rather, it will be more effective to target very specific professional training at the sub-trade that has the greatest potential for delivering efficiency improvements: contractors who work on water heating systems in multifamily buildings. As discussed earlier, in multifamily buildings, water heating systems account for a much higher portion of energy consumption compared to single-family buildings.

These contractors, who have C-4 boiler contractor or a C-36 plumbing contractor license, maintain and install centralized residential and commercial-sector energy-consuming equipment for water heating and space heating and cooling. Specialized training will give these contractors the expertise needed to optimize the specifications and operations of these systems.

This training would focus less on the verification methods and more on the efficiency gains to be made to conventional construction and operation practices. This training also includes combustion safety measures, and could incorporate retro-commissioning.

Energy Analysis Software Training
To help ensure that energy consultants have the capability to properly analyze multifamily buildings, a specialized curriculum should be developed that includes advanced training in multifamily-specific topics not included in the core HERS II trainings, energy analysis training or in the training required to become a Certified Energy Plans Examiner (CEPE) or Certified Energy Analyst (CEA). This advanced Multifamily Energy Consultant Curriculum would include instruction in the use of the California Utility Allowance Calculator, Energy Pro's GreenPoint Rated and high-rise Multifamily HERS II Modules, and supplemental operational energy auditing software (Treat and EA-QUIP).

c. Consolidated Qualifications

The minimum professional qualifications and associated training required for various programs statewide should be consolidated to maximize the programs' ability to share trained workforces, and to limit the number of trainings and certifications required of participating building professionals.

Stakeholders have noted that for whole-building performance-based programs, a review of LIEE/Weatherization and MFEER assessment/audit protocols and a comparison with HERs II plans would be helpful. Ideally, the protocols would be aligned so that data collected in first two programs could be applied to HERS II. The California Multifamily Existing Building Rater Training, which was first offered in Fall 2010 in conjunction with the California Whole-House Home Energy Rating System (HERS II) program, has already addressed this alignment of protocols.

To streamline program delivery across regions and project types, the MF HERCC has already developed whole-building audit protocols for multifamily building upgrade programs in California. These baseline protocols are designed to be tailored to the needs of individual programs. Provided in the form of a template, the protocols describe best practices for conducting whole-house energy, water and green building audits of multifamily buildings. The document includes sample language that programs can use to create their own customized Audit Specifications or Audit Protocol document.[21]

California's various individual measure programs (MFEER, LIEE, WAP) all have separate networks of contractor delivery partners, with non-standardized minimum professional qualifications. It is important to explore ways these different networks can be integrated, while continuing to sustain the community-based organizations that are currently delivering the individual measures.

3. Whole-Building Performance Approach

The MF HERCC recommendations primarily pertain to multifamily whole-building performance-based programs, such as those emerging as part of Energy Upgrade California (EUC). As discussed below, the MF HERCC recommends that the industry not attempt to develop packages of prescriptive measures for a whole-building approach due to the complexity of multifamily building types. It is important to note, however, that individual measure incentives should continue to be offered to multifamily properties that are not able or ready to take a comprehensive whole-building performance-based approach.

[21] To download the Audit Protocol document, go to the Technical Resources page of www.multifamilygreen.org and follow the link to HERCC information.

Recommendations

a. ***Offer whole-building programs utilizing a performance approach for multifamily energy efficiency improvements, rather than a prescriptive approach to whole building improvements. This performance approach should be based on Title 24 and HERS II protocols for multifamily residential buildings that consider the energy end-uses of heating, cooling, water heating (including solar pre-heat), appliances and lighting.***
b. ***Require a minimum of 10 percent energy efficiency performance improvement for all projects, with additional improvement targets for projects to reach 15 percent improvement and 20 percent improvement.***
c. ***Ensure that program total resource cost is minimized by eliminating administrative inefficiencies and optimizing leveraging among programs.***
d. ***Provide utility-funded incentives for the whole-building performance approach to stimulate demand for comprehensive energy upgrades.***

Background and Analysis

a. Performance Approach Based on Title 24 and HERS II Protocols

For multifamily whole-building programs, the MF HERCC recommends a performance approach to energy savings analysis and the selection and funding of upgrades. This recommendation means that emerging whole-building programs should offer a performance-based approach but multifamily building developer/owners and tenants should still have access to prescriptive incentives for change-out of individual pieces of equipment.

Single-family upgrade programs have traditionally taken a prescriptive approach, allowing for specific, clearly defined packages of improvements to be made to participating buildings as an option in parallel to the whole-building performance approach. This prescriptive path is seen as a “ramp-up” for increasing workforce capacity. After extensive analysis, the MF HERCC has concluded that a whole-building prescriptive approach is not feasible as a primary tactic for the multifamily sector. Because of the diversity of building types, system types and other factors discussed earlier that distinguish multifamily buildings from the single-family residential sector, a comprehensive statewide prescriptive approach to multifamily whole-building upgrades would require 16 or more distinct packages of measures.[22] This would likely create a huge administrative burden, confuse the market and drive up program costs.

A performance approach to whole-building improvements is well-suited to the multifamily sector, which is more professionalized than the single-family residential sector. Multifamily developer/owners are

[22] Sixteen packages would cover the variables of inland vs. coastal (cooling or no cooling) strategies, central vs. individual mechanical systems, and high-rise vs. low-rise building types. This number of packages would not take into account building-specific variables, ownership types or nuances among the 16 climate zones. If a prescriptive whole-building package per climate zone were developed, it would require four packages per climate zone, resulting in 64 packages statewide.

likely to have the motivation and resources to undertake a more sophisticated analysis to target the best investment of available funds to serve the unique energy savings needs of their project.

The MF HERCC further recommends that the performance approach be based on Title 24 and HERS II protocols for residential buildings. These protocols consider the energy end-uses of heating, cooling, water heating, appliances and lighting. The protocols also include renewable energy such as solar photovoltaics and solar domestic hot water (although solar hot water is already part of the Title 24 performance calculation, photovoltaics is not). The HERS II methodology for multifamily buildings is being piloted by the GreenPoint Rated Existing Home Multifamily[23] program, building on the protocols of the performance-based Designed for Comfort program.

b. Performance Improvement Targets by Building Vintage

Many statewide policy objectives cite the California Public Utility Commission's (CPUC) strategic plan, which has set a goal of reducing energy consumption in existing homes by 20 percent by 2015 and 40 percent by 2020. In accordance with these policy objectives, a 20 percent performance improvement might at first glance seem to be the initial target to require of project upgrades. A subset of the MF HERCC members[24] analyzed what it would mean to achieve a range of performance-based energy improvement targets for various multifamily building types. This analysis suggests another approach: while a 20 percent minimum savings target would exclude upgrades to be undertaken in newer buildings, a 15 percent or 10 percent improvement might be feasible for newer buildings that are already reasonably efficient. This analysis establishes feasible minimum energy savings targets for buildings based on the year they were built. This feasibility analysis is described below.

The consultant team developed baseline models of three prototype multifamily buildings: a 4-unit low-rise, a 40-unit low-rise, and an 80-unit high-rise. These were then modeled in Title 24 code compliance/HERS II software to demonstrate measures necessary to achieve 20 percent and 40 percent energy performance improvements. The modeling was done for each of the 16 California climate zones with both central and individual domestic hot water systems and with both gas and electric heating systems. From this analysis it was determined that:

- 10 percent energy improvement was feasible across the board for all building types, system types, vintages and climate zones.
- 20 percent improvement required upgrades to both windows and wall insulation in many climate zones.

[23] The Energy Foundation and StopWaste.Org are jointly funding the development of a third-party rating system for multifamily retrofits as an extension of Build It Green's GreenPoint Rated program. As of March 2011, approximately 500 pilot multifamily dwelling units have been designed and/or constructed to meet GreenPoint Rated Existing Multifamily pilot program criteria including required energy reduction targets according to HERS II methodology.

[24] StopWaste.Org (project lead), Douglas Beaman & Associates (lead HERS II analysis), Heschong Mahone Group, Inc. (prototype development based upon Designed for Comfort projects), Nehemiah Stone (central water heating tune-up measures), Energy Soft (code compliance software baselines and improvements), California Energy Commission (HERS II direction), and various third-party HERS and GreenPoint Raters (pilot project energy measures verification, Title 24 documentation created and submitted to Doug Beaman for HERS II conversion).

- Older buildings and buildings with deferred maintenance will have many measure upgrade options for achieving a minimum 20 percent energy improvement target and are therefore the most likely program participants. However, programs should not be structured to exclude the portion of the building stock that has already undertaken some improvements and therefore might not achieve a 20 percent improvement in the current program enrollment.
- 40 percent improvement is often not possible to achieve in coastal climate zones without the use of solar pre-heat for domestic water heating.

For each of the prototype buildings analyzed, the following minimum targets for performance improvement were determined to be feasible (see Table 3). The MF HERCC recommends using these as baseline assumptions when designing multifamily energy upgrade programs.

Table 3. Feasible Performance Improvement Targets

Building Vintage	Minimum % improvement	Baseline
Pre-1980 (pre-Title 24)	20%	CEC default (statewide average data)
1980–2000	15%	CEC default (statewide average data)
2001–2008	10%	Code compliance (detailed energy performance data by climate zone)

California's Building Energy Efficiency Standards (Title 24) were established in 1978, so it is reasonable to assume that by 1980 they had taken effect and were being enforced. Buildings built before the code took effect represent the greatest opportunity for percent improvement over baseline. In this case, the baseline used for modeling improvement is based on average statewide data provided by the California Energy Commission (CEC).

In 2001, Title 24's energy efficiency requirements became much more stringent than they had been. As a result, buildings constructed from 2001 to 2008 will have fewer opportunities for improving energy performance, hence the lower recommended target of 10 percent. Buildings built in the two decades between 1980 and 2000 were not required to be as energy efficient as more recent buildings, and thus are targeted for a 15 percent level of improvement.

Cost/Benefit Analysis of Performance Improvement Targets

What will it cost multifamily developer/owners to achieve these levels of performance improvement? To answer that question, the team analyzed a variety of scenarios, looking at the costs of various energy-saving measures in different building types and climate zones.

The Appendix includes tables showing the results of some of these scenarios. These tables serve to illustrate typical measures that might be used to achieve the performance targets for different types of buildings in different climate zones with different water heating systems. These tables are merely examples and should not be construed as recommendations for specific packages of measures.

What follows is a summary of these illustrative examples; refer to the Appendix for details. (Note that these costs are construction-related expenses only and do not include any administrative costs, energy analyst costs, or other ancillary costs and they do not take into account variables in wage assumptions such as Davis Bacon Requirements).

- **For a 40-unit low-rise building built before 1980,** achieving a 20 percent performance improvement might include improving the attic and wall insulation, replacing windows and sealing ducts. The estimated cost would be $2,861 per dwelling unit, with a straight line payback ranging from 5.2 years to 14.3 years, depending on the climate zone.
- **For the same prototype building built between 1980 and 2000,** achieving a 15 percent performance improvement might include improving attic insulation, sealing and insulating ducts, verifying refrigerant charge, and replacing air conditioners and water heaters. The cost per dwelling unit is estimated at $3,117, with a payback ranging from 6.6 years to 9.9 years, depending on climate zone.
- **For the same prototype building built between 2001 and 2008,** achieving a 10 percent performance improvement might include improving attic insulation, verifying refrigerant charge, sealing and insulating ducts, and replacing water heaters for an estimated cost of $1,970 per dwelling unit and a payback ranging from 9.5 to 19.1 years.

As discussed below, stimulating demand for these improvements will require appropriately structured incentive programs.

c. Ensuring Administrative Efficiencies

Cost-effectiveness evaluations typically limit their analysis to the hard cost of the upgrade versus the amount of energy saved by that upgrade. The CPUC Total Resource Cost (TRC) of a program includes a cost-effectiveness analysis, as well as other program administration and measure life considerations. While this metric is useful to gage effective use of public funds, there are many other cost-related considerations that are not part of a TRC calculation which determine program success. Stakeholders have expressed concern about using TRC/cost effectiveness as the exclusive standard by which these efforts are based. Particularly for programs serving low income households, there may be other bases for justifying a program beyond the typical Utility program/CPUC's Total Resource Cost methodology. Below are some examples of perspectives that program administrators may wish to consider, even though they may not be integrated into the formal cost-effectiveness analysis.

- **Developer/owner perspective:** While some building owners are interested to obtain rebates for individual measures, discussions at the Multifamily Weatherization Forum[25] indicated that current individual-measure programs (particularly LIEE and WAP) may not be cost effective for multifamily rental properties that are weighing their investment of time

[25] Developer Panel: Eden Housing statements by Melanie Burnett.

against the project's potential return and the constraints the project might put on other decision-making factors. These developer/owners want depth or breadth: if they are going to spend the time to participate, they want to undertake substantial upgrades to one property (depth), or individual measure upgrades across an entire portfolio (breadth).

- **Energy measure savings perspective:** Appendix A provides an illustrative cost-benefit analysis that informs these recommendations. The costs in Appendix A are based on the DEER database, which some stakeholders believe to underestimate actual costs, and may not factor in local market conditions and prevailing wage rules that are required when leveraging certain government funding.
- **Program design and implementation perspective:** The original report provides a set of recommendations to improve the cost-effectiveness of program design and implementation that reduces program delivery costs by minimizing duplication of efforts, leveraging existing infrastructure and resources, reducing barriers to participation, and streamlining program offerings and administration. The optimal mf program environment is one which fully ssleverage and integrate low-income programs, individual measure programs, whole building performance based programs with all applicable State, Federal and local programs in order to streamline and improve program delivery, and achieve maximum energy efficiency savings relative to the expenditures by ratepayers, taxpayers, and other financial investments.

c. Whole-building performance based Incentives

Current incentive programs for multifamily buildings are not typically attractive enough to motivate building developer/owners to undertake costly and complex retrofit and rehab projects. Instead, these incentive programs are structured to "piggyback" onto the owner's existing substantial retrofit/rehab budget. The incentive amount may be enough to partially offset the cost of higher efficiency equipment, for example, but is typically not enough to be the deciding factor for whether to undertake the retrofit/rehab project. As an added complication, it can take years for owners to assemble financing for complex retrofit/rehab projects that include energy upgrades; in the meantime, energy savings opportunities are lost.

Although this report does not provide recommendations for specific incentive levels, the MF HERCC does recommend offering:

- Utility-funded rebates and technical assistance based on a Title 24/ HERS II performance approach requiring a minimum of 10 percent to 20 percent energy savings depending on the vintage of building.
- Utility-funded rebates in combination with technical assistance, professional training and marketing benefits. Table 4 shows an example multifamily incentive package. This comprehensive approach to incentivizing improvements is utilized by the well-established multifamily programs offered by the New York State Research and Development Authority (NYSERDA).

Table 4. Example Package of Incentives for Multifamily Developers/Owners

Type of Incentive	Function of Incentive
Cash rebates for meeting performance targets	Offset or cover hard cost of installed upgrade measures
Added cash incentives ("kickers")	Encourage exceptional performance well beyond the program goals; encourage comprehensive third-party verified green building program certification
Rater verification rebate	Offset cost to developer of hiring rater/verifier
Energy consultant rebate	Offset cost to developer of hiring energy consultant
Technical assistance	Help owners meet program requirements and align energy compliance documentation with other funding sources
Building operator training	Provide free or discounted building operator training to improve developer/owner's ability to operate buildings efficiently
Marketing assistance	Assist developer/owner with promoting energy efficiency efforts through benefits such as labeling programs, awards, publicity opportunities and collateral material

Individual programs need to conduct their own cost-effectiveness analyses based on the program's specific parameters. They should evaluate the pros and cons and cost issues of per-unit performance-based incentives versus incentives based on actual savings or percentage savings for the whole building. While the simplicity of a per-unit approach to incentives may appeal to developers, utilities may be more comfortable with incentives designed to correlate with incremental predicted kWh & Therm savings.

The performance approach must have minimum savings goals (either percentage of TDV savings, source Btus or dollars saved, or actual kWh/kW/therms), that are reasonable and scaled to the appropriate incentive offering. Deemed savings from individual measures could not apply to the performance-based target, but ideally, some type of software could be used to save and layer installation records so that savings are appropriately accounted for.

Whole-building incentives should reflect the significance of the investment involved in a performance-based upgrade, including the expense of an audit. It should be sufficiently larger than the incentives that can be gathered by a comparable series of single-measure incentives, to provide adequate incentive to participate in the performance path.

4. Energy Analysis Software

Recommendations

a. ***Use code compliance software as the standard baseline reference for energy savings reporting in ARRA or utility funded programs.***

b. ***Use supplemental software programs where necessary to optimize analysis of energy savings opportunities.***

c. ***Apply CEC HERS II type residential multifamily low-rise protocols to high-rise multifamily in the code compliance software.***

d. ***Align funding programs' use of various software platforms for compliance to reduce administrative barriers to program participation.***

Background and Analysis

a. Code Compliance Software and HERS II

For energy code, incentive or green building program compliance in California, the performance approach to energy savings documentation most commonly utilizes Title 24 energy code compliance software. The calculation rules used with the software are defined in the Alternative Calculations Method (ACM) manual.

Code compliance software programs, which are often referred to as ACM software, are limited to measures that can be shown to have cost-effective savings in Title 24; these programs do not include any kind of operational savings that can be calculated using other energy auditing performance software. Despite this, it is preferable to use the ACM software programs as the common platform in multifamily building upgrade programs because:

- They are standardized statewide and include the various baselines, assumptions, and time dependent valuation (TDV) consistent with the energy code for new construction.
- There is a large workforce of professionals who are proficient with these programs.
- Projects are required by state law to utilize them for building permit purposes; requiring another program would be redundant and add cost to the design process.

The HERS II program has a special module built into the ACM software, as well as integrated to the HERS provider's registries. This module allows the user to:

- Compare multiple runs (several proposed improvement package options) against existing conditions (baseline) and receive a building performance score relative to Net Zero Energy.
- Create a summary report of resulting energy savings in therm, kWh and kW for baseline versus options (proposed) using California TDV methodology.
- Integrate the proposed measures with the statewide system established for measure installation verification.

The HERS II software is currently being improved to:

- Better allocate savings from residential appliances and lighting to multifamily projects (the software's original algorithms were based on single-family assumptions);
- Treat high-rise multifamily similarly to low-rise multifamily; and
- Compare building improvements not only to existing conditions but also to Title 24 (benchmark)/CEC vintage defaults. This will enable the energy analyst to account for improvements made to a building over the life of the structure.

Longer term plans to improve HERS II software for multifamily that will require a Title 24 code change and/or extensive research for adoption include:

- Modeling and savings estimates for central domestic hot water (CDHW) recirculation controls (time-clock, temperature modulation controls and demand controls).
- Modeling and savings estimates for ventilation in high-rise multifamily buildings.

b. Supplemental Energy Auditing Software

While it is ideal for California building upgrade programs to require energy analysis and reporting in standardized software programs, there are benefits to using other programs that might do a better job of analyzing operational energy improvements associated with building commissioning, maintenance, adding controls, optimizing daylight and other measures. Unlike EnergyPro, which is a software program commonly used for CA Title 24 code compliance, other software programs such as TREAT and EA-QUIP are specifically designed to handle energy auditing.

c. Software for High-rise Buildings

Currently, the HERS II compliance software addresses low-rise but not high-rise multifamily buildings. The MF HERCC recommends that the HERS II version of the compliance software be modified to apply also to high-rise multifamily buildings. This improvement in the software will allow the HERS II report to show the non-residential and residential end-use calculations embedded in the code assumptions for high-rise buildings all in one performance calculation.

d. Software Required by Funding Programs

As discussed in the Introduction to this report, to carry out complex building construction or improvement projects, multifamily developers/owners typically have to access funding from a variety of sources. Currently, many of these funding programs require developers to use different compliance software. If an owner is pursuing multiple sources of funding, it is expensive and inefficient to have to produce multiple models and compliance reports using different software for the same building.

For example, there are a number of software programs, including TREAT and EA-QUIP which do not have the CA T-24 ACM integrated, that DOE has approved for use in WAP. In California, WAP implementation entities require multifamily projects to use these DOE-approved programs. As a result, multifamily projects often have to undergo energy analysis in multiple software programs to meet the requirements of code compliance, utility incentive programs and Weatherization Assistance Program (WAP).

Coordinating the software compliance requirements of these funding sources will eliminate barriers to participating in utility, WAP and other building upgrade programs.

5. Performance Measurement, Tracking and Benchmarking

Recommendation

a. Develop technical infrastructure for consistent building performance data analysis and tracking.

Background and Analysis

a. Technical Infrastructure

In order to ensure that projects are achieving the predicted energy savings, and to inform improvements to building energy savings estimates, the MF HERCC recommends that programs require a verification of achievement of performance improvement following the completion of the project, ideally based on bill analysis which accounts for external influences on usage during the period of evaluation. This performance feedback would help to evolve performance program guidelines and goals to reflect realized savings. However, in order to actualize this recommendation, the MF HERCC recommends development of the technical infrastructure—including consistent protocols, policies and tools—for multifamily building owners and asset managers to:

- Track, analyze, and evaluate their buildings on a portfolio level,
- Track building performance and improvements over time, and
- Receive Automated Benchmarking Service (ABS) for Multifamily properties through their local utility.

Improved ability to consistently track and analyze building performance and improvements would likely result in an increase in the rate and effectiveness of energy efficiency upgrades in multifamily buildings. In addition, the ability to demonstrate meaningful, actual data and energy performance to financial institutions might result in additional availability of incentives or financing for energy upgrade projects.

Lack of access to information about energy used by a building's individual dwelling units is currently a major barrier to multifamily energy upgrades. The commercial building industry's effort to benchmark[26] energy performance needs a parallel in the multifamily sector. Improved automatic access to utility data is necessary to give property owners and program managers a means of understanding the efficacy of proposed and completed upgrades, and is necessary for program administrators to evaluate the cost-effectiveness and efficacy of their programs.

For individually metered buildings, access to aggregated anonymous data is vital for obtaining a complete picture of energy use beyond the common areas. Ideally, aggregated anonymous data would be available directly from the utilities, ensuring customer anonymity while providing completeness of the data. There are alternate methods of obtaining this information, which provide an estimate of actual data usage. One commonly used approach is to extrapolate the data based on a sample of individual units, but results in spotty data. A second approach, which would likely have high administrative costs in

[26] Commercial buildings utilize EPA's ENERGY STAR Portfolio Manager tool to receive a benchmark of energy performance for program compliance. In CA AB 1103 is motivating the utilities to provide ABS to commercial properties.

addition to spotty data, is to obtain waivers from residents allowing access their utility bills. A third approach is to access data through periodic program Impact Evaluation. The evaluation typically reviews twelve months of utility bill usage data before and after participating in the program, however this information is only available on a comprehensive level several months or years after a project has participated in a program and is not typically completed for all buildings in a program.

6. Low-Income and Energy Efficiency Program Access and Coordination

Unless otherwise stated, the recommendations in Sections 1 through 5 above pertain equally to low-income and market rate properties. Additional recommendations that are entirely specific to low-income weatherization programs are found here in Section 6.

Some of the MF HERCC and extended stakeholder discussions pertaining to the low-income weatherization programs are generalized to recommendations about individual measure vs. whole building program interrelation, and to the leveraging of programs to improve cost-effectiveness. The low-income specific individual measure programs (including LIEE and WAP) are discussed in these recommendations, in the context of suggesting they consider offering a whole-building performance approach in addition to their individual measure approach. The adoption of the whole-building approach for these programs has specific implications and barriers, especially since LIEE and WAP have a history of only serving the individual dwelling units and not the common areas due to concerns that public funding serve the low-income residents rather than a landlord.

Recommendations

a. ***Coordinate and integrate energy efficiency retrofit and weatherization programs serving the low-income sector by developing consistent program requirements, standards and audit protocols; modifying program structures to provide more flexibility for multifamily building owners; and supplementing prescriptive approaches with whole-building performance approaches.***
b. ***Improve accessibility of low-income energy efficiency and weatherization programs to rent-restricted rental housing providers, thereby achieving additional market penetration and deeper energy savings by streamlining eligibility and administrative procedures.***
c. ***Build capacity in the affordable housing industry for use of energy efficiency-based utility allowances and project specific utility allowance calculators.***

Background and Analysis

For the multifamily housing sector, one of the major barriers to upgrading a building's energy performance is the plethora of sometimes confusing and often overlapping program requirements, incentives, financing sources, protocols and compliance software requirements. While this situation is a challenge for market-rate developers, it is even more challenging for developer/owners of income-restricted properties, who face additional complicated program and funding requirements. In addition, CPUC ratepayer-funded low-income energy efficiency (LIEE) programs and DOE/HUD funded

Weatherization Assistance Programs (WAP) utilize a single-family program delivery model and have other barriers that make them largely inaccessible to multifamily rental properties.

As a result of these factors, many low-income apartments in California have not benefitted from or have been underserved by energy upgrade programs. To reduce barriers to participation, improved access to these programs and coordination of their requirements is essential.

a. Coordination and Integration

Low-income program services are not coordinated with other energy efficiency programs, incentives or rebates, making it difficult for owners to maximize benefits and energy efficiency opportunities. This lack of consistency between requirements in low-income and energy efficiency programs holds true when speaking in the broader sense of low-income programs (for example, affordable housing financing through TCAC, HUD, CDLAC or HCD that requires energy efficiency and sustainable practices) as well as the energy-specific programs within the CPUC-funded Low-Income Energy Efficiency (LIEE)[27] and DOE/HUD-funded Weatherization Assistance program (WAP).

For the developer/owner, it is difficult to decipher which programs they are eligible for, what the various compliance and verification requirements are, and whether it is worthwhile to piece together multiple prescriptive programs to undertake a comprehensive building rehab. While there is significant funding in low-income programs, owner/developers of affordable multifamily rental housing who attempt to participate in LIEE and WAP programs confront many barriers. The following strategies would substantially minimize those barriers:

- **Coordinate delivery of energy efficiency and weatherization programs.** Program implementers oriented toward single-family homes often assume that their programs work equally well for multifamily buildings. However, as discussed in Sections 1 and 2 above, their delivery mechanisms and protocols are designed for single-family homeowners and are not appropriate for the developer/owner who provides housing for tenants. In addition, low-income and weatherization programs each have their own unique service delivery structure. Unless, for example, a provider for the weatherization assistance program is the same provider for a utility low-income energy efficiency program, energy services cannot be leveraged or combined without utilizing a separate set of contractors. For multifamily properties, this fragmentation can be addressed by empowering the multifamily owner to carry out the approved scope of work by hiring and managing qualified contractors, with concurrence or approval from the program providers.
- **Adopt whole-building performance approaches.** Implementers of some low-income programs for single-family, energy efficiency and weatherization programs have typically limited the range of measures available to multifamily properties. This prescriptive-list approach constrains the scope of work undertaken by property owners and residents, and often misses opportunities to make substantive improvements to central heating, cooling and water heating systems and other building elements contributing to energy use. A whole-building performance-based approach, as described in

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Section 3 above, would expand the scope of the improvement and contribute to greater resource leveraging.

- **Adopt consistent energy audit protocols.** Multifamily energy efficiency and weatherization programs use different energy auditing and assessment tools and protocols for determining the range of allowable investment. The federal Weatherization Assistance Program relies on TREAT or EA-QUIP, and is further developing standardized audit tools, which is markedly different than the energy analysis requirements under Title 24 or those used by other energy upgrade programs. Allowing cross-use of the auditing tools and protocols would enable greater integration and leveraging.

b. Improved Access

Because most low-income energy efficiency and weatherization programs were originally designed to serve single-family homeowners, certain program requirements or restrictions make it difficult if not impossible for multifamily properties to participate. The following strategies will improve access for multifamily properties:

- **Streamline eligibility procedures.** Low-income energy efficiency and weatherization programs require individual households to complete applications for energy efficiency improvements and assistance. These programs also require each household to individually agree to participate and individually allow access, even though lease agreements usually give building owners/managers the right to authorize such work. This process impedes participation by low-income properties. Allowing property owners to apply for and authorize energy improvements on behalf of low-income households would reduce barriers to reaching this market segment and enable whole-property energy upgrade approaches. For regulated affordable housing properties, this process can be further streamlined by permitting households to be qualified for the program based on certified income records maintained by the property owner pursuant to state or federal regulations.
- **Achieve additional market penetration, and deeper energy savings, in low-income programs** by designing programs that are attractive to owner/developers of affordable multifamily rental properties- the entities who provide housing to the majority of the state's low-income population.[28] The low-income market has expressed interest in a performance based whole-property approach

[28] Data from utility filings of June 1, 2007 and the May 10, 2007 workshop presentations on renter access issues in CPUC Rulemaking 07-01-042 (available at http://docs.cpuc.ca.gov/published/proceedings/R0701042.htm) The share of dwellings serviced by LIEE programs that are multifamily closely reflect the share of low-income dwellings that are multifamily. This break-down does not reflect which measures were installed in multifamily units, and whether or not the units were in rental or ownership housing projects. (See following table).

Multifamily Dwellings Service By LIEE	PG&E	SCE	SDG&E	SoCalGas
Estimated MF low-income dwellings by utility as a % of all low-income dwellings (2003)	28%	54%	50%	41-66%
MF dwelling treated through 2006 , as a % of all dwellings serviced through 2006	26%	44%	49%	37%
MF dwellings treated by utility (2009), as a % of all dwellings serviced 2009	16%	13%	52%	23%

for their existing portfolio, similar to what they are used to implementing in their high-performance new construction projects which participate in incentive and green building programs.

- **Include new individual measures in LIEE.** New individual measures could be proposed for inclusion in the LIEE program that would better serve the needs of multifamily dwellings. In particular the measures in multifamily buildings that serve the common areas or central systems should not be excluded as they represent missed energy savings opportunities. In addition, consider utilizing the definition of accrual of benefits from common-area installations to individual tenants as defined in the California Solar Initiative's (CSI) Multifamily Affordable Solar Homes (MASH) program.[29]
- **Adopt categorical income-eligibility policies for WAP and LIEE programs.** Examples of categorical income-eligibility are found in HUD[30] national protocols and NYSERDA[31] multifamily program low-income by proxy income eligibility. Conditions for income eligibility approach might include:
    - Principal contact is property owner and/or manager, on behalf of tenants,
    - Income documentation certified through other programs and regulations should be accepted,
    - A minimum of 66 percent of households should qualify the whole building, and/or
    - When single-measures in individual units are applicable, still allow individual units to income qualify.

  If adopting categorical income-eligibility policies for WAP, include as one of the qualifying categories for categorical enrollment into LIEE appropriate parameters of tenants residing in low-income public housings, via the process directed by the CPUC in Decision 08-11-031.

  Also, program administrators should identify multifamily buildings in utility service territories whose tenants already automatically qualify for the LIEE program without income or categorical documentation in accordance with Ordering Paragraph 6 of CPUC Decision 08-11-031.

- **Interpret WAP Savings to Investment Ratio (SIR) calculations as allowed to be bought-down with owner investment or incentives in order to give more flexibility to developers around which measures they install.** Multifamily rental property owners said that many of the building upgrade measures of most interest to them are not supported by the WAP program if they do not show a positive SIR calculation. For example, when window improvements do not show a positive SIR calculation in mild climate zones, this measure is not supported by the WAP program. In order to

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[29] MASH Track 2 allows applicants to compete for higher incentives above Track 1 rates if the installation provides a quantifiable "direct tenant benefit" (i.e., any operating costs savings from solar that are shared with their tenants). Other categories of benefits that are considered in determining an award include energy efficiency improvements, green job creation or training, outreach and education for tenants on sustainability topics (MASH Semi Annual Progress Report, July 2010).

[30] To access the HUD announcement, instructions and the relevant forms and worksheets, visit the GREEN website Developer/Owner Resources page (see the links below "Self-Certification Documents for Addition to the DOE Multifamily Weatherization Listing"): www.chpc.net/preservation/OWNERRESOURCES.html.

[31] To See NYSERDA Multifamily Performance program for Existing Buildings Income-Eligibility by proxy, click *Project Interest Form* at www.getenergysmart.org/MultiFamilyHomes/ExistingBuilding/BuildingOwner/Participate.aspx.

capture the minimal amount of energy savings, in combination with other benefits of sound exterior assemblies, moisture damage repair and improved occupant comfort, the owner should be able to demonstrate investment of construction funding to buy-down the SIR calculation (on an individual measure basis or a whole building performance basis) and achieve weatherization funding contribution towards more energy efficient windows.

Additional considerations for SIR calculations include:

- Leveraging to buy down SIR should be sought and allowable by utility and government funding sources, including other federal funding sources such as Energy Efficiency Conservation Block Grant funding (EECBG).
- Calculating SIR on a whole-package basis as an alternative to calculating SIR on a measure-by-measure basis may better enable whole building approach.
- Variables used in the SIR calculation should be clearly defined (discount rate, fuel escalation rate, general inflation rate, measure life, how energy cost rates are calculated.etc).

d. *Energy Efficiency-Based Utility Allowances and Project-Specific Utility Allowance Calculators*

Utility Allowances are mechanism specific to affordable housing. For information on the utility allowance concept see: http://www.gosolarcalifornia.org/affordable/cuac/ . Energy efficiency based utility allowances are a mechanism to provide building owners with a pay-back for investments in energy efficiency. While HUD has deemed their use as best practice, individual Public Housing Authorities who often set utility allowances for projects often do not have the resources to implement their use.

- **Pool resources.** Resources should be pooled and coordination take place among California Energy Commission (CEC), Tax Credit Allocation Committee (TCAC), Housing and Urban Development (HUD), Public Housing Authorities (PHAs), to:
  - Provide technical assistance to Public Housing Authorities for interpretation and implementation of EEBUA/CUAC policies.
  - Develop and implement EEBUA for new construction and existing buildings on a more uniform and wide-spread basis.
  - Train energy consultants on the use of the CEC project-specific California Utility Allowance Calculator (CUAC).
  - Establish protocol/case study for the current CEC/LIHTC CUAC new construction tool to work for low-income financing programs in addition to LIHTCs (e.g., HUD section 8 tenant voucher program or other HUD programs).

CONCLUSION

In California, policies and programs for energy and green building improvements have traditionally treated multifamily buildings as a subset of the single-family residential or commercial building sector. Tremendous energy savings opportunities have been overlooked because these policies and programs have not adequately recognized the unique infrastructure and market realities of the multifamily building sector.

The MF HERCC's work has brought to light the importance of tailoring energy and green upgrade policies and programs to the specific market opportunities and challenges faced by the multifamily sector. By adopting the recommendations in this report, energy and green upgrade programs can more quickly and effectively deliver their services and achieve their goals of energy savings, greenhouse gas emissions reduction and job creation.

ACKNOWLEDGMENTS

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The first draft was released on October 7, 2010 at a public stakeholder meeting attended by more than 80 industry professionals. Recommendations pertaining to coordination of energy efficiency and low-income programs were further developed at a Multifamily Weatherization Forum held at Housing and Urban Development offices in San Francisco on February 10, 2011 where 70 low-income housing and energy efficiency professionals discussed program design, coordination and capacity building for low-income programs to better serve multifamily rental housing. During and since the October public stakeholder meeting and the Multifamily Weatherization Forum, additional items have been identified as clarifications and refinements to the original report and as priorities for improving the MF HERCC's program design recommendations.[32]

MF HERCC participants are listed here. Participation in MF HERCC meetings does not constitute endorsement of any specific recommendation in this report by the organizations represented.

[32] The October 2010 report and clarifications and additional recommendations in the March 25th Addendum were developed and discussed at the following meetings: MF HERCC (3/10, 4/10, 7/10, 8/10, 10/8/10, 12/7/10, 1/27/11), IT task group (11/16/10, 1/21/11), Weatherization task group (11/5/10, 12/21/10, 1/31/11, 2/2/11, 3/2/11), HERS II Tools task group (11/12/10, 1/7/11, 1/26/11, 2/15/11, 3/8/11), Public Stakeholder (10/08/10) Weatherization Forum (02/10/11).

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REFERENCE STANDARDS

The following standards comprise a basis for reference in multifamily retrofit programs:

- ASHRAE, Commercial Building Audit Standards (2004)
- Building Performance Institute, Inc., *Technical Standards for Multifamily Building Analysts* (2008)
- California Energy Commission, "Energy Efficiency Standards for Residential and Nonresidential Buildings" (Title 24–2008)
- California Energy Commission, *HERS Technical Manual (2008)*
- City of Berkeley, "Money For Energy Efficiency Audit Standard"
- Enterprise, "San Francisco Bay Area Affordable Multifamily Retrofit Initiative Audit Protocol"
- GreenPoint Rated Existing Home Multifamily program
- RESNET, *RESNET Standards,* Chapter Seven, Comprehensive Home Energy Audit
- U.S. Department of Housing and Urban Development, *Energy Conservation for Housing—A Workbook* (1998)

APPENDIX A: Cost/Benefit Analysis for a 40-unit Low-rise Prototype

The tables below illustrate the cost/benefit analysis process described in the Recommendations section of this report. The cost/benefit analysis is shown for a 40-unit low-rise prototype in representative climate zones 3, 8, 10 and 12. These tables are not recommendations for specific packages of measures; rather, they are merely examples intended to demonstrate the types of measures—and their associated costs—that might be used to achieve a certain performance target for a specific building type, vintage and climate zones.

Table A- 1. Pre-code Baseline
Example measures to achieve at least 20% energy savings across climate zones

Energy Efficiency Measures Used in Calculations			DEER Cost Data unless noted			
Measure	Baseline	Improved	Material	Labor	Total/DU	
Attic Insulation	R-11	R-38	0.75/s.f.	0.61/s.f.	$478	Total Cost for building divided by 40
Wall Insulation	R-0	R- 13	0.32/s.f.	0.62/s.f.	$263	
Window Replacement	Single Pane Metal Frame	Dual Pane Vinyl Frame	16.00/s.f.	5.70/s.f.	$1,622	
Seal Duct Leakage	28%	15%	$56/DU	$442/DU	$498	
Estimated Material & Installation Cost				**Total**	**$2,861**	

	Estimated Improvements Summary				First Year Savings		Estimated Installation Cost	Straight Line Payback (yrs)
CZ		HERS Index	kWh	Therm	Total	Per Dwelling		
3	Vintage Baseline	154	138,121	13,530	$73,567			
	Improved House	127	129,243	10,020	$65,572			
	Savings		8,878	3,510	$7,995	$199.88	$2,861	14.3
	Percent Improvement	17.5%	6.4%	25.9%	10.9%			
8	Vintage Baseline	174	166,072	10,403	$82,349			
	Improved House	142	144,347	8,939	$71,021			
	Savings		21,725	1,464	$11,328	$283.20	$2,861	10.1
	Percent Improvement	18.4%	13.1%	14.1%	13.8%			
10	Vintage Baseline	214	208,770	11,321	$102,461			
	Improved House	163	169,236	9,191	$82,351			
	Savings		39,534	2,130	$20,110	$502.75	$2,861	5.7
	Percent Improvement	23.8%	18.9%	18.8%	19.6%			
12	Vintage Baseline	229	194,862	15,597	$101,119			
	Improved House	164	156,889	11,118	$79,103			
	Savings		37,973	4,479	$22,016	$550.40	$2,861	5.2
	Percent Improvement	28.4%	19.5%	28.7%	21.8%			

Table A- 2. 1980-2000 Code Baseline
Example measures to achieve at least 15% energy savings across climate zones

Energy Efficiency Measures Used in Calculations			DEER Cost Data unless noted			
Measure	Baseline	Improved	Material	Labor	Total/DU	
Attic Insulation	R-19 or R-30	R-38	0.4/s.f.	0.45/s.f.	$300	Total Cost for building divided by 40
Duct Leakage	28%	15%	$56	$442	$498	
Refrigerant Charge	Standard	Verified	$12/ton	$37/ton	$72	1.5 ton AC system
Replace A/C system	SEER 8.9	SEER 13.0	$12/ton	$37/ton	$72	
Duct Insulation	R-4.2 or R-2.1	R-8	$612/ton	$448/ton	$1,590	Cost Estimated
Water Heater	EF .52	EF .62	$550	$200	$750	
Indoor Lights	Incandescent	CFL	$25	$0	$25	
Outdoor Lights	Incandescent	CFL & Sensor	$10	$100	$110	
Estimated Material & Installation Cost				**Total**	**$3,117**	

					First Year Savings		Estimated Installation Cost	Straight Line Payback (yrs)
CZ		HERS Index	kWh	Therm	Total	Per Dwelling unit		
3	Vintage Baseline	133	134,399	10,670	$67,280			
	Improved House	110	107	9,024	$54,722			
	Savings		134,292	1,646	$12,558	$313.95	$3,117	9.9
	Percent Improvement	17.3%	99.9%	15.4%	18.7%			
8	Vintage Baseline	151	151,230	9,188	$74,362			
	Improved House	119	119,141	7,520	$58,203			
	Savings		32,089	1,668	$16,159	$403.98	$3,117	7.7
	Percent Improvement	21.2%	21.2%	18.2%	21.7%			
10	Vintage Baseline	180	182,592	9,621	$88,771			
	Improved House	143	142,996	7,917	$69,241			
	Savings		39,596	1,704	$19,530	$488.25	$3,117	6.4
	Percent Improvement	20.6%	21.7%	17.7%	22.0%			
12	Vintage Baseline	184	169,778	12,069	$85,917			
	Improved House	149	132	9,935	$67,002			
	Savings		169,646	2,134	$18,915	$472.88	$3,117	6.6
	Percent Improvement	19.0%	99.9%	17.7%	22.0%			

Table A- 3. 2001-2008 Code Baseline
Example measures that will achieve at least 10% energy savings across climate zones

Energy Efficiency Measures Used in Calculations			DEER Cost Data unless noted			
Measure	Baseline	Improved	Material	Labor	Total/DU	
Attic Insulation	R-30	R-38	0.40/s.f.	0.45/s.f.	$300	Total Cost for building divided by 40
Refrigerant Charge	Standard	Verified	$12/ton	$37/ton	$72	1.5 ton AC system
Seal Duct Leakage	28%	15%	$56/DU	$442/DU	$498	
Duct Insulation	R-2.1	R-8			$350	Estimated Cost
Water Heater	EF .575	EF .62	$550	$200	$750	
Estimated Material & Installation Cost				**Total**	**$1,970**	

Estimated Improvements Summary					First Year Savings		Estimated Installation Cost	Straight Line Payback (yrs)
CZ		HERS Index	kWh	Therm	Total	Per Dwelling		
3	Vintage Baseline	125	131,044	9,407	$66,838			
	Improved House	116	124,151	8,486	$62,717			
	Savings		6,893	921	$4,121	$103.03	$1,970	19.1
	Percent Improvement	7.2%	5.3%	9.8%	6.2%			
8	Vintage Baseline	144	150,527	8,071	$73,934			
	Improved House	130	139,091	7,321	$67,995			
	Savings		11,436	750	$5,939	$148.48	$1,970	13.3
	Percent Improvement	9.7%	7.6%	9.3%	8.0%			
10	Vintage Baseline	172	180,983	8,442	$87,870			
	Improved House	152	163,665	7,918	$79,237			
	Savings		17,318	524	$8,633	$215.83	$1,970	9.1
	Percent Improvement	11.6%	9.6%	6.2%	9.8%			
12	Vintage Baseline	175	168,413	10,733	$84,943			
	Improved House	155	152,763	9,567	$76,655			
	Savings		15,650	1,166	$8,288	$207.20	$1,970	9.5
	Percent Improvement	11.4%	9.3%	10.9%	9.8%			

APPENDIX B: Investor-Owned Utility Programs Available for the Multifamily Sector

The following table is a draft list of investor-owned utility programs available for the multifamily sector.

Investor Owned Utility Programs Available for the Multifamily (MF) Sector

ering	Eligibility	Application Requirements	Target # Units (2010-2012)	Program Budget (2010-2012)	Program Websites
cost energy efficiency appliance repair and acement measures. st measures available to le family are available MF units as long as upants are income ified and building ier/property manager has sented to the work.	Tenants are eligible with approval of property owner or manager. In program year 2009 MF dwellings accounted for 27% of total LIEE project work. Entire complexes can also be verified based on the 80–20 rule.	Income must be verified by service provider and each participant must sign an application. Utility verified CARE recipients are automatically eligible though still require independent income verification.	Total: 747,054 PG&E: 249,982 SCE: 166,890 SCG: 289,414 SDG&E: 40,768	PY2010: $310,685,254 PY2011: $318,786,772 (LIEE program budget cycle is from 2009-2011; only figures for applicable years are listed.)	www.socalgas.com/residential/assistance www.sdge.com/residential/assistance/energyTeam.shtml www.pge.com/energypartnerswww.sce.com/residential/income-qualified/ema/energy-management-assistance.htm
formance based ntives starting at $0.18/ h, $0.73/therm, and 63/kW at 15% > Title with incentive caps at 5 > Title 24. $100 unit e incentive. PV kicker; tional incentives for pact and green certified nes. Design and nical assistance vided.	New MF construction and performance-based "gut and remodel" of existing MF structures. New construction, affordable, and market-rate MF complexes of three dwelling units or more.	Projects can apply any time between 1/1/2010 and 12/15/2012, prior to project completion (defined as prior to drywall installation). Applying early in design phase is highly recommended. Project applications should be submitted six months prior to any financing applications. Recommended project documents for submittal include a letter of intent, building plans, lot plan, application form, Title 24 checklist and other Title 24 documentation, and other energy efficiency documentation.	No specific unit goal for the multifamily segment.	$51,383,787 total PG&E: $13,521,688; SCE: $24,894,000; SDG&E: $4,398,013; SCG: $8,570,086	www.pge.com/newhomes www.CaliforniaAdvancedHomes.com www.sce.com/builder www.sdge.com/builderservices/newHomes.shtml

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of federal poverty level. Multifamily is defined as 5 or more units.

ering	Eligibility	Application Requirements	Target # Units (2010-2012)	Program Budget (2010-2012)	Program Websites
gle family: performance ntives up to $4,000 for allation of measures ucing energy use by ; prescriptive incentives o $1,000 for installation asic package of sures.[2] **incentive packages rently under elopment.**	Existing buildings, major energy efficiency upgrades.	Application available on Energy Upgrade California website.	No specific target for MF	Currently only available for single family dwellings; incentives aimed at MF market expected in 2011.	www.sdge.com/energyupgrade www.sce.com/residential/rebates-savings www.socalgas.com/rebates/residential PG&E website to be determined.
cribed rebates on a ge of energy efficiency ting, appliances, and ding envelope for lling and common s. Non-incentive rings include education he value of energy ciency and cross-keting with LIEE rings.	Existing buildings, minor energy efficiency upgrades. Affordable and market rate complexes of 2 dwelling units or more. Tenants eligible to receive services with landlord approval.	Funds available until depleted, held on a first come, first serve reservation basis. Supporting documents must be submitted within 45 calendar days of reservation. Documents include Multifamily Reservation Form, Rebate Application, Invoice / Proof of Purchase. SDG&E documents also include Product Location Forms for common area and apartments.	PG&E: 15,000 direct mailers/year. SDG&E, SCE: 20,000 mailers/year. SCG: No stated targets.[3]	$80,188,539 total PG&E: $20,856,887; SCE: $45,732,227; SDG&E: $5,131,751; SCG: $8,467,674	www.pge.com/multifamily www.sdge.com/residential/multiFamilyRebate.shtml www.sce.com/residential/rebates-savings/multifamily/multifamily-energy-efficiency.htm www.socalgas.com/rebates/multifamily

ic insulation, pipe wrap for all accessible domestic hot water heater piping, duct sealing, and an optional measure—low flow showerhead or verheads.

rogram delivery targets such an ensuring properly licensed contractors and direct outreach to large property managers (3 per year for PG&E,

Investor Owned Utility Programs Available for the Multifamily (MF) Sector

ering	Eligibility	Application Requirements	Target # Units (2010-2012)	Program Budget (2010-2012)	Program Websites
e pick-up and recycling ligible, functioning liances along with a netary incentive.	Refrigerators, freezers, and room AC units (excluding SCE) available for pick up from residential and commercial locations.	Participants phone-in or schedule a pick up via website.	15,722 recycled appliances per year. There is no specific MF target.	$67,784,646 total PG&E: $20,241,876; SCE: $39,342,770; SDG&E: $8,200,000	www.appliancerecycling.com/weborder/rebatex.aspx?ProgramID=1 www.sce.com/residential/rebates-savings/appliance/fridge-freezer-recycling.htm www.sdge.com/residential/rebates.shtml
ES provides ortunities for residents ssess the energy impact heir dwelling spaces, liances and plug load ces.	Residential single family and multifamily units.	Customer may take the survey on line or via mail.	**PG&E:** 42,000 on line, 7,245 mail in, 4,000 in home, and 105 phone surveys. **SCE:** 21,875 on line, 13,125 mail in, 7,875 in home, and 875 phone surveys. **SDG&E:** 2,500 on line, 800 mail in surveys. **SCG:** 5,000 on line, 5,000 mail in, and 5,500 in home surveys.	$32,396,994 total PG&E: $21,018,892; SCE: $6,950,911; SDG&E: $2,049,080; SCG: $2,378,112	www.socalgas.com/residential/energysurvey/index.html No website info has been supplied by PG&E, SCE, or SDG&E for this program.

ering	Eligibility	Application Requirements	Target # Units (2010-2012)	Program Budget (2010-2012)	Program Websites
culated and tailored ntives for non-dential retrofits. Non-ntive offerings include nical assistance for ication preparation.	Common areas of multifamily complexes.	Standard application form available online. Pre and post project inspections.	All commercial rated customers - no specific target for multifamily.	$149,047,635 total PG&E: $84,820,223; SCE: $52,007,662; SDG&E: $4,248,850; SCG: $7,970,900	www.sce.com/customized_solutions/www.sdge.com/business/esc www.pge.com/mybusiness/energysavingsrebates No website info has been supplied by SCG for this program.
ee audit levels: basic ts, integrated audits, retrocommissioning x) audits. Basic and ne integrated audits et users below 200 kW; x audits are intended for er users. Each audit erates a final audit report recommendations for rovements. Program rs technical assistance ncrease conversion rates.	All non-residential commercial establishments. Specific audits geared towards different customer types.	Online energy audits available for specific business types (including apartment complexes). To request a more in-depth audit, customers are routed to the business customer service center.	Only commercial rated customers.	$34,192,073 total PG&E: $20,237,598; SCE: $10,559,031; SDG&E: $1,562,143; SCG: $1,833,301	www.pge.com/mybusiness/energysavingsrebates/analyzer/index.shtml www.sce.com/business/ems www.sdge.com/business/rebatesincentives/programs/allPrograms.shtml www.socalgas.com/rebates
upfront cost covered eligible measures and omers with good credit, etermined by IOU. mated energy savings t be greater than debt icing. Financing vided at 0% interest over ars,[4] $5,000 to 0,000 loans tied to er.	Active accounts in good credit standing with at least two years bill payment history. Multifamily common area locations (owner not living on premises). **Financing <u>does not qualify</u> for residential applications.** Measures must qualify for a rebate or incentive through IOU program.	Standard application form available online. IOU inspects project prior to commencement and verifies calculated energy savings. Must submit energy saving workbook indicating existing and proposed equipment, operating hours, and technical specifications.	All commercial and industrial customers.	$143,554,308 total PG&E: $18,500,000 SCE: $15,000,000 SDG&E: $5,000,000 SCG: $3,500,000	www.sdge.com/obf No website info has been supplied by SCG, PG&E, or SCE for this program.

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match expected life of measure.

ering	Eligibility	Application Requirements	Target # Units (2010-2012)	Program Budget (2010-2012)	Program Websites
vides rebates to non-dential customers for alling energy efficient ting, refrigeration, food ice, natural gas (PG&E SDG&E only) and other nologies.	All nonresidential commercial establishments. Portions of multifamily complexes / facilities on a commercial rate (i.e., corridors, atriums, etc.)	Standard application form available online.	All commercial customers.	$143,554,308 total PG&E: $58,516,685; SCE: $53,263,233; SDG&E: $16,520,919; SCG: $15,253,471	www.pge.com/businessrebates www.pge.com/tradepro www.sce.com/Express_Solutionswww.sdge.com/businessrebates www.socalgas.com/energyefficiency
vice providers promote gram through icipating HVAC tractors who receive ntives to perform ity installation and ity maintenance service new and existing HVAC ems.	Customer must have an active residential single family or small commercial electric account. Installation must take place at a PG&E service address, and must be located in Climate Zones 2, 4, 11, 12, or 13 for DTS. No climate zone requirement for RCA.	Contractor is paid an incentive for performing work for customer. Contractors enter into agreements with Verified Service Provides who administer program and quality assurance checks.	N/A	Residential QI: PG&E: $13,711,409 SCE: $3,080,674 SDG&E: $83,481 SCG: $87,168 Comm. QI: PG&E: $7,383,067 SCE: $2,499,972 SDG&E: $61,695 SCG: $55,996 Res / Com QM: PG&E: $9,378,683 SCE: $28,486,042 SDG&E: $97,751 SCG: $203,209	www.pge.com/myhome/saveenergymoney/rebates/coolheat/duct/ No website info has been supplied by SoCal Gas, SCE, or SDG&E for this program.

DRAFT **Investor Owned Utility Programs Available for the Multifamily (MF) Sector** DRAFT

ering	Eligibility	Application Requirements	Target # Units (2010-2012)	Program Budget (2010-2012)	Program Websites
Bold Energy Efficiency tegies and innovative roaches to encourage gy efficiency. Effective avioral messaging pilot, To-Save marketing paign and pilot projects. -Stop-Shop for Palm ert residents, On-Bill ncing for public agencies businesses. Support to 's AB811 Energy pendence Program (EIP).	Commercial and residential customers in the City of Palm Desert.	Palm Desert Applications on Set-To-Save website.	457,072 gross Therm (2010-12 goal) [5]	$649,300 (Approved budget through 12/31/2010)	www.settosave.com
e energy audit and ntives for efficiency sures for lighting, AC and building elope. MF Plus serves n dwelling units and mon space.	Deemed and calculated incentives are provided to participating contractors for the installation of qualified energy efficiency products in existing MF complexes with 2 or more dwelling units.	Participating contractor must submit Incentive Application Form and signed Site Access Agreement prior to installation. Following completion of project, participating contractor submits an Installation Verification Form and supporting documentation.	N/A	Approx. $3,000,000 for PY2010-2012	www.sfenergywatch.org/multifamily.html
e energy assessment and installation of ciency measures, such as nprehensive lighting, insulation, pipe wrap, water heater blankets, low flow showerheads faucet aerators. MIDI es both multifamily lling units and common e.	MIDI targets customers at 200% - 400% above federal poverty level. Tenants eligible with approval of property owner/mgr. Also serves common spaces in low income buildings (LIEE does not serve common spaces). Consistent with LIEE, MF dwellings are defined as those in buildings with five or more dwelling units. Also serves single family.	MIDI serves multifamily customers who are approached by LIEE but determined to be ineligible for LIEE during the income verification process.	N/A	$4,352,000 for PY2010-2011	TBD

re non-resource programs that coordinate and support all Core Program offerings including Residential Multi-family by leveraging the authority, unique local expertise and roles ey serve. Through its effort in energy efficiency education, training, reach codes and community outreach, the M&O component of each LGP Program is designed to increase eater participation in all Core Programs including those for Multi-family.

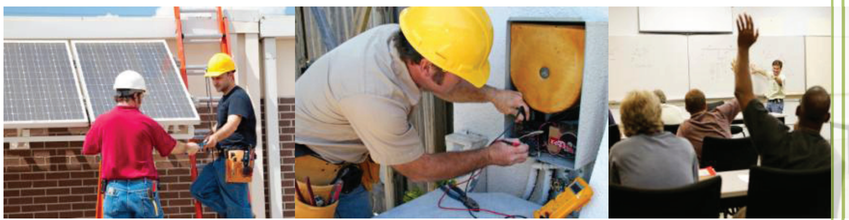
Investor Owned Utility Programs Available for the Multifamily (MF) Sector

DRAFT

ering	Eligibility	Application Requirements	Target # Units (2010-2012)	Program Budget (2010-2012)	Program Websites
ns to encourage large rtment building owners property mgrs. to install r water heating systems swimming pools. uires installation of r collectors, booster nps, solar system troller, and additional erial and appurtenances luding, but are not ted to hot water CPVC ng, valves, fittings, ns, air separators, sors, and insulation and ector structural support).	Apartment complexes with minimum of 40 occupied residential units with pools that are heated throughout the year.	Customers qualify to receive products and services through completion of a Customer Enrollment Form and Installation Agreement: contractor shall provide for review and approval a copy of Installation Agreement Form that program will use to document execution of those services selected by the customer.	Goals for 2010-11 are 105 installations/ projects	$1,497,491	www.energxsolar.com
ers no-cost direct allation of water heating ices (low-flow werheads, bathroom ators, kitchen aerators, common area pipe p) and provides valuable ciency education to both tifamily property ers and tenants.	**MFDTS:** Existing buildings within the following SCG service counties: Los Angeles, Ventura, Kern, San Luis Obispo, and Santa Barbara. **MFHTUP:** Existing buildings within the following SCG service counties: Orange, San Bernardino, Riverside, and Imperial.	Customers who have qualified to receive energy efficiency devices and services complete a Customer Enrollment Form. The Customer Enrollment Form records program participation and contains relevant customer information.	Target # of installations or projects: **2010** - MFDTS: 1,200 MFHTU: 21,067. **2011- MFDTS:** 600 **MFHTUP:** 44,123.	MFDTS: $3,044,872 MFHTUP: $1,895,109	MFDTS: https://buildingsolutions.honeywell.com/Cultures/en-US/Markets/Utilities/ MFHTUP: www.ecosconsulting.com/solutions/utility
gram sells and installs and control rculation pumps to ified customers.	MF residence apartment complexes with central boilers and a timeclock or no control.	Potential participant is contacted via phone and screened for applicability; participant is sent program collateral and directed to program website for more info; participant submits a rebate application.	810	$2,575,400	www.oderebateprogram.com

ering	Eligibility	Application Requirements	Target # Units (2010-2012)	Program Budget (2010-2012)	Program Websites
gram implements nestic hot water (DHW) trol systems in hotels, els, resort dominiums, and senior facilities plus other ciated hot water end (e.g., on-site kitchen laundry facilities).	DHW control systems in hotels, motels, resorts and senior care facilities plus other associated hot water end uses (e.g., on-site kitchen and laundry facilities).	Customers will participate in a web-based interactive presentation which uses as an example technology on similar facilities to those installed (size and plumbing configuration).	# of installed lodging rooms: 55,000 # of installed kitchen/laundries: 360	$2,985,110	www.savegas.com/PagesPublic/Programs.aspx
formance based ntives starting at $0.18 / n, $0.73 / therm, and 63 / kW at 15% > Title Incentives plateau at > Title 24. $100 / unit incentive. Additional ntives for energy sultants at $50/unit and d party verification at /unit that cap at 200 s.	New MF construction and performance based "gut and remodel" of existing MF structures. New construction, affordable and market rate MF complexes of three dwelling units or more.	Though projects can apply at any time prior to completion between 1/1/2010 through 12/15/2012, applying early in the design phase is highly recommended to ensure acceptance of proposal. Application package includes signed application, W9 form, building plans, Title 24 documentation, and service territory verification	N/A	$4,408,293	http://multifamily.h-m-g.com/

EXHIBIT 8



INVESTMENT OF PROCEEDS FROM RGGI CO_2 ALLOWANCES

Benefits of Regional Greenhouse Gas Initiative (RGGI)-funded programs in Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont.

February 2011

RGGI Inc.

Table of Contents

Executive Summary

The First Market-Based Program to Reduce Greenhouse Gas Emissions

In 2008, ten states – Connecticut, Delaware, Maine, Massachusetts, Maryland, New Hampshire, New Jersey, New York, Rhode Island, and Vermont – launched the first market-based regulatory program to reduce greenhouse gas (GHG) emissions in the United States. Through the Regional Greenhouse Gas Initiative (RGGI), each participating state caps carbon dioxide (CO_2) emissions from power plants, auctions CO_2 emission allowances[i], and invests the proceeds in strategic energy programs that further reduce emissions, save consumers money, create jobs, and build a clean energy economy. Each RGGI participating state has developed its own plan for investment of CO_2 allowance proceeds. This analysis translates the investment plans of the ten RGGI participating states into common, comparable terms to identify regional trends and demonstrate the benefits of RGGI participating state investments.

The Value of CO_2 Allowances

A key design element of RGGI is the distribution of CO_2 allowances through quarterly, regional CO_2 allowance auctions. Building on the experiences of earlier cap-and-trade programs, which distributed allowances to regulated entities for free, the RGGI participating states each chose to auction the majority of their CO_2 allowances and invest the proceeds in consumer benefit programs. Table 1 (below) shows the percentage of CO_2 allowances offered through auction by each state, as well as the percentage of CO_2 allowances offered for sale directly to certain qualifying emitters at a fixed price of $2.00 per allowance, as specified in each state's regulations. Across all ten RGGI states, approximately 86 percent of CO_2 allowances are offered at auction[ii] and approximately 4 percent of CO_2 allowances are offered for sale at a fixed price.

Table 1: CO_2 Allowance Allocation By State

STATE	Initial Annual CO_2 Allowance Budget	Percent Offered through Auctions	Percent Offered for Sale at a Fixed Price
Connecticut	10,695,036	77%	13%
Delaware[iii]	7,559,787	60%	n/a
Maine	5,948,902	80%	n/a
Maryland	37,503,983	80%	n/a
Massachusetts	26,660,204	98%	n/a
New Hampshire	8,620,460	69%	n/a
New Jersey[iv]	22,892,730	74%	25%
New York	64,310,805	94%	n/a
Rhode Island	2,659,239	99%	n/a
Vermont	1,225,830	99%	n/a
Total	**188,076,976**	**86%**	**4%**

[i] A CO_2 allowance is a limited authorization to emit one short ton of CO_2 from a regulated power plant.

[ii] The percentage of CO_2 allowances offered at auction may increase as participating states allocate CO_2 allowances remaining in set-aside accounts, as specified in state CO_2 Budget Trading Program regulations.

[iii] In Delaware, the percentage of CO_2 allowances distributed through auctions will increase by 8 percent per year from 2009-2014, such that 100 percent of CO_2 allowances will be auctioned in 2014.

[iv] For New Jersey, percentages shown here are based on actual percentages of CO_2 allowances distributed through auction and direct sale in 2009. Pursuant to New Jersey CO_2 Budget Trading Program regulations, a combined 99 percent of the annual New Jersey CO_2 allowance budget is offered through both auction and a fixed-price sale to qualifying industrial cogeneration facilities. The number of CO_2 allowances offered through direct sale is based on recent CO_2 emissions from qualifying industrial cogeneration facilities. CO_2 allowances that are offered through direct sale and not sold through such offers are offered through auction. In 2010, 99 percent of New Jersey's CO_2 allowance budget was offered through auctions.

Auctioning CO_2 allowances provides three important benefits in the context of a cap-and-trade system. First, auctions ensure all parties have access to CO_2 allowances under uniform terms. Second, auctions realize the value of CO_2 allowances for investment in strategic energy programs that reduce CO_2 emissions, save consumers money, and create jobs. Third, reinvestment of auction proceeds in energy efficiency and renewable energy programs allow cap-and-trade programs to address CO_2 emissions at both the supply side (power plants) and the demand side (energy use), delivering emission reductions at lower cost.

Table 2 shows the total amount of proceeds yielded from the sale of RGGI CO_2 allowances for each state and for the entire 10-state RGGI region, through December 31, 2010.

Table 2: CO_2 Allowance Proceeds by State through Dec 31, 2010

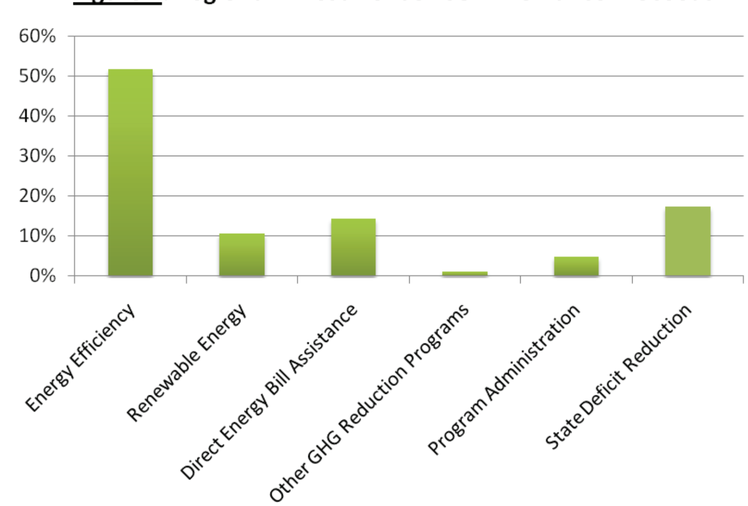
STATE	Proceeds – Auctions 1-10	Proceeds – Direct Sale ('09-'10)	Total Allowance Proceeds
Connecticut	$44,900,580	$441,094	$45,341,674
Delaware	$18,858,578	n/a	$18,858,578
Maine	$23,544,204	n/a	$23,544,204
Maryland	$147,530,363	n/a	$147,530,363
Massachusetts	$123,229,478	n/a	$123,229,478
New Hampshire	$28,215,274	n/a	$28,215,274
New Jersey	$90,913,275	$11,310,356	$102,223,631
New York	$282,272,683	n/a	$282,272,683
Rhode Island	$12,340,209	n/a	$12,340,209
Vermont	$5,701,535	n/a	$5,701,535
REGION	**$777,506,180**	**$11,751,450**	**$789,257,630**

Investing in a Clean Energy Economy

Each RGGI participating state has developed its own plan for investing its share of CO_2 allowance proceeds. While each state directs its own investment strategy, overall, states have allocated proceeds as follows:

- **52 percent** to improve energy efficiency;
- **11 percent** to accelerate the deployment of renewable energy technologies;
- **14 percent** to provide energy bill payment assistance, including assistance to low-income ratepayers;
- **1 percent** for a wide variety of greenhouse gas reduction programs, including programs to promote the development of carbon emission abatement technologies, efforts to reduce vehicle miles traveled, and programs to increase carbon sequestration. For regional comparison purposes, climate change adaptation measures are also included in this category.

Figure 1: Regional Investment of CO_2 Allowance Proceeds



Triple Benefits: for the Environment, Consumers and the Economy

Investments by RGGI participating states in energy efficiency and renewable energy reduce greenhouse gas emissions and generate important consumer benefits, including energy bill savings, greater electric system reliability, and new jobs.

◆ Environmental Gains

Investments Reduce Emissions

Investments in energy efficiency and renewable energy reduce reliance on fossil fuels, lowering emissions of CO_2 as well as other harmful pollutants, including sulfur dioxide (SO_2) and nitrogen oxides (NO_x), which cause acid rain. Investments that improve energy efficiency and increase renewable generation capacity in the electricity sector (e.g. incentives for the deployment of solar electric generation systems on homes and businesses) complement the RGGI CO_2 emission cap, helping to reduce power sector CO_2 emissions at least cost. Investments that improve energy efficiency and increase use of renewable energy outside the capped electricity sector (e.g., incentives for improving the efficiency of oil and natural gas space heating) generate additional emission reductions beyond those achieved through the RGGI CO_2 emission cap.

◆ Consumer Savings

Investments Save Consumers Money

At the household and business level, energy efficiency investments enhance consumers' control over their energy use, typically reducing energy bills by 15 to 30 percent.[1] On a regional level, energy efficiency investments drive down peak and overall electricity demand, which works to depress wholesale electricity prices, improve electric system reliability, and mitigate the need for investment in new or expanded electric generation facilities, transmission lines, and distribution systems.

◆ Economic Benefits

Investments Create Jobs

Investments in energy efficiency and renewable energy drive demand for new products and services and stimulate the economy with energy bill savings, thereby creating jobs. A 2010 analysis by Environment Northeast estimates that energy efficiency programs funded with CO_2 allowance proceeds through December 2010 are projected to create nearly 18,000 job years – that is, the equivalent of 18,000 full-time jobs that last one year.[2] Employment benefits result from state program investments and from the reinvestment of consumer energy bill savings in the wider economy. While there has not yet been a similar analysis of RGGI-funded renewable energy programs, data from the Renewable Energy Policy Project shows every $1 million invested in renewable energy systems creates about six full-time manufacturing jobs, as well as additional jobs in construction and facility maintenance.[3]

Investments Create Business Opportunities

Investments in energy efficiency and renewable energy create business opportunities in the clean energy sector. The RGGI CO_2 emission cap sends a long-term price signal for a more efficient, cleaner energy supply. At the same time, the investment of CO_2 allowance proceeds in energy efficiency and renewable energy projects helps emerging technologies achieve economies of scale, accelerating widespread adoption and facilitating growth of the clean energy sector.

Investments Generate Economic Returns

Investments in energy efficiency and renewable energy are economically beneficial. Evaluations of several energy efficiency and renewable energy programs in the RGGI participating states indicate that these programs provide $3-$4 in savings for every dollar invested.[4] When macroeconomic benefits are considered, the benefits are even greater.[5]

Driving Policy Innovation

Innovative elements of RGGI's design are influencing the development of other cap-and trade programs, such as the Western Climate Initiative and the European Union Emissions Trading System. Two key design elements – CO_2 allowance auctions and reinvestment of proceeds in strategic energy programs – have demonstrated how market-based programs can harness the value of a CO_2 emission cap to deliver emission reductions at low cost.

In particular, the investment of CO_2 allowance proceeds in energy efficiency and renewable energy within the electricity sector reduces the demand for fossil-fuel generated electricity, which reduces CO_2 emissions and the demand for CO_2 allowances. The result is lower CO_2 allowance prices and lower program impacts on wholesale electricity prices.[v] When considering the overall consumer benefits provided through energy efficiency and renewable energy programs — in the form of energy bill savings, demand-induced reductions in wholesale electricity prices, improved electric system reliability, and job creation—economic benefits are expected to outweigh the minimal impact of the RGGI cap-and-trade program on electricity prices.[vi]

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[v] On average, in 2009, the cost of CO_2 allowances accounted for 0.4 percent to 1 percent of average residential electricity bills, depending on the state (based on actual or estimated CO_2 component of ISO wholesale electricity prices, state residential retail electricity prices, EIA residential electricity usage data, and a 2009 average CO_2 allowance spot price of $3.06). Based on typical household electricity usage, this translates into a weighted average of 73 cents per month for residential consumers across the 10-state RGGI region.

[vi] Building on data issued by the RGGI participating states, a number of economic, energy, and regulatory policy analysts are working to evaluate the benefits of investments in the electricity sector. See: Derek Murrow and Peter Shattuck, *Economy-Wide Benefits of RGGI: Economic Growth through Energy Efficiency,* Environment Northeast, December 2010; Bruce Biewald, Max Chang, Lucy Johnston and David White, *Electricity Energy Efficiency Benefits of RGGI Proceeds: An Initial Analysis*, Synapse Economics, October 5, 2010.

Recent Highlights: Benefits of RGGI Participating State Investments

Below are examples of the estimated environmental, consumer, and economic benefits associated with RGGI participating state investments of CO_2 allowance proceeds. The examples included below are intended to provide a high-level snapshot of some of the benefits associated with each state's investments, and are not intended to facilitate comparison among state programs. Estimated program benefits are drawn from independent, state-level analyses and may reflect different variables and/or calculation methods.

Programs Funded Exclusively by CO_2 Allowance Proceeds:
The programs described below are funded exclusively by CO_2 allowance proceeds.

Maryland: Strategic Energy Investment Fund (SEIF)
Through June 30, 2010, Maryland has invested $19.9 million in CO_2 allowance proceeds in energy efficiency and renewable energy. To date, more than 17,000 Marylanders and their families have taken part in CO_2 allowance proceeds that funded energy efficiency and renewable energy programs, saving more than $77 million over the life of the investments. As a result of clean energy programs funded by Maryland's investment of CO_2 allowance proceeds:

- More than 3,000 low-income apartments have received energy efficiency retrofits;
- More than 350 farmers have received funding for energy efficiency projects;
- More than 900 people have received training for careers in energy efficiency;
- Grants to local governments and non-profits to have helped over 7,500 low-income Marylanders;
- Marylanders have purchased nearly 5,000 energy efficient appliances.[6]

New Hampshire: Greenhouse Gas Emissions Reduction Fund (GHGERF)
Through 2010, New Hampshire has awarded $31 million[vii] in CO_2 allowance proceeds to 36 projects and programs that improve energy efficiency, support energy education and outreach, and provide energy efficiency job training to workers across the state. Through July 2010, 30 of the projects received a total of $17.7 million. Through July 2010, those 30 projects have:

- Supported energy efficiency job training for more than 170 workers across the state;
- Supported energy use assessments and energy audit evaluations for 436 buildings across the state.[7]

In addition, those 30 projects are projected to:

- Reduce consumer energy costs by $60.6 million over the lifetime of the installed measures;
- Avoid the emission of 220,000 tons of CO_2 pollution over the lifetime of the installed measures.[8]

New Jersey: Clean Energy Solutions Capital Investment (CESCI) Loan/Grant Program
Through 2010, New Jersey has awarded $29.6 million in CO_2 allowance proceeds to 12 large-scale energy efficiency and renewable energy projects in the commercial and industrial sectors through its Clean Energy Solutions Capital Investment (CESCI) Loan/Grant Program. These 12 projects:

- Represent 29.6 megawatts (MW) of new, clean electric generation capacity;
- Are projected to generate more than 167 million kWh of electricity annually, enough to meet the equivalent needs of more than 19,600 New Jersey households each year;
- Are projected to avoid 84,000 tons of CO_2 emissions per year and 1.7 million tons of CO_2 emissions over the lifetime of the projects.[9]

[vii] Includes anticipated proceeds from 2011 CO_2 allowance auctions.

Programs Funded in Part by CO_2 Allowance Proceeds:
The programs described below are funded by CO_2 allowance proceeds, in addition to other funding sources, such as state Systems Benefit Charges and/or the American Recovery and Reinvestment Act of 2009.

Connecticut: Utility-Administered Energy Efficiency Programs
Utility-administered energy efficiency programs overseen by the Energy Conservation Management Board (ECMB) in 2010 are projected to:

- Save 3.7 billion kWh of electricity over the lifetime of the installed measures, enough to meet the needs of more than 442,476 homes for one year;
- Reduce consumer energy costs by $744 million over the lifetime of the installed measures;
- Avoid 2.4 million tons of CO_2 pollution over the lifetime of the installed measures.[10]

CO_2 allowance proceeds represented about 7 percent of the ECMB's total funding in 2010.[11]

Delaware: Energize Delaware Appliance Rebate Program
Between September 2009 and September 2010, the Energize Delaware Appliance Rebate Program provided more than 15,900 rebates for energy-efficient household appliances to Delaware consumers. These rebates are:

- Saving more than 1.9 million kWh of electricity annually;
- Saving participating consumers a total of more than $366,000 per year;
- Avoiding 1,916 tons of CO_2 pollution annually.[12]

According to program administrators at the Sustainable Energy Utility, CO_2 allowance proceeds represented about 40 percent of the Appliance Rebate Program's total funding.

Maine: Efficiency Maine Energy Efficiency Programs
Energy efficiency programs administered by Efficiency Maine in 2010 are projected to:

- Save nearly $3 for every $1 invested over the lifetime of the installed measures;
- Generate $95.8 million in lifetime economic benefits for the state of Maine;
- Avoid more than 429,901 tons of CO_2 pollution over the lifetime of the installed measures.[13]

According to staff of Efficiency Maine, CO_2 allowance proceeds represented 35 percent of Efficiency Maine's total funding in 2010.

Massachusetts: Utility-Administered Energy Efficiency Programs
Expanded energy efficiency programs administered by the state's electric utilities over the three-year period 2010-2012 and funded in part by CO_2 allowance proceeds are projected to:

- Reduce consumer energy costs by $6 billion over the lifetime of the installed measures;[14]
- Save 2.6 billion kWh of electricity over the lifetime of the installed measures, enough to meet the needs of more than 350,000 Massachusetts households for a year;
- Avoid 15 million tons of CO_2 pollution over the lifetime of the installed measures.[15]

CO_2 allowance proceeds are projected to represent 11.5 percent of the total funding provided for these programs over the three-year period 2010-2012.[16]

New York: Investments in New York's Clean Energy Economy
Through 2010, New York has committed $150 million in CO_2 allowance proceeds to consumer benefit programs that reduce greenhouse gas emissions while promoting energy efficiency and renewable energy. These investments save consumers money, create jobs, reduce the flow of dollars outside the state for imported fossil fuels and protect public health and the environment. Highlights to date include:

$112 million in CO_2 allowance proceeds dedicated to Green Jobs/Green New York for energy efficiency audits and financing, sustainable community development, workforce training, and green job creation. GJ/GNY is designed to leverage additional public and private capital to:

- Provide energy audits for 100,000 households and small businesses and support the implementation of 56,000 projects;
- Result in electricity savings of approximately 675,000 MWh and energy bill savings of $600 million over the lifetime of the installed measures;
- Support training programs for 6,000 workers.[17]

$12 million supports installation of 383 solar photovoltaic systems (3,710 kW), with anticipated production of 4,370 MWh per year.[18]

Vermont: Vermont Community Energy Mobilization Project

Vermont is investing CO_2 allowance proceeds in Efficiency Vermont's Vermont Community Energy Mobilization (VCEM) project, a program to train volunteers to install energy efficiency measures in homes across the state. In 2009 and 2010:

- More than 500 volunteers received training;
- More than 1,100 homes received energy-efficient upgrades;
- The homes saved an estimated total of 590,000 kWh.[19]

According to staff of Efficiency Vermont (EVT), CO_2 allowance proceeds represented about 25 percent of the funding for EVT's heating and process efficiency programs, including VCEM, in 2010.

Rhode Island: Utility-Administered Energy Efficiency Programs

Rhode Island has invested nearly $4 million of its CO_2 allowance proceeds in cost-effective energy efficiency programs administered by National Grid. In 2010, these programs:

- Provided energy efficiency services to more than 150,00 Rhode Islanders;
- Saved more than 80 million kWh of electricity.[20]

According to National Grid, RGGI proceeds accounted for approximately 14 percent of the total funding provided for these programs.

Introduction

> "*Each Signatory State agrees that 25% of the allowances will be allocated for a consumer benefit or strategic energy purpose*."
>
> ~ RGGI Memorandum of Understanding, December 20, 2005

Ten Northeast and Mid-Atlantic states – Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island and Vermont – have put into effect the first market-based regulatory program to reduce greenhouse gas emissions in the United States. The Regional Greenhouse Gas Initiative (RGGI) establishes a regional cap on carbon dioxide (CO_2) emissions from the power sector and requires power plants to possess CO_2 allowances[viii] equal to their CO_2 emissions over each three-year control period. The regional CO_2 emission cap comprises the sum of each RGGI participating state's annual CO_2 allowance budget. For the first six years of the program (2009-2014) the emission cap is 188 million short tons of CO_2 per year. Beginning in 2015, the cap will decrease by 2.5 percent per year, such that it will be 10 percent lower by the end of 2018.

In a 2005 Memorandum of Understanding (MOU), the RGGI participating states each committed to allocate a minimum of 25 percent of their CO_2 allowances for a "consumer benefit or strategic energy purpose." In practice, the RGGI participating states have each chosen to auction the vast majority of their CO_2 allowances and invest the proceeds in consumer benefit programs. Auctioning CO_2 allowances provides three important benefits in the context of a cap-and-trade system. First, auctions ensure all parties have access to CO_2 allowances under uniform terms. Second, auctions realize the value of CO_2 allowances for investment in programs that reduce energy costs for consumers and build a clean energy economy. Third, reinvestment of auction proceeds in energy efficiency and renewable energy programs allow cap-and-trade programs to address CO_2 emissions at both the supply side (power plants) and the demand side (energy use), delivering emission reductions at lower cost.[ix]

Table 2 (below) shows the total amount of proceeds yielded from the sale of RGGI CO_2 allowances for each state and for the entire 10-state RGGI region, through December 31, 2010.

Table 2: CO_2 Allowance Proceeds by State through Dec 31, 2010

STATE	Proceeds – Auctions 1-10	Direct Sale Proceeds ('09-'10)	Total Allowance Proceeds
Connecticut	$44,900,580	$441,094	$45,341,674
Delaware	$18,858,578	n/a	$18,858,578
Maine	$23,544,204	n/a	$23,544,204
Maryland	$147,530,363	n/a	$147,530,363
Massachusetts	$123,229,478	n/a	$123,229,478
New Hampshire	$28,215,274	n/a	$28,215,274
New Jersey	$90,913,275	$11,310,356	$102,223,631
New York	$282,272,683	n/a	$282,272,683
Rhode Island	$12,340,209	n/a	$12,340,209
Vermont	$5,701,535	n/a	$5,701,535
REGION	**$777,506,180**	**$11,751,450**	**$789,257,630**

[viii] A CO_2 allowance represents a limited authorization to emit one ton of CO_2 from a regulated power plant.

[ix] In competitive wholesale electricity markets, CO_2 allowances are treated as assets by electricity generators, regardless of how they were obtained. Therefore, the market value of CO_2 allowances is passed through in the price of wholesale electricity, regardless of whether CO_2 allowances are auctioned or distributed for free. Cap-and-trade programs with CO_2 allowance auctions benefit consumers by harnessing the value of the CO_2 allowances for investment in programs that reduce energy demand, CO_2 emissions, and consumer energy costs.

Section 1: Regional Trends in State Investment Plans

> *"Consumer benefit or strategic energy purposes include the use of the allowances to promote energy efficiency, to directly mitigate electricity ratepayer impacts, to promote renewable or non-carbon-emitting energy technologies, to stimulate or reward investment in the development of innovative carbon emissions abatement technologies with significant carbon reduction potential, and/or to fund administration of this Program."*
>
> ~RGGI Memorandum of Understanding, December 20, 2005

Each RGGI participating state has developed its own plan for investment of CO_2 allowance proceeds in consumer benefit and strategic energy programs. The plans, which are individually administered by each state, encompass a wide variety of initiatives to improve energy efficiency, increase renewable energy generation, reduce consumer energy costs, and drive the transition to a clean energy economy. Each state's investment plan is summarized in Section 4 of this report. This analysis translates the regional portfolio of investments across all ten RGGI participating states into four key program areas: energy efficiency, renewable energy, direct energy bill assistance, and other greenhouse gas (GHG) reduction programs. The four categories are described below.

Energy Efficiency:	Programs to increase end-use energy efficiency
	States have tailored their programs to their own economies, but programs across the region typically include initiatives to weatherize homes, businesses and public buildings; provide incentives for the purchase of energy-efficient appliances and equipment; provide grants for large-scale commercial and industrial energy efficiency projects; foster community-wide commitments to improve energy efficiency; and provide job training for workers in the energy efficiency field.
Renewable Energy:	Programs to accelerate the deployment of renewable energy technologies
	Programs vary from state to state; however, the majority of regional CO_2 allowance proceeds are currently devoted to the deployment of solar energy generation technologies on residential, municipal, and non-profit buildings, with a smaller portion supporting the deployment of wind, solar and biomass technologies in commercial and industrial settings.
Direct Energy Bill Assistance:	Programs to directly mitigate consumer energy costs
	Programs vary, but most programs provide direct energy bill payment assistance to ratepayers with moderate or limited income and/or households with a demonstrated inability to cover energy costs.
Other GHG Reduction Programs:	Varied programs to reduce greenhouse gas emissions
	Programs include a wide variety of initiatives to promote research, development and deployment of carbon emission abatement technologies, efforts to reduce vehicle miles traveled, and carbon sequestration (terrestrial and geologic). For regional comparison purposes, climate change adaptation measures are also included in this category.

Table 3 (below) shows each state's investment of CO_2 allowance proceeds by percentage across the regional program categories for the period September 25, 2008 (the debut of the RGGI CO_2 allowance auctions) through December 31, 2010. In addition to program investments, the table also shows the percent of proceeds used by each state to cover costs associated with the administration of a state's CO_2 Budget Trading Program and/or related consumer benefit programs, as well as the percent of proceeds dedicated to state budget deficit reduction measures, for the period September 25, 2008 through December 31, 2010.

Table 3: Percent of State Investments by Category (September 25, 2008-December 31, 2010)

State	Percent of Total Proceeds	Energy Efficiency	Renewable Energy	Direct Energy Bill Assistance	Other GHG Reduction Programs	Program Admin.	State Budget Deficit Reduction	TOTAL
Connecticut	6.02%	69.5%	23.0%	--	4.5%	3.0%	--	100%
Delaware	2.38%	64.8%	18.2%	5.0%	7.0%	5.0%	--	100%
Maine	2.97%	94.0%	--	--	1.0%	5.0%	--	100%
Maryland[x]	18.64%	23.2%	7.3%	66.4%	--	3.1%	--	100%
Massachusetts	15.57%	89.0%	9.3%	--	--	1.7%	--	100%
New Hampshire	3.56%	86.6%	--	--	--	2.4%	11.0%[xi]	100%
New Jersey	12.91%	18.0%	18.0%	14.2%	0.5%	5.3%	44.0%[xii]	100%
New York	35.66%	48.7%	10.5%	--	1.7%	7.3%[xiii]	31.8%[xiv]	100%
Rhode Island	1.56%	95.0%	--	--	--	5.0%	--	100%
Vermont	0.72%	98.0%	--	--	--	2.0%	--	100%
Region	**100%**	**51.6%**	**10.7%**	**14.4%**	**1.1%**	**4.8%[xv]**	**17.4%**	**100%**

[x] In Maryland, CO_2 allowance proceeds from auctions conducted before March 1, 2009 (auctions 1 and 2) are allocated according to Senate Bill 268: An Act Concerning Regional Greenhouse Gas Initiative (S-268). CO_2 allowance proceeds from auctions conducted after March 1, 2009 (Auctions 3-10) are allocated according to House Bill 101: The Budget Reconciliation and Financing Act of 2009 (H-101). The percentages shown here reflect a weighted average between H-101 and S-268, with H-101 factored at 2/10 and S-628 factored at 8/10.

[xi] As part of the New Hampshire 2010 State budget, $3.1 million of CO_2 allowance proceeds was diverted to the State General Fund in 2010. The percentage figure here accounts for the entire amount.

[xii] As part of the New Jersey 2011 State budget, $65 million of CO_2 allowance proceeds are anticipated to be diverted to the State General Fund over the course of fiscal year 2011 (through June 2011). The percentage figure here accounts for $45 million, the amount anticipated to be diverted to the State General Fund through December 31, 2010.

[xiii] The percentage figure here includes 4.7 percent for program administration, 1.2 percent for State Cost Recovery Fee, 0.8 percent for New York's prorata share of ongoing RGGI, Inc. operating costs through 2011, and 0.6 percent for RGGI, Inc. start-up costs.

[xiv] As part of an emergency Deficit Reduction Plan enacted in 2009, $90 million of CO_2 allowance proceeds was diverted to the State General Fund. The percentage figure here accounts for the entire amount.

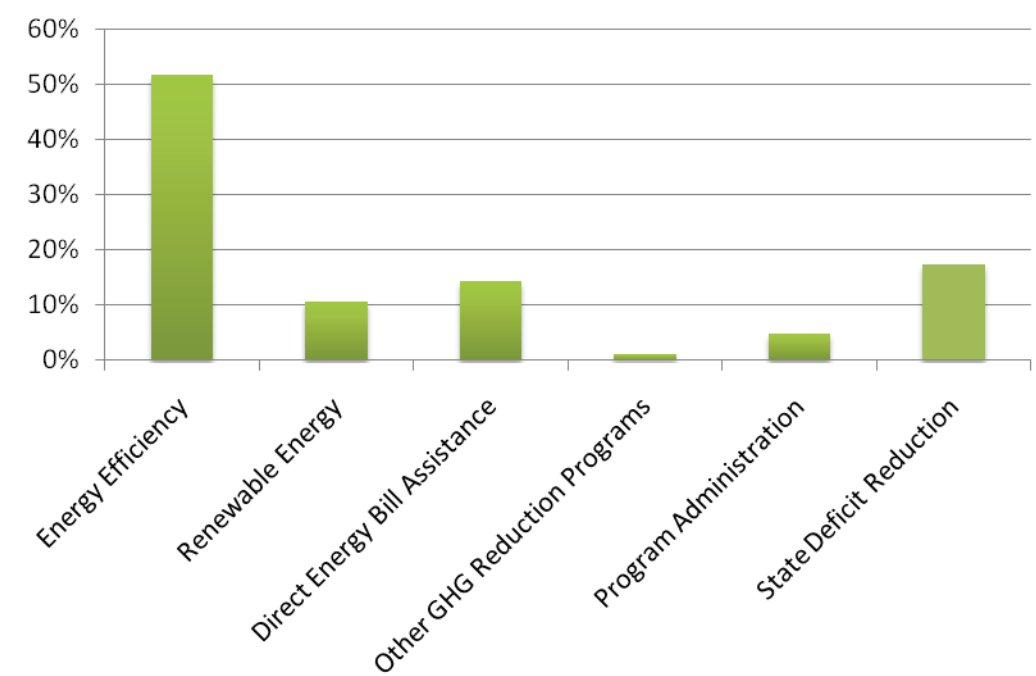
[xv] RGGI, Inc. operating costs through 2010 account for approximately 15 percent of the CO_2 allowance proceeds allocated to program administration (represented in this category) and approximately 0.7 percent of total regional CO_2 allowance proceeds through December 31, 2010.

While each state directs its own investment strategy, the following regional trends emerge:

- Overall, states are investing 52 percent of CO_2 allowance proceeds in energy efficiency programs;
- Overall states are investing 11 percent of CO_2 allowance proceeds in renewable energy programs;
- Regionally, states are investing 14 percent of CO_2 allowance proceeds in direct energy bill payment assistance programs, including assistance to low-income ratepayers;
- Regionally, states are investing 1 percent of CO_2 allowance proceeds in a wide variety of programs to promote research, development and deployment of other greenhouse gas emission reduction techniques and technologies;
- For five of ten states, investments in energy efficiency programs account for more than 85 percent of CO_2 allowance proceeds; and
- For seven of ten states, investments in energy efficiency and renewable energy programs account for more than 85 percent of CO_2 allowance proceeds.

Figure 1 shows the estimated portion of total regional CO_2 allowance proceeds (through December 31, 2010) invested in each program category by RGGI participating states.

Figure 1: Regional Investment of CO_2 Allowance Proceeds



Section 2: Energy Efficiency, Renewable Energy, and a Clean Energy Economy

Overall, the RGGI participating states are investing the vast majority of CO_2 allowance proceeds in programs to improve energy efficiency and accelerate the deployment of renewable energy technologies. These investments deliver triple benefits – to the environment, consumers, and the economy. Some of the benefits provided by RGGI state investments include:

	Environmental Gains		Consumer Savings			Economic Benefits			
	Reduced Emissions of GHGs	Improved Air Quality	Consumer Control over Energy Use & Costs	Reduced Electricity Demand & Lower Wholesale Prices	Reduced Need for New Power Generation Facilities	Increased Demand for Clean Energy Products & Services	New Jobs in Clean Energy Industries	Increased Investment in Emerging Businesses & Technologies	Positive Returns on Investment
Energy Efficiency	✓	✓	✓	✓	✓	✓	✓	✓	✓
Renewable Energy	✓	✓	✓	✓	✓	✓	✓	✓	✓

Sections 2.1 and 2.2 below describe some of the energy efficiency and renewable energy programs funded with CO_2 allowance proceeds, and explain how these programs contribute to the benefits described above. Sections 2.3 and 2.4 describe energy bill assistance programs and other greenhouse gas reduction programs funded with CO_2 allowance proceeds.

2.1 Energy Efficiency

Energy efficiency is the most cost-effective tool for reducing greenhouse gas emissions in the near-term. It typically costs about 2.5 cents to save a kilowatt-hour of electricity though energy efficiency, and between 6 and 15 cents to generate a kilowatt-hour from conventional generation sources.[21] To harness the vast potential for cost-effective energy efficiency gains, the RGGI participating states are investing 52 percent of CO_2 allowance proceeds to improve energy efficiency in residential, commercial, industrial, institutional, and municipal sectors. Some of the many energy efficiency programs being funded with CO_2 allowance proceeds include:

- Home weatherization and retrofitting
- Incentives for energy-efficient appliances
- Energy efficiency retrofits for small businesses
- Educational programs for businesses and consumers
- Large-scale commercial and industrial energy efficiency projects, including combined heat and power
- Municipal clean energy projects
- Energy sector occupational training programs

Home Weatherization and Retrofitting

Home weatherization and retrofitting measures, including duct sealing, window replacements, and heating system repairs, typically reduce household heating energy needs by 15 to 30 percent while improving indoor air quality and overall comfort for occupants.[22] The same measures also reduce CO_2 emissions by an average of one metric ton of CO_2 per year per weatherized home.[23] All of the RGGI participating states are investing CO_2 allowance proceeds to weatherize homes, especially in low-income communities where homeowners and renters spend a disproportionate percentage of their income on energy. Programs funded with CO_2 allowance proceeds include:

New York – Green Jobs/Green New York (GJ/GNY): GJ/GNY is a statewide $112 million program to promote energy efficiency and the installation of clean energy technologies to reduce energy costs and greenhouse gas emissions. GJ/GNY provides approximately $20 million to support energy audits for an anticipated 100,000 households and small businesses. The program also offers approximately $50 million in financing options to support the implementation of many of these projects. It is estimated that all of the projects implemented using GJ/GNY audits and/or financing may result in 675,000 megawatt-hours in electricity savings, more than 25,000,000 MMBTU in thermal savings, and about $600 million in energy bill savings over the lifetime of the installed measures. In addition, GJ/GNY is designed to support sustainable community development and create green job opportunities. For instance, the program provides approximately $8 million in funds to support job training programs that will reach approximately 6,000 New York workers.[xvi]

Success Story: RGGI Funds Help Low-Income Family in Upstate New York Cut Energy Costs and Increase Comfort

EmPower New York is investing $3 million of RGGI proceeds to help 700 low income households save money while making their homes more comfortable. For example, in Watertown, N.Y., the program helped a family add attic insulation, seal doorways and install a programmable thermostat. The contractor, certified by the Building Performance Institute, reduced air leakage paths above 15 recessed lights, repaired the bathroom vent and vented the dryer to the outside. In addition, high efficiency lighting was funded through New York's System Benefits Charge. The family reports that the house is quieter and less drafty, and the program estimates that the household will save $670 a year in the cost of home heating oil, and $60 in electricity bills annually.

EmPower serves households with income below 60 percent of state median income and pays for 100 percent of the approved work scope.

Connecticut – Home Energy Solutions Program (HES): HES provides weatherization measures to help renters and homeowners, including those with limited incomes, reduce their energy costs. In 2010, these programs serviced over 34,000 customers, saving them a total of more than $10.4 million per year.[24] In 2010, CO_2 allowance proceeds accounted for approximately 7 percent of the total funding provided for this program.[25]

Massachusetts – Heating Emergency Assistance Retrofit Task Weatherization Assistance Program (HeartWAP): In 2009, the Massachusetts Department of Housing and Community Development (DHCD) deployed $4 million in CO_2 allowance proceeds to replace more than 1,300 heating system units in low-income households. DHCD estimates that the program reduced

[xvi] While a portion of the GJ/GNY projects are expected to access a GJ/GNY Loan, a significant number of participants may complete the installation of their energy-related improvements exclusively with alternative financial support.

household heating energy costs by 25 percent, equivalent to about $500 in energy savings per household per year.[26]

Incentives for Energy-Efficient Appliances

Replacing outdated household appliances, such as refrigerators, room air conditioners, water heaters, dishwashers, dehumidifiers, clothes washers, clothes driers, and lighting, with more energy-efficient models can result in significant energy savings. For example, by replacing a 20-year-old refrigerator with a new, energy-efficient model, consumers can reduce their annual electricity costs by about $80, while avoiding roughly one ton of CO_2 emissions per year.[27] Similarly, by replacing an incandescent light bulb with an ENERGY STAR-qualified compact fluorescent light (CFL), consumers can save $30 over the life of the bulb.[28] All of the RGGI participating states have in place programs to incentivize the purchase of energy-efficient appliances or lighting, and several (Connecticut, Delaware, Maryland, Maine, New Hampshire, and Rhode Island) are investing RGGI CO_2 allowance proceeds to expand these programs. Examples of programs funded with CO_2 allowance proceeds include:

Connecticut – Retail Products Program: Connecticut's Retail Products Program promotes the sale of discounted CFLs in many of Connecticut's grocery, pharmacy, home improvement and big box stores. In 2010, the program served more than 797,000 consumers, saving them a total of more than $37 million per year.[29] In 2010, approximately 7 percent of the program's funding was provided by Connecticut's investment of CO_2 allowance proceeds.[30]

Maine – Efficiency Maine Residential Lighting Program: Efficiency Maine's Residential Lighting Program works closely with lighting manufacturers and retailers to encourage them to produce and sell energy-efficient lighting products. In 2010, the program resulted in more than 303,000 megawatt-hours in annual electricity savings, and generated more than $5.70 in lifetime benefits for every $1.00 invested.[31] According to staff of Efficiency Maine, CO_2 allowance proceeds represented 55 percent of the program's total funding in 2010.

Rhode Island – ENERGY STAR Lighting and Products: Rhode Island is investing CO_2 allowance proceeds in a variety of appliance discount and rebate programs administered by National Grid. A program similar to those currently being funded by CO_2 allowance proceeds leveraged a National Grid Partnership with Sears to provide a $20 mark down on Energy-Star-certified room air conditioners. The program serviced more than 500 Rhode Islanders, saving them a collective total of more than $7,000 in energy bills annually.[32]

Delaware – Energize Delaware Appliance Rebate Program: The Sustainable Energy Utility's Energize Delaware Appliance Rebate Program provides rebates of up to $200 for the purchase of an ENERGY STAR-qualified clothes washer, dishwasher, room air conditioner, or gas water heater. Between September 2009 and September 2010, the program provided more than 15,900 rebates to Delaware consumers, saving them a collective total of more than $366,000 in energy bills annually. [33] According to program administrators at the Sustainable Energy Utility, CO_2 allowance proceeds represented approximately 40 percent of the program's total funding.

Energy Efficiency Retrofits in Small Businesses

Several of the RGGI participating states are investing CO_2 allowance proceeds to provide technical and financial assistance to help small businesses reduce their energy budgets through energy efficiency. Examples of programs funded with CO_2 allowance proceeds include:

New Hampshire – Business Energy Conservation Revolving Loan Fund: In 2009, New Hampshire invested $2 million of its CO_2 allowance proceeds to establish an energy conservation revolving loan fund administered by the Business Finance Authority. Through July 2010, a total of $650,000 in loans has been approved for three recipients, which together employ nearly 660 people in high-wage manufacturing jobs.[34] The loans, which would not have been funded through other lending institutions, are helping New Hampshire businesses lower energy expenses and improve their competitiveness. Loan repayments are being reinvested in the fund to help additional businesses finance energy improvements.

Success Story: RGGI Funds Help New Hampshire Rehabilitation Center Save Energy

Crotched Mountain Rehabilitation Center, a charitable organization that provides education, rehabilitation and residential support services, is realizing significant energy savings with help from New Hampshire's investment of CO_2 allowance proceeds. Using a $176,500 grant funded by CO_2 allowance proceeds, the center connected one of its buildings to a state-of-the art central district heating system that uses wood chips harvested locally from New Hampshire forests. As a result of the project, the building now requires the equivalent of 6,000 gallons of heating oil per year, down from 25,000 gallons prior to the retrofit.

"Our residents now enjoy comfortable, regulated heat, from an efficient system fueled by wood from a nearby family-run business" said Ray Sebold, project manager at Crotched Mountain. "As the largest employer in the area, with more than 800 employees, keeping our costs low is a top priority. The RGGI grant is enabling us to save resources, cut costs, and support a local business with sustainable fuel purchases."

The project was funded by $176,500 in CO_2 allowance proceeds.

Connecticut – Small Business Energy Advantage Program (SBEA): SBEA provides small business owners with the means to reduce their energy budgets. In 2010, SBEA's authorized contractors conducted energy assessments and provided energy-efficient upgrades to nearly 1,900 businesses. The upgrades are saving participating businesses more than $5.8 million annually, while avoiding nearly 18,000 tons of CO_2 emissions per year.[35]

Success Story: RGGI Funds Help Connecticut Restaurant Improve Energy Efficiency

Chick's Drive-In, a landmark restaurant in West Haven, Connecticut, was just one of nearly 1,900 small businesses to benefit from SBEA in 2010. Through SBEA, the restaurant received financial incentives for the purchase and installation of more efficient lighting and refrigeration equipment. As a result, the owner Joseph "Chick" Celentano is now saving hundreds of dollars on his electricity bill each month. The eatery will save 468,000 kilowatt-hours of electricity—the equivalent of planting 56 acres of trees or saving more than 17,000 gallons of gas—over the lifetime of the new equipment.

In 2010, CO_2 allowance proceeds represented about 7 percent of SBEA's total funding.

Maine – Efficiency Maine Business Incentive Program: The Efficiency Maine Business Incentive Program provides cash incentives and free, independent technical advice to help businesses save energy. In 2010, the program completed 1,656 projects for 1,029 companies. Participating businesses will save more than $50 million in electric bills over the lifetime of their new equipment.[36] According to staff of Efficiency Maine, CO_2 allowance proceeds represented 50 percent of the program's total funding in 2010.

Educational Programs for Businesses and Consumers

Increasing awareness of both the opportunities for energy efficiency as well technical and financial resources available to consumers can lead to measurable energy and cost savings. An evaluation of New York's Consumer Education Program for Residential Energy Efficiency showed that more than two-thirds of people who participated in the program in 2006 implemented recommended practices.[37] Those who implemented the practices reduced their home energy bills by an average of approximately $400 annually and avoided nearly 2.5 metric tons of CO_2 emissions per year.[38] Many of the RGGI participating states are investing CO_2 allowance proceeds in similar programs to educate consumers and help them realize cost-effective energy efficiency improvements. Examples of programs funded with CO_2 allowance proceeds include:

Vermont – Vermont Community Energy Mobilization (VCEM) Project: Vermont is investing CO_2 allowance proceeds to engage local town energy committees and other groups to organize and train volunteers to undertake door-to-door visits in their communities. In 2009 and 2010, more than 500 volunteers visited approximately 1,100 homes to install simple energy-saving measures and teach homeowners about larger opportunities for energy efficiency improvements. Over the first two years of the program, the installed measures saved an estimated total of 590,000 kilowatt-hours of electricity and 1,750 MMBTU of heating energy.[39]

The home energy visits also incited participants to implement additional energy efficiency measures beyond those provided through the program. In a follow-up survey conducted in 2009, approximately 62 percent of participants said that they had already taken additional steps to improve energy efficiency in their homes, while 72 percent said that they planned to take additional steps to improve efficiency as a result of the home energy visit.[40]

Success Story: Residents of Manchester, Vermont Reap Benefits of RGGI-Funded Energy Efficiency Program

As a result of energy efficiency measures installed through the Vermont Community Energy Mobilization (VCEM) Project, participating residents in Manchester, Vermont, are now saving a collective total of more than $5,000 per year, based on average residential electricity rates. Manchester's efforts brought 34 Efficiency Vermont-trained volunteers into a total of 48 homes in Manchester, Dorset and Peru to identify potential energy-saving retrofits, install energy-efficient products, and educate residents about ways to further reduce energy costs.

"A great component of this project is that it truly reflects Vermont's state ethos of neighbors helping neighbors," said VCEM statewide coordinator, Paul Markowitz.

According to Efficiency Vermont, CO_2 allowance proceeds currently represent approximately 25 percent of VCEM's total funding.

Maryland – General Awareness Campaign: Based on the EmPOWER Maryland 15 percent energy efficiency goals, the General Awareness Campaign provided 15 tips for saving money and energy and guided consumers through the process of implementing home energy efficiency improvements. Between fiscal year 2009 and fiscal year 2010, the Maryland Energy Administration's (MEA's) website traffic increased by more than 34 percent. During the same period, MEA's newsletter increased its reach to more than 3,600 opt-in subscribers each month, up from 2,300 in fiscal year 2009. The campaign was funded in part by $1.6 million of Maryland's CO_2 allowance proceeds.[41]

Large-Scale Commercial and Industrial Energy Efficiency Projects

Commercial and industrial operations represent significant potential for energy efficiency gains. Together, the sectors account for 50 percent of national energy use[42] and about 65 percent of national cost-effective energy efficiency potential.[43] Many of the RGGI participating states are investing CO_2 allowance proceeds to improve energy efficiency in large-scale commercial and industrial settings. Maine and New Jersey are each investing a significant portion of CO_2 allowance proceeds to provide loans and grants for process improvements and combined heat and power (CHP) systems in these sectors. Examples of programs funded with CO_2 allowance proceeds include:

Maine – Large Projects Grant Program: Maine has invested \$7.1 million of its CO_2 allowance proceeds to provide grants ranging from \$100,000 to \$1 million for large-scale commercial and industrial energy efficiency projects. Through December 2010, a total of 36 grants were awarded, 19 of which were funded with CO_2 allowance proceeds. Those 19 projects are expected to save 533,876 megawatt-hours of grid electricity over the lifetime of the projects, preventing the emission of 506,861 tons of CO_2. Awarded projects range from installing variable-speed drives, to heat recovery and CHP systems.[44]

Success Story: RGGI Funds Help Waldo County's Largest Industrial Manufacturer Reduce Energy Costs

With the help of a \$314,000 grant from Efficiency Maine, GAC Chemical in Searsport, Maine, is implementing a variety of innovative measures to recycle steam from the manufacturing process to heat water. Together the measures are projected to:

- Save 275,000 gallons of #6 fuel oil over their lifetime, enough to heat 247 homes for a year
- Save 223,861 kWh of electricity over their lifetime, enough to power 35 homes for a year

GAC Chemical is the largest industrial manufacturer in Waldo County, employing 60 people. The project will help keep these jobs in Waldo County and make GAC more competitive with companies outside the state.

GAC Chemical is just one of 19 companies to receive a RGGI-funded grant for large-scale efficiency retrofits from Efficiency Maine.

New Jersey – Clean Energy Solutions Capital Investment (CESCI) Loan/Grant Program: Through 2010, New Jersey has allocated \$36.8 million of its CO_2 allowance proceeds to provide zero-interest loans and grants for large-scale energy efficiency and renewable energy projects. Through 2010, 12 projects have received a total of \$29.6 million in grants or loans funded by CO_2 allowance proceeds for CHP systems and commercial-scale solar electric systems. The CHP and solar-electric systems represent 29.6 megawatts of new, clean generation capacity. These projects are projected to generate more than 167,000 megawatt-hours of electricity per year, enough to meet the equivalent annual electricity needs of more than 19,600 typical New Jersey households, and are projected to avoid 84,000 tons of CO_2 emissions per year and 1.7 million tons of CO_2 emissions over the lifetime of the projects.[45] CESCI is funded exclusively by New Jersey's investment of CO_2 allowance proceeds.

Municipal Clean Energy Programs

Energy efficiency improvements in public buildings and facilities can generate significant energy cost savings for local governments, freeing up funds for important public services. All of the RGGI participating states have in place programs to assist local governments with energy efficiency measures, and several (Connecticut, Maryland, Massachusetts, New Hampshire, New Jersey, and New York) are investing CO_2 allowance proceeds to expand their efforts. Examples of programs funded with CO_2 allowance proceeds include:

Massachusetts – Green Communities Program: Nearly 150 cities and towns have qualified to receive free technical assistance as they strive to qualify for grants for municipal energy efficiency and renewable energy projects through the Green Communities Program. Through the program, contractors are providing more than $1.62 million in energy consulting services to help cities and towns meet five criteria required to receive designation as "Green Communities." Municipalities that meet the five criteria are then eligible for grants to expand municipal renewable energy and energy efficiency programs. Grants are funded exclusively by CO_2 allowance proceeds. As of December 16, 2010, 35 municipalities had received grants totaling $8.1 million. Another 18 communities that recently met eligibility requirements for Green Communities grants will share an additional $4 million in grants this winter, and a subsequent $4 million grant round will take place during the spring and summer of 2011.[46]

Success Story: RGGI Funds Improve Working Conditions for City Employees in Athol, Massachusetts

Eighty years after its construction, the Town Hall in Athol, Massachusetts, had become an uncomfortable place for its 29 employees. "The town clerk's office was so cold that we put plastic up inside the window," David Ames, Athol's town manager, said in a November interview with *Governing Magazine*. But when Ames looked into replacing the old single-pane windows, the total cost ($100,000) prevented the project from moving forward.

In 2010, all that changed when Athol received a $98,000 grant from the Massachusetts Department of Energy Resources for new Energy Star-certified windows. The grants, made possible by the Green Communities Program, are enabling Athol to realize significant energy bill savings while improving working conditions for its employees.

The Green Communities Program is funded exclusively by CO_2 allowance proceeds.

New Hampshire – EnergySmart Schools Program: New Hampshire has invested $500,000 in CO_2 allowance proceeds to provide energy benchmarking services to New Hampshire's K-12 schools. Each school will receive a report that documents energy use, costs, and CO_2 emissions for each building, and provides recommendations for immediate strategies to improve energy efficiency. As of July 2010, 62 schools have been provided with benchmarking reports.[47]

New York – Climate Smart Communities Program: New York has allocated $1.7 million in CO_2 allowance proceeds to connect local governments with regional planning boards, Municipal Planning Organizations (MPOs), and other consortia that can provide senior staff, technical platforms, and best practices to help local governments develop greenhouse gas inventories and commit to aggressive, achievable greenhouse gas emissions reduction targets.[48] More than $100 million are available through other New York funding sources to help communities implement identified efficiency and renewable energy measures. The Climate Smart Communities Program is funded exclusively by CO_2 allowance proceeds.

Energy Sector Occupational Training Programs

Investments in energy efficiency and renewable energy drive demand for new products and services and stimulate the economy with energy bill savings, thereby creating jobs. A 2010 analysis by Environment Northeast estimates that energy efficiency programs funded with CO_2 allowance proceeds through December 2010 will create nearly 18,000 job years – that is, the equivalent of 18,000 full-time jobs that last one year.[49] Employment benefits result from state program investments and from the reinvestment of consumer energy bill savings in the wider economy. While there has not yet been a similar analysis of RGGI-funded renewable energy programs, data from the Renewable Energy Policy Project shows every $1 million invested in renewable energy systems creates about six full-time manufacturing jobs, as well as additional jobs in construction and facility maintenance.[50]

To ensure people have the training and certification they need to take advantage of emerging opportunities, the RGGI participating states are partnering with a variety of organizations, including electric utilities, trade associations, and community colleges, to train and certify workers to fill entry-level and advanced jobs in clean energy industries. Programs implemented from Maine to Maryland are engaging third parties to train new building energy analysts, heating energy technicians, energy auditors, and green building architects. Programs funded with CO_2 allowance proceeds include:

New Hampshire – Building Analyst Course through Lakes Region Community College: In 2009, New Hampshire invested $174,000 of its CO_2 allowance proceeds to establish a new certification program for building analysts through Lakes Region Community College (LRCC) and at five other locations around the state.[51] Scholarships equal to up to 50 percent of program's tuition are available, and graduates emerge as Building Performance Institute (BPI)-certified energy auditors. Between late 2009 and December 2010, LRCC conducted 13 energy-auditor trainings, reaching more than 170 professionals from across New Hampshire.[52]

Participants are reporting significant benefits as a result of the program. In a survey conducted among recent graduates, 38 percent said they were better able to perform existing job duties as a result of the program; 9 percent said they had become employed in the energy field; and 10 percent said they had started a new energy business.[53]

Success Story: RGGI-Funded Job Certification Program Gives Rise to New Business

One company to emerge from a new training program for building analysts at Lakes Region Community College (LRCC) is NHNRG, a full-service energy auditing and building performance contractor. The company was founded by Shad Lawton and Jamie Myers, both students in the October 2009 Littleton class. After completing the course, Lawton and Myers decided to found NHNRG in Lisbon, New Hampshire. As a company, they have conducted more than 140 energy audits and performed more than 80 building retrofits.

“I really enjoyed the course,” said Mr. Lawton. “I had wanted to get certified for a while, but the cost and distance to the closest course were preventative for me. Then LRCC advertised the BPI BA course with the discounted tuition and it was a no brainer.”

“The key components of the audits that we are now doing every day are taught in the Building Analyst course,” he added. “We had a very busy year in 2010, but there is enough housing stock in the North Country alone to keep several companies busy for years to come.”

The BPI certification program at LRCC was funded by an initial grant of $174,000 in CO_2 allowance proceeds in 2009 and an additional grant of $400,000 in CO_2 allowance proceeds in 2010.

Maryland – Home Energy Retrofit and Weatherization Workforce Training Program: Through June 30, 2010, Maryland invested $1.37 million of its CO_2 allowance proceeds to expand the Home Energy Retrofit and Weatherization Workforce Training Program, which offers a "one-stop" training source for any energy retrofit career path, including careers with local weatherization agencies and with Maryland's utility providers. Through June 30, 2010, the program provided energy efficiency-related job training to more than 900 individuals and businesses across the state.[54]

Massachusetts – Energy Efficiency Skills and Innovation Initiative: Massachusetts has invested $1.9 million of its CO_2 allowance proceeds in the Energy Efficiency Skills and Innovation Initiative. Under the Initiative, Springfield Technical Community College (STCC) was awarded a three-year $1.87 million contract to coordinate energy efficiency workforce training programs across the state. STCC is serving as a statewide clearinghouse for energy efficiency training activities and services, and is coordinating job training at community colleges across the state.

New York – Workforce Development Programs: New York has committed $8 million in CO_2 allowance proceeds to greatly expand the workforce training infrastructure needed to prepare workers to design, implement, and maintain energy efficiency projects. Funds are used to provide apprenticeship and internship incentives to employers and training institutions, expand existing training centers, fund basic skill initiatives, provide funding for training equipment, and improve field testing and certification processes to help increase the number of qualified workers. The funds are projected to support training programs that will reach approximately 6,000 workers.

2.2 Renewable Energy Programs

Harnessing the power of renewable energy sources, such as solar, wind, and geothermal, is central to developing a clean energy economy. However, renewable energy generation projects often confront market barriers associated with higher upfront costs and access to capital. To overcome these barriers, the RGGI participating states are investing 11 percent of CO_2 allowance proceeds to support the deployment of renewable energy technologies. The vast majority of the programs provide grants and low- or no-interest loans for on-site renewable energy generation systems on homes, businesses, and public buildings, and in commercial and industrial settings.

On-Site Renewable Energy Generation

On-site renewable energy generation systems, such as solar, geothermal, and wind, have several unique benefits compared to conventional large-scale power plants. By generating clean, renewable electricity at the point of use, renewable energy generation systems reduce demand for conventional grid electricity, depressing wholesale electricity prices and improving overall electric system reliability. These investments also reduce CO_2 emissions and, in some cases, generate excess power that consumers can sell back to the grid for a profit. Examples of programs funded with CO_2 allowance proceeds include:

New York – Statewide Photovoltaic Program: Through October 2010, New York has committed $12 million of its CO_2 allowance proceeds to support end-use solar installations for commercial, industrial, and residential customers, as well as electric utility applications. The program, which includes targeted financial incentives, is designed to help establish a sustainable market for solar energy throughout New York. The program is also designed to improve the performance of distribution circuits and reduce peak electric load in critical load pockets. Through October 2010, the program has supported the installation of 383 solar photovoltaic systems with a total capacity of approximately 3,710 kilowatts. It is estimated that these systems will produce 4,371 megawatt-hours of electricity annually.[55]

Success Story: Developer Invests in Solar Panels to Cut Electricity Costs for Medical Group in New York

Benerofe Properties, a third-generation family real estate business with properties in the Eastern United States, has installed 308 solar modules on the rooftop of its property in Harrison, N.Y., to help its tenant, WestMed Medical Group, cut electricity costs. The 80 kilowatt system is expected to produce approximately 93,000 kilowatt-hours of electricity each year, reducing the building's carbon footprint by 960 tons of CO_2 over the lifetime of the system. Mercury Solar, the qualified PV installer, estimates that WestMed Medical Group will save approximately $14,000 in electricity costs each year. WestMed Medical Group is a Westchester County-based medical group that has been helping the community since 1996.

New York supported this project with $200,000 in CO_2 allowance proceeds.

Connecticut – On-Site Distributed Generation Program: Through October 2010, Connecticut has approved the use of $4.7 million of its CO_2 allowance proceeds for municipal renewable energy projects through the On-Site Distributed Generation Program administered by the Connecticut Clean Energy Fund. The allocation funds solar photovoltaic energy systems on municipal buildings. Between November 2009 and October 2010, 22 projects were approved, 15 on schools and seven on town buildings, with a total capacity of 1,236 kilowatts It is estimated that these systems will produce 1,456 megawatt-hours of electricity annually.[56]

Maryland – Residential Renewable Energy Grant Program: Through June 30, 2010, Maryland invested $3.4 million of its CO_2 allowance proceeds to provide grants for the installation of solar, wind and geothermal electricity and hot water systems in homes and small businesses. Through July 2010, more than 820 Marylanders received grants for renewable energy systems. Together, the projects are estimated to generate and save more than 4,000 megawatt-hours of electricity annually.[57]

Success Story: Solar Energy Grants Help Maryland Couple Reduce Power Bill by 33%

Frank and Lois Bohdal are among more than 820 Marylanders who received grants to help them install home solar, wind or geothermal energy systems. Bohdal, a computer programmer with the state comptroller's office, has blanketed the south-facing roof of the couple's Millersville rancher with 40 solar panels. The panels cost a total of $55,000, but Maryland helped cover their installation with nearly $14,000 in grants. The electricity the Bohdal's solar system generates has reduced the couple's power bill by nearly a third.

Maryland's Residential Renewable Energy Grant Program was funded by $3.4 million in CO_2 allowance proceeds in fiscal years 2009 and 2010.

New Jersey – Clean Energy Solutions Capital Investment (CESCI) Loan/Grant Program: Through 2010, New Jersey has allocated $36.8 million of its CO_2 allowance proceeds to provide zero-interest loans and grants for large-scale energy efficiency and renewable energy projects. Through 2010, 12 projects have received a total of $29.6 million in grants or loans funded by CO_2 allowance proceeds for CHP systems and commercial-scale solar electric systems. The CHP and solar-electric systems represent 29.6 megawatts of new, clean generation capacity. These projects are projected to generate more than 167,000 megawatt-hours of electricity per year, enough to meet the equivalent annual electricity needs of more than 19,600 typical New Jersey households, and are projected to avoid 84,000 tons of CO_2 emissions per year and 1.7 million tons of CO_2 emissions over the lifetime of the projects.[58] CESCI is funded exclusively by New Jersey's investment of CO_2 allowance proceeds.

2.3 Direct Energy Bill Assistance Programs

Direct energy bill payment assistance programs, such as the federal Low-Income Heating Energy Assistance Program (LIHEAP) and state Universal Service Funds, provide essential lifelines to many low-income residents in the Northeast and Mid-Atlantic regions. Regionally, the RGGI participating states are investing 14 percent of CO_2 allowance proceeds to supplement existing funds, helping to deliver benefits to the greatest possible number of qualifying consumers. In particular, Delaware, Maryland, and New Jersey are using CO_2 allowance proceeds for these purposes. Other states, including Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont, are investing CO_2 allowance proceeds to help reduce consumer energy costs through weatherization programs. Examples of programs funded with CO_2 allowance proceeds include:

Maryland – Electric Universal Service Program (EUSP): Through June 30, 2010, Maryland invested $45.4 million of its CO_2 allowance proceeds to provide electric bill payment assistance to low-income consumers across the state. Funds are invested to provide Bill Payment Assistance and Arrearage Retirement Assistance benefits to low-income eligible households through the Electric Universal Service Program (EUSP). Bill Payment Assistance benefits are based upon electric usage and household income with a portion of electric bills being paid by the benefit. Arrearage Retirement Assistance benefits, available once every seven years per applicant, are used to retire energy bills up to a maximum of $2,000. In fiscal years 2009 and 2010, CO_2 allowance proceeds provided more than 35,000 households with benefits totaling $45.4 million. All benefits were paid directly to utilities on behalf of program applicant.[59]

Delaware – Delaware Energy Assistance Program (DEAP): Delaware is investing CO_2 allowance proceeds to support the Delaware Energy Assistance Program (DEAP). DEAP is administered on a contractual basis with Catholic Charities, Inc. DEAP programs include: the Low-Income Heating Assistance Program (LIHEAP), which provides discounted heating fuel to qualifying low-income consumers; Summer Cooling Assistance Program (SCAP), which provides electricity bill assistance, as well as free or discounted air conditioning units, to income-eligible households during the summer months; and a Crisis Assistance program to provide supplemental grants to low-income residents who are unable to pay their energy bills and are facing service cutoffs during the winter months.

2.4 Other Greenhouse Gas Reduction Programs

The RGGI participating states are investing one percent of CO_2 allowance proceeds in a wide variety of programs to promote research, development, and deployment (RD&D) of carbon emission abatement technologies, adaptation measures, and carbon sequestration (terrestrial and geologic). Five states are investing proceeds in this program area: Connecticut, Delaware, Maine, New Jersey, and New York. Programs vary significantly from state to state, and are typically designed to build upon a particular state's existing partnerships and RD&D programs. Examples of programs funded with CO_2 allowance proceeds include:

New York – Advanced Power Delivery Program:
New York's Advanced Power Delivery program is led by the New York Smart Grid Consortium, a group consisting of utilities, the New York Independent System Operator (NYISO), New York State agencies and authorities, and industry representatives. The program will provide targeted grants for specific technology areas, including but not limited to: energy storage, distribution automation, advanced metering, dynamic pricing, and reactive power management to reduce electric system losses.

Maine – Forestry Offset Research:
Maine is investing up to $100,000 of its annual CO_2 allowance proceeds in terrestrial carbon sequestration projects. These projects build on Maine's standing expertise in forest management and its innovative work on the development of new offset project categories and methodologies.

Section 3: Driving Policy Innovation

Innovative elements of RGGI's design are influencing the development of other cap-and trade programs, such as the Western Climate Initiative and the European Union Emissions Trading System. Two key design elements – CO_2 allowance auctions and reinvestment of proceeds in strategic energy programs – have demonstrated how market-based programs can harness the value of a CO_2 emission cap to deliver emission reductions at low cost.

In particular, the investment of CO_2 allowance proceeds in energy efficiency and renewable energy within the electricity sector reduces the demand for fossil-fuel generated electricity, which reduces CO_2 emissions and the demand for CO_2 allowances. The result is lower CO_2 allowance prices and lower program impacts on wholesale electricity prices.[xvii] When considering the overall consumer benefits provided through energy efficiency and renewable energy programs — in the form of energy bill savings, demand-induced reductions in wholesale electricity prices, improved electric system reliability, and job creation—economic benefits are expected to outweigh the minimal impact of the RGGI cap-and-trade program on electricity prices.[xviii]

[xvii] On average, in 2009, the cost of CO_2 allowances accounted for 0.4 percent to 1 percent of average residential electricity bills, depending on the state (based on actual or estimated CO_2 component of ISO wholesale electricity prices, state residential retail electricity prices, EIA residential electricity usage data, and a 2009 average CO_2 allowance spot price of $3.06). Based on typical household electricity usage, this translates into a weighted average of 73 cents per month for residential consumers across the 10-state RGGI region.

[xviii] Building on data issued by the RGGI participating states, a number of economic, energy, and regulatory policy analysts are working to evaluate the benefits of investments in the electricity sector. See: Derek Murrow and Peter Shattuck, *Economy-Wide Benefits of RGGI: Economic Growth through Energy Efficiency,* Environment Northeast, December 2010; Bruce Biewald, Max Chang, Lucy Johnston and David White, *Electricity Energy Efficiency Benefits of RGGI Proceeds: An Initial Analysis*, Synapse Economics, October 5, 2010.

Section 4: Summaries of State Investment Plans

This section provides a summary of each RGGI participating state's plan for the investment of CO_2 allowance proceeds in consumer benefit programs. Each summary contains a table showing how the state's investments have been apportioned among the following program categories for comparison across the 10-state RGGI region: energy efficiency, renewable energy, direct energy bill assistance, other greenhouse gas emission reduction programs, and program administration.

Where a state's investments encompass more than one program category, the administering state agency was consulted to define a valid ratio for apportionment among relevant program categories. Those ratios are based on a state's investment plan, current project proposals, current program results, and/or policy guidance from the administering state agency.

4.1 Connecticut

Connecticut is using the vast majority of CO_2 allowance proceeds to expand existing energy efficiency and renewable energy programs overseen by the Energy Conservation Management Board (ECMB) and the Connecticut Clean Energy Fund (CCEF). In addition, the state is using a small portion of proceeds to support program administration and additional climate programs overseen by the Connecticut Department of Environmental Protection (DEP).

Investment Plan: Summary and Categorization

Proceeds from the sale of CO_2 allowances are invested according to the state's CO_2 Budget Trading Program regulations: Section 22a-174-31: Control of Carbon Dioxide Emissions/CO_2 Budget Trading Program (Section 22a-174-31).

Table 1 summarizes the investments specified in Section 22a-174-31 and shows how those investments are apportioned among regional program categories for comparison.

Table 1: Summary of Section 22a-174-31

State Program	Percent Allocated in State Plan	Regional Program Category
Energy Conservation Management Board Energy Efficiency Programs	69.5%	Energy Efficiency (100%)
Connecticut Clean Energy Fund Renewable Energy Programs	23%	Renewable Energy (100%)
Additional Climate Programs and Program Administration	7.5%	Other GHG Reduction Programs (60%) Program Administration (40%)

Program Descriptions

ECMB Energy Efficiency Programs

The ECMB is an appointed group of 14 members who advise the state's three electric distribution companies – Connecticut Light and Power Company (CL&P), United Illuminating Company (UI), and the Connecticut Municipal Electric Energy Cooperative (CMEEC) – in the development and implementation of cost-effective energy efficiency programs. Between 2008 and 2009, electric and natural gas energy efficiency programs overseen by the ECMB have been shown to produce system benefits of between $3.00 and $4.00 for every $1.00 invested.[60] Historically, programs overseen by the ECMB were funded exclusively through the Systems Benefit Charge. Today, those programs are supported through the SBC, CO_2 allowance proceeds, the Forward Capacity Market and the sale of Renewable Energy Credits. In 2010, CO_2 allowance proceeds accounted for about 7 percent of the total funding for ECMB programs.

The ECMB's current energy efficiency programs are concentrated in four areas: residential energy efficiency; public education and outreach; commercial and industrial process improvement; and workforce development. Programs are designed to provide energy savings to consumers, businesses and municipalities, while supporting growth of clean energy industries in Connecticut. According to a 2009 study by Navigant Consulting, 2,675 Connecticut jobs are currently directly attributed to energy efficiency.[61] These jobs create $137 million of employment income, at an average of $50,000 per year across all industry segments (residential, small business, commercial and industrial).[62] Another 4,280 "induced" jobs are attributable to energy efficiency, as consumers and businesses spend and invest the money they would otherwise have spent on energy.[63]

In addition to supporting the growth of emerging clean energy industries in Connecticut, a significant portion of the ECMB's energy efficiency programs are tailored to benefit low-income consumers, for whom the immediate benefits of lower energy costs are greatest. In 2010, the ECMB's low-income auditing, weatherization and retrofitting programs provided a total of more than $6.1 million dollars in annual energy savings to participating consumers.[64]

CCEF Renewable Energy Programs

The CCEF was created by the Connecticut Legislature to promote, develop, and invest in clean energy sources for the benefit of Connecticut consumers. Since its inception in 2000, the CCEF has provided over $100 million for the installation of more than 1,000 clean energy systems, including fuel cell, solar photovoltaic, biomass, wind, landfill gas, and advanced hydro, across 88 percent of all Connecticut towns.[65]

CCEF programs are concentrated in three areas: community education and goal setting, grants for on-site renewable energy installations and power generation, and large-scale renewable energy generation capacity development. At this time, the CCEF is using CO_2 allowance proceeds to fund initiatives in the second category – specifically, to fund installations of solar PV systems on government and non-profit buildings. Between November 2009 and October 2010, 22 projects were approved, 15 on schools and seven on town buildings, with a total capacity of 1,236 kilowatts It is estimated that these systems will produce 1,456 megawatt-hours of electricity annually.[66]

Administration and Additional Climate Change Programs

The Connecticut Department of Environmental Protection (DEP) has reserved 7.5 percent of the state's CO_2 allowance proceeds to support assessment and design of additional measures to reduce greenhouse gas emissions and mitigate the impacts of climate change. Funds in this category may also be used for reasonable administrative costs associated with the implementation of Connecticut's CO_2 Budget Trading Program and costs incurred by state agencies associated with the adoption of regulations plans and policies. Through December 2010, it is estimated that approximately 3 percent of Connecticut's total proceeds have been allocated to administration.

4.2 Delaware

Delaware is investing the vast majority of CO_2 allowance proceeds in innovative energy efficiency and renewable energy programs administered by the Sustainable Energy Utility (SEU). The state is also investing proceeds to expand existing low-income energy assistance programs and to provide competitive grants for greenhouse gas emission reduction projects. A small portion of proceeds is invested in program administration, implementation, and monitoring, as well as additional multi-sector climate change programs.

Investment Plan: Summary and Categorization

Proceeds from the sale of CO_2 allowances are allocated according to Senate Bill No. 263: An Act to Amend Title 7 of the Delaware Code Relating to a Regional Greenhouse Gas Initiative and CO_2 Emission Trading Program (Senate Bill No. 263).

Table 1 summarizes the investments specified in Senate Bill No. 263 and shows how those investments are apportioned among regional program categories for comparison.

Table 1: Summary of Senate Bill No. 263

State Program	Percent Allocated in State Plan	Regional Program Category
Sustainable Energy Utility: Conservation, Energy Efficiency, and Renewable Energy Programs	65%	Energy Efficiency (75%) Renewable Energy (25%)
Weatherization Assistance Program (WAP)	10%	Energy Efficiency (100%)
Low-Income Heating Energy Assistance Program (LIHEAP)	5%	Direct Energy Bill Assistance (100%)
Competitive Grants for Greenhouse Gas Emission Reduction Projects	10%	Energy Efficiency (60%) Renewable Energy (20%) Other GHG Reduction Programs (20%)
Administration, Implementation, Monitoring and Additional Multi-Sector Climate Change Programs	10%	Other GHG Reduction Programs (50%) Program Administration (50%)

Program Descriptions

Sustainable Energy Utility: Conservation, Energy Efficiency, and Renewable Energy Programs

The SEU is a public/private partnership established to help residents, businesses, and industries use less energy and generate energy cleanly. Programs are designed to provide maximum net benefits to households, small businesses, and local governments, and to create incentives for inventors and entrepreneurs to bring renewable and energy-efficient innovations to the marketplace.

SEU programs include initiatives to provide: consumer rebates for ENERGY STAR-approved refrigerators, freezers, washing machines, dehumidifiers, and compact fluorescent lighting; subsidized energy auditing and weatherization services for Delaware residents; incentives for energy-efficient new construction; grants and loans for large-scale commercial and industrial energy efficiency retrofits; and innovative funding techniques for large-scale renewable energy installations.

Low-Income Fuel and Weatherization Assistance

CO_2 allowance proceeds dedicated to this program area support the Weatherization Assistance Program (WAP) and the Delaware Energy Assistance Program (DEAP). Both programs are designed to reduce energy costs for consumers with incomes equal to or lower than 200 percent of the federal poverty level.

Weatherization Assistance Program (WAP)
WAP is administered under contracts with Neighborhood House, Inc., which operates weatherization programs in New Castle County, and First State Community Action Agency, which operates programs in Kent and Sussex Counties. Each agency subcontracts with private construction and heating contractors to install energy efficiency measures, including, air sealing, insulation, window and door replacement, and furnace repair and replacement.

Delaware Energy Assistance Program (DEAP)
DEAP is administered on a contractual basis with Catholic Charities, Inc. DEAP programs include the Low-Income Heating Assistance Program (LIHEAP) and Summer Cooling Assistance Program (SCAP), both of which provide energy bill payment assistance to low-income ratepayers. DEAP programs also include a Crisis Assistance program to provide supplemental grants to low-income residents who are unable to pay their energy bills or are facing service cutoffs during the winter months.

Competitive Grants for Greenhouse Gas Emission Reduction Projects
CO_2 allowance proceeds dedicated to this program area are invested to provide grants for energy efficiency, renewable energy, sustainable land use, and other projects to reduce greenhouse gas emissions. Grants are awarded by the Delaware Department of Natural Resources and Environmental Control (DNREC) through a competitive selection process. Through December 2010, 31 projects have received a total $1.3 million in grants. Projects include 11 energy efficiency and green building projects, six renewable and clean energy installations, six sustainable land use projects, five education and outreach programs, and three other projects to reduce greenhouse gas emissions.

Administration, Implementation, Monitoring and Additional Climate Change Projects
The DNREC has reserved ten percent of CO_2 allowance proceeds to support assessment and design of additional multi-sector climate change programs and to cover reasonable administrative costs associated with the administration, implementation, and monitoring of Delaware's CO_2 Budget Trading Program and related consumer benefit programs.

4.3 Maine

Maine is investing the vast majority of CO_2 allowance proceeds to support residential and commercial energy efficiency programs, and to provide grants for large-scale industrial energy efficiency and conservation projects. The Maine Department of Environmental Protection (DEP) and Efficiency Maine are also using a small portion of proceeds to support program administration, as well as additional carbon offsets research.

Investment Plan: Summary and Categorization

Proceeds from the sale of CO_2 allowances are allocated according to Title 35-A §10009: Regional Greenhouse Gas Initiative Trust Fund (Title 35-A §10009), which establishes the Maine Energy and Carbon Savings Trust (Trust) and directs trustees to invest proceeds as summarized in Table 1.

Table 1 summarizes the investments specified in Title 35-A 10009 and shows how those investments are apportioned among regional program categories for comparison.

Table 1: Summary of Title 35-A §10009

State Program	Percent Allocated in State Plan	Regional Program Category
Electric Energy Efficiency Programs	85%	Energy Efficiency (100%)
Fossil Fuel Efficiency Programs	15%	Energy Efficiency (100%)
Carbon Offset Research	Up to $100,000 annually	Other GHG Reduction Programs (100%)
Program Administration	Up to $800,000 annually	Program Administration (100%)

Program Descriptions

Electric Energy Efficiency Programs

CO_2 allowance proceeds dedicated to this program area support programs administered by Efficiency Maine, an initiative to promote energy efficiency throughout Maine's economy. Efficiency Maine has a proven track record of implementing cost-effective energy efficiency programs for residential, commercial, and industrial energy consumers. In 2010, Efficiency Maine's programs resulted in annual energy savings of more than 93,000 megawatt-hours and generated an estimated $95.8 million in lifetime economic benefits for the state of Maine.[67] Efficiency Maine's existing residential and commercial energy efficiency programs have been shown to produce benefits between 2:1 and 6:1 for every dollar invested.[68]

Residential programs currently supported with CO_2 allowance proceeds include the Efficiency Maine Residential Lighting Program, Efficiency Maine Appliance Rebate Program, and an appliance recycling program. Programs are designed to reduce energy demand and provide sustained energy cost savings for Maine consumers. Efficiency Maine is also using CO_2 allowance proceeds to expand the Efficiency Maine Business Incentive Program, which provides prescriptive and custom incentives for businesses to replace out-of-date equipment and upgrade to energy-efficient alternatives. Qualified appliances and equipment currently include compact fluorescent lighting, HVAC equipment, NEMA Premium® energy-efficient motors, variable-speed motor drives, commercial refrigeration, and agricultural equipment. As of August 1, 2009, eligible organizations may receive Business Program incentives of up to $300,000 in a single calendar year period.

Fossil Fuel Energy Efficiency Programs

In 2008 and 2009, the Trust invested a small portion ($650,000) of CO_2 allowance proceeds to weatherize160 homes across the state. Since then, the Trust has invested remaining CO_2 allowance proceeds in a competitive grant program for large-scale industrial energy efficiency projects. Grants ranging from $100,000 to $1 million are being awarded to projects with the highest potential for reducing kilowatt-hour electricity use, decreasing greenhouse gas emissions, creating jobs, and producing additional economic benefits. Through December 2010, a total of 36 grants were awarded, 19 of which were funded by CO_2 allowance proceeds. Those 19 projects are expected to save 533,876 megawatt-hours of grid electricity over the lifetime of the projects.[69]

To allow for joint delivery of fossil fuel and electrical energy efficiency programs, the Trust has also directed 25 percent of the proceeds allocated to electricity energy efficiency to this large-scale industrial grant program.

Carbon Offset Research
$100,000 of CO_2 allowance proceeds are set aside per year for DEP-approved carbon offset research projects. Those projects have not yet been identified.

Administration
Title 35-A §10009 allows up to $800,000 in CO_2 allowance proceeds per year to be used to cover costs associated with administering the CO_2 Budget Trading Program and associated consumer benefit programs.

4.4 Maryland

Maryland is investing proceeds from the sale of CO_2 allowances to in the state Strategic Energy Investment Fund (SEIF), a special, non-lapsing fund administered by the Maryland Energy Administration (MEA). MEA has been deploying SEIF funds to deliver on its mission to promote affordable, reliable and clean energy. As part of Governor's O'Malley's "Smart, Green and Growing" initiative, these programs have helped reduce household bills, create new green collar jobs, address global climate change, and promote energy independence.

Investment Plan: Summary and Categorization

Proceeds from CO_2 allowance auctions conducted before March 1, 2009 and after June 30, 2012 (auctions 1, 2 and 17 onward) are allocated according to Senate Bill 268: An Act Concerning Regional Greenhouse Gas Initiative (S-268).

Table 1 summarizes the investments specified in S-S68 and shows how those investments are apportioned among regional program categories for comparison.

Table 1: Summary of Senate Bill 268

State Program	Percent Allocated in State Plan	Regional Program Category
Low- and Moderate-Income Residential Energy Efficiency	23%	Energy Efficiency (100%)
Multi-Sector Energy Efficiency and Conservation	23%	Energy Efficiency (100%)
Clean Energy and Climate Change	10.5%	Renewable Energy (100%)
Residential Rate Relief	23%	Direct Energy Bill Assistance (100%)
Low-Income Energy Assistance	17%	Direct Energy Bill Assistance (100%)
Administration	3.5%	Administration (100%)

Temporary Amendments: March 1, 2009 - June 30, 2012

Proceeds from CO_2 allowance auctions conducted between March 1, 2009 and June 30, 2012 (auctions 3-16), are allocated according to the House Bill 101: Budget Reconciliation and Financing Act of 2009 (H-101). H-101 is a temporary amendment enacted to provide emergency energy cost relief to Maryland consumers.

Table 2 summarizes the investments specified in H-101 and shows how those investments are apportioned among regional program categories for comparison.

Table 2: Summary of House Bill 101

State Program	Percent Allocated in State Plan	Regional Program Category
Low- and Moderate-Income Residential Energy Efficiency	8.75%	Energy Efficiency (100%)
Multi-Sector Energy Efficiency and Conservation	8.75%	Energy Efficiency (100%)
Clean Energy and Climate Change	6.5%	Renewable Energy (100%)
Residential Rate Relief	23%	Direct Energy Bill Assistance (100%)
Low-Income Energy Assistance	50%	Direct Energy Bill Assistance (100%)
Administration	3%	Administration (100%)

In total, the more than $100 million in investments made by MEA and its partners through June 30, 2010 resulted in numerous benefits for Marylanders.

To save Maryland households and businesses money:

- MEA invested $16.5 million in energy efficiency programs that:
  - will save Marylander's $68.3 million over the life of the investments;

- created 150 jobs;
    - avoided CO_2 emissions equivalent to removing 3,474 cars from the road;
    - retrofitted more than 3,000 low-income apartments;
    - gave grants to more than 7,500 local governments and non-profits;
    - helped more than 350 farms;
    - trained more than 900 people for careers in energy efficiency;
    - helped Marylanders purchase nearly 5,000 energy efficient appliances.
- The Maryland Department of Housing and Community Development (DHCD) invested $2.5 million for home retrofits and weatherization.
- The Maryland Department of General Services (DGS) invested $502,235 to pay personnel costs.
- The Maryland Department of Budget and Management invested $7.8 million to make repayments on state agency loans.

To encourage adoption of renewable energy, promote energy awareness and address climate change:

- MEA invested $4.9 million in renewable energy and education programs that:
    - Helped 820 Maryland families buy solar, wind and geothermal systems;
    - Saved approximately 4,000 MWh of traditional power;
    - Reached Marylanders through large-scale and grass-roots media campaigns, increasing understanding of simple, no and low-cost energy changes Marylanders can undertake.
- The Maryland Department of the Environment (MDE) invested $3.2 million conducting research and implementing measures to help the state reduce its carbon footprint.

To provide residential rate relief: $23.5 million was distributed through the Public Service Commission and utilities to provide Maryland's nearly 5.7 million citizens an average credit on their utility bills of $0.17 per month.

To help low income households pay electricity bills and arrearage: the Maryland Department of Human Resources distributed $45.4 million to assist over 50,000 households to pay current and past energy bills, paying an average benefit of $817 per household.

Program Descriptions

MEA is investing CO_2 allowance proceeds in the following programs:

Multi-Family Housing Retrofits for Low and Moderate Income Families

A significant portion of low and moderate income families are renters, yet apartments and condominiums have not been included in the traditional weatherization programs. Through the Multi-Family Energy Efficiency Housing Affordability (MEEHA) Program, MEA, in coordination with the Department of Housing and Community Development (DHCD) and housing nonprofit organizations, conducts energy efficiency retrofits in apartment units to reduce energy bills for low and moderate income families.

Jane E. Lawton Conservation Loan Program

Named for the late Delegate Jane E. Lawton, a tireless advocate for energy efficiency and protecting our natural resources, the Lawton Loan Program provides below market loans to local governments, nonprofits and businesses for energy efficiency improvements. As those loans are repaid, MEA re-loans the money to new recipients, ensuring that the Lawton SEIF funds continue to benefit Marylanders for many years to come.

State Agency Loan Program (SALP)
SALP is a revolving loan program administered by MEA. To assist the state in leading by example, SALP provides zero interest loans (with a 1 percent administrative fee) to state agencies for energy efficiency improvements.

EmPOWERing Clean Energy Communities Grants
The EmPOWERing Clean Energy Communities Grant program provides funds to local governments and non-profit organizations to facilitate projects that increase the energy efficiency and/or the use of renewable energy to benefit the local government or community and to promote affordable, reliable, and clean energy. Examples include a housing authority that makes improvements to a building complex to reduce the energy bills of the low income residents or a feasibility study to enable a town to analyze opportunities for energy efficiency and/or renewable energy.

Farm Energy Technical Assistance and Incentives
Maryland's 12,000 farms spent about $26 million on electricity in 2008. Maryland farms spend tens of millions on petroleum products, gasoline, diesel fuel, natural gas, propane, fuel oil, and other fuels. This statewide project provides energy assessments to Maryland farms, and offers cash rebates for the installation of qualifying farm energy efficiency measures.

State Energy Efficient Appliance Rebate Program
MEA worked with Maryland's utilities to enhance their existing appliance rebate programs and put more rebates in the hands of Maryland consumers. This program provides additional rebates for super-efficient clothes washers and refrigerators, adding onto the amount offered as part of the utility programs. It also added a new product rebate for ENERGY STAR electric heat pump water heaters. Many utilities and retail appliance outlets offered appliance recycling which helped in the reduction of greenhouse gases.

Clean Energy Workforce Training and Capacity Building
MEA has partnered with the Department of Housing and Community Development (DHCD) and Maryland's community colleges to establish a workforce development program. The program provides training for trainers, the purchase of curriculum, materials, and equipment to support the Home Performance with ENERGY STAR program with the utilities. This Program, along with funding from the DHCD Weatherization Program, has resulted in the enrollment of nearly 1000 students in energy auditor/contractors classes. This new workforce will provide energy efficiency upgrades in homes throughout Maryland at all income levels. In addition, MEA used these funds for existing home retrofit quality assurance and support of the Maryland Home Performance website.

State Agency Energy Efficiency Improvements
During fiscal year 2010, MEA established a partnership with the Maryland Department of Naturals Resources to provide energy efficiency audits and upgrades to dozens of small State Park cabins throughout the state. The $200,000 program funds training for state park maintenance staff and Maryland Conservation Corps members to audit and retrofit cabins and small administrative buildings.

Residential Renewable Energy Grants
Marylanders understand that residential solar, geothermal, and wind can significantly reduce their energy bills and reduce the state's carbon footprint. Soaring demand for MEA's grant program has resulted in hundreds of Maryland households engaging in this ever increasingly popular program. MEA uses SEIF funds to serve applications as they come forward. Contractors market the program heavily and demand for renewable grants continues to be high.

Consumer Awareness - Educational Outreach Programs

The Maryland Energy Administration oversees the State's educational outreach efforts related to energy efficiency and clean energy, as well as the marketing of all related programs available through the MEA. The focus is on promoting general energy awareness, in connection with practical, low and no-cost energy saving tips for consumers, while tying all messaging back to our State goal of EmPOWER Maryland: 15 percent energy reduction by 2015. The MEA strives to create relevant and impactful campaigns and community partnerships which will reinforce the resources available through the MEA and EmPOWER this demographic to make smart energy decisions.

4.5 Massachusetts

Massachusetts is investing the vast majority of CO_2 allowance proceeds to support energy efficiency programs administered by the state's electric utilities. Programs are designed to improve energy efficiency in residential, commercial, and industrial sectors, decrease consumer energy costs, and create employment opportunities in the green energy sector. Massachusetts is also using proceeds to establish an innovative grant program to help local governments improve energy efficiency and increase renewable energy deployment. A small portion of CO_2 allowance proceeds are supporting additional state energy efficiency and clean energy projects.

Investment Plan: Summary and Categorization

Proceeds from the sale of CO_2 allowances are allocated according to Chapter 169 of the Acts of 2008: An Act Relative to Green Communities (Green Communities Act), which directs at least 80 percent of proceeds to utility-administered energy efficiency programs and up to 20 percent of proceeds to municipal energy efficiency and renewable energy programs, additional utility-administered energy efficiency programs, and other programs. The utility-administered energy efficiency programs supported with CO_2 allowance proceeds over the three year period 2010-2012 are projected to result in lifetime electricity savings of more than 2.6 billion kWh, enough to power more than 350,000 households for a year.[70]

Table 1 summarizes the investments specified in the Green Communities Act and shows how those investments are apportioned among regional program categories for comparison.

Table 1: Summary of the Green Communities Act

State Program	Percent Allocated in State Plan	Regional Program Category
Utility-Administered Energy Efficiency Programs	At least 80%	Energy Efficiency (100%)
Green Communities Program; Other Energy Efficiency and Clean Energy Projects; Zero-Interest Loans to Municipalities for Energy Efficiency Programs; as well as, where required, reimbursements to municipalities	Up to 20%	Energy Efficiency (50%) Renewable Energy (50%)
Program Administration	Currently 1.7%	Program Administration (100%)

Program Descriptions

Utility-Administered Energy Efficiency Programs

The Green Communities Act requires the state's four electric utilities – National Grid, NSTAR, Unitil/Fitchburg Gas & Electric Co., and Western Massachusetts Electric Co. – and the Cape Light Compact, a municipal aggregator that operates energy efficiency programs for part of the state, to jointly prepare comprehensive energy efficiency plans to "provide for the acquisition of all available energy efficiency and demand reduction resources that are cost-effective or less expensive than supply." The current plan sets an energy savings target of 2.4 percent of electricity sales by 2012. The new target will significantly increase energy efficiency savings, reversing the historic trend in overall electricity usage – from growing at a rate of roughly 1 percent per year to declining by 1.4 percent per year. With energy savings of 2.4 percent per year going forward, Massachusetts will meet about 30 percent of its electricity needs through improved energy efficiency, rather than additional electric generation, by 2020. [71]

The plan is funded by at least 80 percent of Massachusetts' CO_2 allowance proceeds, distribution charges on electricity bills, regional capacity market auction proceeds, and third-party capital. Programs are providing workforce training, fully-subsidized energy auditing and weatherization, rebates for energy-efficient boilers and additional residential retrofitting, industrial process improvements and combined heat and power, subsidies to promote the development of markets for energy-efficient technologies, building code consultations; public education and outreach, and additional programs to support the development and commercialization of energy-efficient products and practices.

Green Communities Program, Additional Energy Efficiency and Clean Energy Programs, and Municipal Reimbursements

The Green Communities Act directs remaining CO_2 allowance proceeds, up to 20 percent, to support primarily energy efficiency and clean energy generation, including the Green Communities Program; other energy efficiency and clean energy projects; zero-interest loans to municipalities for energy efficiency programs; as well as, where required, reimbursements to municipalities in which property tax revenues are reduced as a result of the RGGI CO_2 cap-and-trade program. Currently, Massachusetts is directing funding to:

The Green Communities Program

The Green Communities Act creates a Green Communities Division at the Department of Energy Resources (DOER) to provide an annual total of up to $10 million in grants and technical assistance to communities for energy efficiency and renewable energy projects. The program is designed to enable cities and towns to improve energy efficiency in schools, city halls, firehouses, and other public buildings; generate some of their energy needs from wind, solar, and forest trimmings; and make other decisions that reduce their environmental impact and carbon footprint.

Additional Energy Efficiency and Clean Energy Projects and Programs

CO_2 allowance proceeds dedicated to this program area support additional state energy efficiency and clean energy projects and programs. Current projects and programs include:

- Heating system replacements in low-income households, through the Department of Housing and Community Development (DHCD)'s HeartWAP program;
- Workforce development and training programs focused on energy efficiency for homes, businesses, and public buildings. At this time, the majority of proceeds in this category are allocated to the Energy Efficiency Skills and Innovation Initiative, which provides job training for energy auditors and installers of insulation and other energy efficiency measures;
- Seed grants and other support for innovative energy efficiency delivery models that will allow the energy efficiency industry to reach a new level of capacity and employment;
- Assistance to municipalities for energy efficiency projects identified in DOER audits, but previously unfunded.

Program Administration

The Green Communities Act allows CO_2 allowance proceeds to be used to cover costs to the Commonwealth associated with administering the CO_2 Budget Trading Program. Through December 31, 2010, approximately $2 million (1.7 percent of the state's total CO_2 allowance proceeds) have been used for this purpose.

4.6 New Hampshire

New Hampshire is investing nearly all CO_2 allowance proceeds in energy efficiency, energy conservation, and demand response projects. Projects are selected through a competitive process and are designed to reduce greenhouse gas emissions, provide energy cost savings to low-income consumers, create new jobs in the clean energy sector, and improve the capacity of local governments to pursue climate change strategies.

Investment Plan: Summary and Categorization

Chapter PUC 2600: Greenhouse Gas Emissions Reduction Fund (Chapter PUC 2600) directs a minimum of 10 percent of CO_2 allowance proceeds to low-income energy efficiency programs, and the balance to electric and fossil fuel energy efficiency programs, including but not limited to: energy audits, weatherization of buildings, energy efficiency-related workforce development, revolving loan funds for energy efficiency investment, deployment of industrial process and control systems, passive solar heating and ventilation, building code compliance, improvements to electric and thermal efficiencies of existing buildings, retrofitting of housing, education and outreach, and demand response programs to reduce peak electricity load.

Table 1 summarizes the investments specified in Chapter PUC 2600 and shows how those investments are apportioned among regional program categories for comparison.

Table 1: Summary of Chapter PUC 2600[xix]

State Program	Percent Allocated in State Plan	Regional Program Category
Low-Income Energy Efficiency Programs	At Least 10.0%	Energy Efficiency (100%)
Competitive Grants for Energy Efficiency Projects and Programs	Up to 90.0%	Energy Efficiency (100%)
Program Administration	Currently 2.4%	Program Administration (100%)

Program Descriptions

In the winter of 2008, New Hampshire invested $1.2 million of its CO_2 allowance proceeds to weatherize low-income homes across the state. Since then, the state has awarded $31 million[xx] in CO_2 allowance proceeds to 36 projects and programs that engage non-profits, utilities, businesses, residents, municipalities, universities, and K-8 schools to improve energy efficiency, support energy education and outreach, and provide energy efficiency job training to workers across the state. Through July 2010, 30 of the projects had received a total of $17.7 million. Through July 2010, those 30 projects have supported energy efficiency job training for more than 170 workers and supported energy use assessments and energy audit evaluations for 436 buildings across the state.[72]
In addition, those 30 projects are projected to reduce consumer energy costs by $60.6 million over the lifetime of the installed measures.[73] Programs funded to date include:

Utility-Administered Residential and Commercial Energy Efficiency Programs

In 2009, New Hampshire awarded grants totaling more than $7.6 million of CO_2 allowance proceeds to four electric utilities (National Grid, New Hampshire Electric Co-op, Public Service of New Hampshire (PSNH), and Unitil) to expand their CORE Efficiency Programs. RE-CORE is a portfolio of programs designed to enhance energy cost savings for residential, low-income, and business

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[xix] As part of the New Hampshire 2010 State budget, $3.1 million of CO_2 allowance proceeds was diverted to the State General Fund. This summary addresses the use of current and future CO_2 allowance proceeds that are unaffected by this one-time budget diversion.

customers. Specific initiatives include: weatherization services for low-income customers, programs to identify and implement low-cost operational and maintenance improvements in large commercial buildings, zero-interest loans for energy efficiency measures through fixed monthly payments on consumer energy bills, appliance rebate and recycling programs, and expanded job training programs.

Low-Income Programs
In 2010, New Hampshire awarded $4 million to low-income energy efficiency programs managed by the New Hampshire Community Loan Fund and the New Hampshire Housing Finance Authority (NHHFA). The Community Loan Fund is leveraging CO_2 allowance proceeds, as well as federal and state funds, to implement deep energy efficiency retrofits, including roof replacements, in manufactured homes for an estimated savings of $614 per unit per year. Grant funds are also invested to train the state's Community Action Agencies to implement basic rehabilitation and energy efficiency measures in manufactured homes. The NHHFA's Greener Homes Program provides deep efficiency retrofits in low-income multi-family housing properties across the state.

Municipal Energy Efficiency and Clean Energy
In 2009, New Hampshire invested CO_2 allowance proceeds in a wide variety of projects to improve energy efficiency in municipal buildings and facilities. Specific initiatives being funded include projects to: track and evaluate building energy-use (benchmarking), provide energy efficiency audits and ongoing technical support services to municipal governments, implement deep energy efficiency retrofits in municipal facilities in Gorham, Fremont, Hancock, Jaffrey, Rochester, Warner, Temple, and Walpole, and establish outreach programs to educate homeowners, businesses, and renters about cost-effective energy efficiency measures.

Job Training Programs for Energy Auditors, Contractors, and Architects
New Hampshire is investing CO_2 allowance proceeds to establish specialized energy efficiency certification programs at New Hampshire community colleges, expand the reach of utility-administered job training initiatives, and train architects, energy auditors and contractors so that they can design, build and remodel homes to meet the National Association of Homebuilders National Green Buildings Standard. Through July 2010, these programs created energy efficiency training opportunities for 170 workers across the state.[74]

Large Energy Users

New Hampshire awarded $5 million to develop a "Pay for Performance (P4P)" program, which provides direct incentives for energy savings in large commercial and industrial facilities. The Program has developed a network of qualified "Partners" who provide technical services under direct contract to building owners. Partners will develop whole-building Energy Reduction Plans (ERPs) to achieve minimum energy savings of 15 percent per facility. Each ERP will include a financial plan, a construction schedule, and an energy verification component to ensure minimum energy savings of 15 percent. The P4P program provides three levels of incentives (based on the projected savings outlined in the ERP) to encourage large energy users to fully implement energy efficiency measures. The program is expected reduce CO_2 emissions by more than 140,000 metric tons over the lifetime of the installed measures.

Administration

[xx] Includes anticipated proceeds from 2011 CO_2 allowance auctions.

New Hampshire statute allows a portion of CO_2 allowance proceeds to be used to cover costs associated with administering the CO_2 Budget Trading Program and associated programs to reduce greenhouse gas emissions. Through December 2010, approximately 2.4 percent of the state's total CO_2 allowance proceeds have been used for this purpose.[75]

4.7 New Jersey

New Jersey plans to use the majority of CO_2 allowance proceeds to support energy efficiency and renewable energy projects in the commercial, industrial, and institutional sectors.[xxi] Energy efficiency investment includes a strong focus on combined heat and power (CHP) projects. New Jersey is also using proceeds to provide low- and moderate-income residential electricity customers assistance in paying electricity bills, and expects to implement programs to support efforts by municipalities to reduce greenhouse gas emissions and enhance the stewardship and restoration of New Jersey forests and tidal marshes that provide important opportunities to sequester carbon.

Investment Plan: Summary and Categorization

In New Jersey, proceeds from the auction and sale of CO_2 allowances are allocated according to the Global Warming Solutions Fund Act (N.J.S.A. 26:2C-45 et seq.), which establishes the Global Warming Solutions Fund and directs proceeds to programs and projects administered by the Department of Environmental Protection (DEP), the Economic Development Authority (EDA), and the Board of Public Utilities (BPU).

The Global Warming Solutions Fund Act specifies that the proceeds in the Global Warming Solutions Fund be distributed as follows:

- 60 percent to the EDA to provide grants and other forms of financial assistance to promote end-use energy efficiency, renewable energy, and state-of-the-art electric generation facilities, such as CHP, in the commercial, industrial, and institutional sectors;[xxii]
- 20 percent to the BPU to assist limited-income households with their electric bills through direct bill payment assistance or reduction in electricity demand;
- 10 percent to the DEP to support programs that help local governments reduce greenhouse gas emissions, including grants and other forms of financial assistance for energy efficiency, renewable energy, distributed energy, and land use planning projects that result in a measurable reduction in greenhouse gas emissions or energy demand;
- 10 percent to the DEP to support investment in forestry and tidal marsh stewardship and restoration to maximize carbon sequestration;[xxiii] and
- In addition, the DEP may use up to 4 percent of annual proceeds for administrative costs related to the above programs and administration of the CO_2 Budget Trading Program, and EDA and BPU may each use up to two percent of annual proceeds for similar administrative

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[xxi] As part of the New Jersey 2011 State budget, $65 million of CO_2 allowance proceeds are anticipated to be diverted to the State General Fund over the course of fiscal year 2011 (through June 2011). This summary addresses the use of current CO_2 allowance proceeds that are unaffected by this one-time budget diversion.
[xxii] In August 2010, the Global Warming Solution Fund Act requirements for use of CO_2 allowance proceeds in the commercial, industrial, and institutional sectors were expanded upon in S. 2036 to include use of CO_2 allowance proceeds to develop qualified offshore wind power projects and to provide financial assistance to manufacturers of equipment associated with qualified offshore wind power projects.
[xxiii] In January 2010, the Global Warming Solution Fund Act requirements for use of CO_2 allowance proceeds for forest stewardship were expanded upon in S. 713, which establishes a non-lapsing Forest Stewardship Incentive Fund that is credited with monies in the Global Warming Solutions Fund that are apportioned to address stewardship of New Jersey forests. This fund will provide incentives for completing forest stewardship plans on nonprofit, local government, and private lands.

costs. These administrative costs are apportioned to each of the agencies prior to distribution of proceeds for program investment.

Table 1 summarizes the programs being implemented, or that are anticipated to be implemented, and shows how program investments are apportioned among regional program areas for comparison.

Table 1: Summary of Global Warming Solutions Fund Act

State Program	Percent Allocated in State Plan	Regional Program Category
EDA – Clean Energy Solutions Capital Investment (CESCI) Loan/Grant Program (energy efficiency, CHP, and renewable energy projects in commercial, industrial, and institutional sectors)	55.2%	Energy Efficiency (50%) Renewable Energy (50%)
BPU – Direct Bill Assistance to Low- and Moderate-Income Electricity Customers	18.4%	Direct Energy Bill Assistance (100%)
DEP – Carbon Sequestration through Stewardship and Restoration of Forests and Tidal Marshes	9.2%	Other GHG Reduction Programs (100%)
DEP – Local Government Greenhouse Gas Reduction Grant Program (energy efficiency, renewable energy, distributed energy, sustainable land use planning, and other GHG reduction projects)	9.2%	Energy Efficiency (33.3%) Renewable Energy (33.3%) Other GHG Reduction Programs (33.3%)
Program Administration	Up to 8.0%	Program Administration (100%)

Program Descriptions

The DEP, EDA, and BPU are coordinating in the administration of consumer benefit programs and projects. As required by the Global Warming Solutions Fund Act, DEP has adopted rules at N.J.A.C. 7:27D to establish guidelines and a priority ranking system that all three agencies apply in evaluating consumer benefit programs and projects.[xxiv]

Commercial, Industrial, and Institutional Energy Efficiency, Combined Heat and Power, and Renewable Energy

Sixty percent of the CO_2 allowance proceeds in the Global Warming Solutions Fund are allocated to the EDA to support efforts to deploy energy efficiency and clean energy technologies in the commercial, industrial, and institutional sectors. EDA is administering the Clean Energy Solutions Capital Investment (CESCI) Loan/Grant Program, which provides zero-interest loans and grants to qualified commercial, institutional, and industrial entities to support end-use energy efficiency projects, construction of state-of-the art electric generation facilities such as CHP, and renewable energy projects. A mix of grants and loans up to $5 million are available for selected projects, with financial support awarded on a rolling basis.

Projects are evaluated using a scoring system developed by DEP and EDA. The scoring system evaluates the degree to which a proposed project is projected to reduce greenhouse gas emissions, the cost effectiveness of the project in reducing greenhouse gas emissions, benefits provided to electricity ratepayers (based on projected grid electricity savings or electricity supplied to the grid, including the portion of electricity savings or generation during peak demand periods), co-benefits

[xxiv] See December 21, 2010, New Jersey Register at 41 N.J.R. 4776.

provided through reduced emissions of other pollutants, and responsiveness to the New Jersey Energy Master Plan goals and the DEP Global Warming Response Act recommendations report.

Through 2010, $29.6 million in funding has been awarded to 12 projects, including CHP facilities and commercial-scale solar photovoltaic systems, with the majority of funding provided through no-interest loans. The 12 CHP and solar photovoltaic projects represent 29.6 megawatts of new, clean electric generation capacity. These projects are projected to generate more than 167,000 megawatt-hours of electricity per year, enough to meet the equivalent annual electricity needs of more than 19,600 typical New Jersey households, and are projected to avoid 84,000 metric tons of CO_2 emissions per year and 1.7 million metric tons of CO_2 emissions over the lifetime of the projects.

Low- and Moderate-Income Energy Assistance

Twenty percent of the CO_2 allowance proceeds in the Global Warming Solutions Fund are allocated to the BPU to assist limited-income households with their electric bills through direct bill payment assistance or programs to reduce electricity demand. Proceeds from CO_2 allowance auctions through 2009 are being dedicated to a Residential Electric Limited Income Emergency Fund (RELIEF) to provide bill payment assistance to low- and moderate-income residential electricity ratepayers. Grants are provided to programs that reduce electricity costs for customers with limited incomes by providing direct financial assistance toward the payment of electricity bills. Customers are eligible for financial assistance if they are: (1) in the low- and moderate-income residential sector (defined as households with an income that does not exceed 400 percent of the federal poverty level); (2) not enrolled in or eligible for either the BPU Universal Service Fund program or the Low-Income Home Energy Assistance Program; and (3) are facing crisis situations that include a documented notice of overdue payment for electric service. Through 2009, BPU has awarded $9.9 million to New Jersey Shares (NJ SHARES) to distribute to limited-income households requiring bill payment assistance. NJ SHARES is a 501(c)(3) not-for-profit organization that provides year-round energy assistance to individuals and families that are experiencing a financial crisis, have exhausted other available sources of assistance, and have demonstrated a good faith effort to pay their energy bills.

Implementation of the program is being accompanied by targeted communications efforts to help low- and moderate-income households reduce their energy costs. Contact information for customers receiving direct financial assistance is provided to the administrators of New Jersey Clean Energy Program residential energy efficiency programs, such as Home Performance with ENERGY STAR. This provides for targeted implementation of existing residential energy efficiency programs to better serve low- and moderate-income households.

Local Government Greenhouse Gas Reduction

Ten percent of CO_2 allowance proceeds in the Global Warming Solutions Fund are allocated to the DEP to support local government efforts to reduce greenhouse gas emissions. The DEP program will support local government efforts to plan, develop, and implement measures that reduce greenhouse gas emissions through energy efficiency, renewable energy, distributed energy, and sustainable land use planning.[xxv] Initial eligible measures or programs include:

- Greenhouse gas action planning and implementation
- Land use planning and transportation
- Transportation system efficiency
- Green infrastructure, sequestration, and resource conservation

[xxv] Implementation of this program is currently pending as a result of the one-time diversion of CO_2 allowance proceeds to the State General Fund as part of the New Jersey 2011 State budget.

- Strengthening local economies (e.g., local food production and gardens; “buy local” programs that reduce vehicle miles travelled)
- Outreach and education campaigns
- Other (e.g., highly warming greenhouse gas capture; micro-grants to community organizations; innovative programs)

Local governments need to demonstrate how proposed projects would result in measurable reductions in greenhouse gas emissions or energy demand. For projects that involve planning, such as a local greenhouse gas emissions inventory and reduction plan, the governing body of the locality needs to include in the project application a resolution to implement at least 50 percent of actions identified through the inventory and plan.

Grants are expected to be available up to $300,000 for one local government agency and up to $700,000 for joint projects involving two or more local government agencies from different municipalities. Eligible local government agencies include municipal, county, and local authorities, which include local boards of education and county colleges.

Forest and Tidal Marsh Stewardship and Restoration
Ten percent of the CO_2 allowance proceeds in the Global Warming Solutions Fund are allocated to the DEP to support DEP-administered programs to enhance stewardship and restoration of forests and tidal marshes to maintain and improve carbon sequestration by these natural resources. Proceeds are to be used to support activities such as forest carbon inventories and the development of sustainable forest management plans on state land and nonprofit, local government, and private lands.

Program Administration
The Global Warming Solutions Fund Act allows a total of up to eight percent of annual proceeds in the Global Warming Solutions Fund to be used to cover costs associated with administering the CO_2 Budget Trading Program and associated consumer benefit programs. These administration funds (four percent to DEP, two percent to BPU, and two percent to EDA) are allocated from the Global Warming Solutions Fund to implementing agencies prior to allocation of the remaining proceeds for a respective program area.

4.8 New York

In New York, proceeds from the sale of CO_2 allowances are to be invested according to the Operating Plan for Investments in New York under the CO_2 Budget Trading Program and the CO_2 Allowance Auction Program. The original Operating Plan (Original Plan) was approved by the New York State Energy Research and Development Authority (NYSERDA) Board of Directors on April 27, 2009. On March 1, 2010, a number of revisions to the Operating Plan were presented to and approved by NYSERDA's Board for inclusion in a revised Operating Plan (Revised Plan), and an updated version of the full Revised Plan was completed in June 2010.

These revisions were made to reflect new legislation, current market prices for CO_2 allowances, and the availability of economic stimulus funds. The Revised Plan includes a modified projection of CO_2 allowance proceeds and commits $112 million in CO_2 allowance proceeds to weatherization and job training programs called for in the Green Jobs/Green New York Act of 2009. The Revised Plan also accounts for the budget deficit reduction measures enacted in 2009 and commitments pursuant to a consent decree that resolved a legal challenge to the State's Regional Greenhouse Gas Initiative program.

Both versions of the Operating Plan were developed by NYSERDA, the Department of Environmental Conservation (DEC), and the Public Service Commission (PSC) and were informed by comments and feedback from an Advisory Group and other stakeholders.

NYSERDA and its partner agencies intend to conduct the annual update of the Operating Plan in early 2011. Among other things, the revised plan will include a lower program planning budget that accounts for the recent trend towards lower CO_2 allowance proceeds. As described below, this process will include stakeholder engagement. The remainder of this summary addresses the programs that are described in the June 2010 Revised Plan.

Investment Plan: Summary and Categorization

The Revised Plan outlines how New York plans to use CO_2 allowance proceeds to complement its existing energy programs and policies and to develop programs that address additional opportunities to reduce greenhouse gas emissions across all fuels and sectors. In particular, the plan includes programs that work in concert with the System Benefits Charge (SBC), Energy Efficiency Portfolio Standard (EEPS), and Renewable Portfolio Standard (RPS).

CO_2 allowance proceeds are invested to address residential, commercial, industrial, and transportation sector energy efficiency; research, development, and deployment of clean and renewable technologies; workforce development; capacity building; and educational initiatives. While the majority of programs are designed to reduce greenhouse gas emissions in the near-term, approximately 28 percent of program funds are invested to develop technologies, processes, and infrastructure needed to reduce greenhouse gas emissions over the long-term. This two-pronged strategy is designed to deliver immediate, cost-effective environmental and consumer benefits, while supporting the aggressive carbon reduction framework needed for a stable climate and a clean energy economy.

The following criteria were considered in developing the portfolio of programs included in the Revised Plan:

- Cost-effectiveness measured by quantity of CO_2-equivalent greenhouse gas emissions reduced per dollar invested

- Long-range potential for the technology or investment to reduce greenhouse gas emissions in New York
- Potential to reduce the costs of achieving the emission reduction requirements of the CO_2 Budget Trading Program
- Other benefits to New York, such as the potential to create jobs, leverage capital investment in New York to promote economic development, provide health and environmental benefits, and enhance municipal capacity to further reduce greenhouse gas emissions
- Opportunities to reduce the disproportionate energy cost burden and environmental impacts on low-income families and environmental justice communities
- Need for funds based upon availability from other funding sources

Table 1 summarizes the investments described in the Revised Plan and shows how those investments are apportioned across regional program categories for comparison.

Table 1: Summary of Revised Operating Plan[xxvi]

State Program	Percent Allocated in State Plan	Regional Program Category
Residential Space and Water Heating Efficiency	36.6%	Energy Efficiency (95%) Renewable Energy (5%)
Commercial, Industrial, Municipal and Institutional Energy Efficiency Programs	19%	Energy Efficiency (95%) Renewable Energy (5%)
Transportation Efficiency	9.5%	Energy Efficiency (100%)
Electric Power Supply and Delivery	14.9%	Renewable Energy (82%) Other GHG Reduction Programs (18%)
Sustainable Agriculture and Bioenergy	1.3%	Renewable Energy (82%) Other GHG Reduction Programs (18%)
Multi-Sector Programs	6.7%	Energy Efficiency (34%) Renewable Energy (33%) Other GHG Reduction Programs (33%)
Administration and Evaluation	12%	Program Administration (60%) Evaluation (40%)

Program Descriptions

Programs funded under the Revised Operating Plan are categorized as follows:

Residential Space and Water Heating Efficiency

Programs in this category are designed to focus on fossil fuel energy efficiency activities not fully addressed through the SBC, EEPS, RPS, and federally-funded energy efficiency activities. This will allow a variety of programs to pursue a “whole-building” approach to improving energy use within homes in New York. RGGI funding will expand the number of households served, increase opportunities for carbon reduction measures in the building sector, and support technical training and workforce development related to fossil fuel energy efficiency technologies. A substantial portion of the funds in this category will be used to support energy efficiency improvements in low-income housing. Seventy percent of the $112 million Green Jobs/Green New York budget has been allocated to this sector to cover the energy audits, workforce development, outreach, financing initiatives and other activities outlined in the Act.

[xxvi] The June 2010 Operating Plan assumed that $342.6 million would be available over three years to implement, administer and evaluate the programs in the plan. The percentages in Table 1 above are calculated using this figure for the denominator. The percentage breakdown shown for New York in Table 3 of Section 1 (page 11) are based upon $282.3 million in auction proceeds through December 31, 2010.

Buildings and Facilities Energy Efficiency
Programs in this category are designed to cover a variety of energy efficiency measures in industrial, municipal and institutional facilities. For instance, one program supports infrastructure projects at water and wastewater facilities that promote energy efficiency improvements and carbon emission reductions. Also, thirty percent of the $112 million Green Jobs/Green New York budget has been allocated to this sector to cover the energy audits, workforce development, financing initiatives, and other activities outlined in the Act for small businesses in New York. In addition, a Competitive Greenhouse Gas Reduction Pilot that is focused on the industrial sector will foster innovative cost-effective emission reductions within the sector. Furthermore, an initiative to empower and enable municipalities to design and realize smart growth objectives is included.

Transportation Efficiency
Programs in this category are designed to reduce greenhouse gas emissions from the transportation sector by accelerating deployment of proven but underutilized technologies that reduce petroleum use and, where feasible, increase the efficiency of electric mass transit. These objectives can be achieved by improving the efficiency of vehicles and transportation infrastructure and expanding the use of electricity and renewable fuels in the sector.

Renewable Energy and Advanced Power Technology
Programs in this category are designed to develop, demonstrate, and deploy technologies needed to ensure sustained reductions in greenhouse gas emissions in the long-term. Programs include initiatives to foster the development and market introduction of promising renewable energy technologies; support the demonstration of technologies that integrate renewable resources, smart-grid capability, advanced meters, energy storage systems, demand-management strategies, and high-efficiency power delivery technologies; and programs to asses and demonstrate the use of carbon capture and sequestration technologies in New York.

Sustainable Agriculture and Bioenergy
This program is designed to expand sustainable non-food biofuel feedstocks; reduce greenhouse gas emissions derived from the agriculture, forestry and waste management sectors; and characterize the potential for carbon sequestration in New York's terrestrial ecosystem. Program priorities will be guided by findings and recommendations from the ongoing *Renewable Fuels Roadmap and Sustainable Biomass Feedstock Supply Study for New York.*

Multi-Sector Programs: Climate Research, Industrial Clean Technology Development, and Climate Research and Analysis
Programs in this category are designed to build the capacity to develop and implement new climate change mitigation and risk management solutions and to realize a clean energy economy in New York. Some funds will be used to build upon New York's existing technology innovation assets and leverage federal funding for, among other things, "Energy Innovation Hubs" established by the U.S. Department of Energy. Business development programs that will provide support for seed- and early-stage clean energy companies and established companies bringing new clean energy products to market are also included. In addition, funds are also provided for conducting research on climate change impacts, mitigation, and adaptation in New York.

Stakeholder Engagement
NYSERDA, the DEC, and PSC are engaging a variety of stakeholders in the design, implementation and evaluation of the State's energy efficiency and renewable energy programs. An Advisory Group consisting of industry, environmental, research and development, environmental justice and other organizations has been convened to advise and inform the New York agency partners on

development and implementation of the plan for investing CO_2 allowance proceeds in a clean energy economy. Stakeholders, including trade associations, unions, regional planning boards, utilities, consumers, non-profits, and community-based organizations, are consistently engaged in the development of the Operating Plan. Beyond the development of the plan, stakeholders will also play an important role in assisting with program implementation.

For instance, CO_2 allowance proceeds are helping build effective partnerships for reducing greenhouse gas emissions. The Climate Smart Communities program, for example, engages local governments to implement effective municipal greenhouse gas emission reduction strategies. The program connects local governments with regional planning boards, Municipal Planning Organizations (MPOs), and other consortia that can provide senior staff, technical platforms, and best practices to help local governments:

- Inventory and reduce greenhouse gas emissions
- Invest in smart growth and the clean energy economy
- Plan for community resiliency in the face of a changing climate

Similarly, under the Green Jobs/Green New York program, New York will work with state and local chapters of industry groups and trade associations, such as the Building Performance Contractors Association, Empire State Petroleum Association (ESPA), Multiple Intervenors, and Manufacturers Association of Central New York (MACNY), to develop comprehensive job training initiatives across the state. Training will be deployed through NYSERDA partnerships with the State Department of Labor, community-based organizations, colleges, trade associations, unions, and professional associations.

4.9 Rhode Island

Rhode Island is investing CO_2 allowance proceeds to expand cost-effective energy efficiency programs administered by the state's primary electric utility, National Grid. Programs are designed to deliver maximum benefits to residential consumers, small businesses, low-income communities, local governments, small non-profit agencies, and institutions of higher education. The state is also investing proceeds to support innovative financing and partnership opportunities to accelerate program development and deployment.

Investment Plan: Summary and Categorization

Rhode Island, through the Office of Energy Resources (OER) in consultation with the Department of Environmental Management (DEM) and the Energy Efficiency and Resources Management Council (EERMC), has issued a plan for the allocation and distribution of CO_2 allowance proceeds.

Table 1 summarizes the investments specified in Rhode Island's Plan for the Allocation and Distribution of Regional Greenhouse Gas Initiative Auction Proceeds (March 2009) and shows how those investments are apportioned among regional program categories for comparison.

Table 1: Summary of Rhode Island's Plan for the Allocation and Distribution of Regional Greenhouse Gas Initiative Auction Proceeds (March 2009)

State Program	Percent Allocated in State Plan	Regional Program Category
Least-Cost Energy Efficiency Utility Account	60%	Energy Efficiency (100%)
Innovative Financing and Partnership Account	40%	Energy Efficiency (100%)
Program Administration	Up to 5.0% or $300,000 annually, whichever is less	Program Administration (100%)

Program Descriptions

Utility-Administered Energy Efficiency Programs

CO_2 allowance proceeds dedicated to this program area are directed to a Least-Cost Energy Efficiency Utility Account for expansion of utility-administered energy efficiency programs. Current programs include: loans and grants to small commercial and industrial companies that provide least-cost energy efficiency services, low-cost financing for residential energy audits and energy efficiency retrofits, marketing to provide one-stop easy access to information about utility-administered energy efficiency initiatives, Energy Information Report Systems to benchmark the energy performance of municipal and non-profit buildings, energy efficiency job training programs for contractors and facility managers, and financial assistance for non-profits that provide energy efficiency services to low-income consumers but are not covered by utility incentive programs.

Research and Deployment of Innovative Energy-Efficient Techniques and Technologies

CO_2 allowance proceeds dedicated to this program area are directed to an Innovative Financing and Partnership Account at National Grid for the sole purpose of investing in research, partnerships, pilot programs, and innovative financing options that accelerate energy efficiency program development.

Administration

Rhode Island may allocate up to 5 percent of CO_2 allowance proceeds or $300,000 annually, whichever is less, to cover costs associated with administering the CO_2 Budget Trading Program and associated consumer benefit programs.

4.10 Vermont

Vermont is investing nearly all of its CO_2 allowance proceeds to implement heating and process fuel efficiency programs administered by Efficiency Vermont. Half of the state's CO_2 allowance proceeds are invested to provide energy efficiency services to low-income consumers.

Investment Plan: Summary and Categorization

Proceeds from the sale of CO_2 allowances are allocated according to Title 30, Chapter 5, Section 255: Regional Coordination to Reduce Greenhouse Gases (Title 30, Chapter 5, Section 255), which directs 100 percent of proceeds to programs that support whole-building heating and process energy efficiency and facilitate appropriate fuel switching. Fifty-percent of CO_2 allowance proceeds support programs that are tailored to low-income energy consumers.

Table 1 summarizes the investments specified in Title 30, Chapter 5, Section 255 and shows how those investments are apportioned among regional program categories for comparison.

Table 1: Summary of Title 30, Chapter 5, Section 255

Program	Percent Allocated in State Plan	Regional Program Category
Heating and Process Energy Efficiency Programs (50% of CO_2 allowance proceeds are invested to benefit low-income energy consumers)	100%	Energy Efficiency (100%)
Program Administration	Currently 2%	Program Administration (100%)

Program Descriptions

Vermont is investing the vast majority CO_2 allowance proceeds to expand heating and process energy efficiency programs administered by Efficiency Vermont, the nation's first ratepayer-funded energy efficiency utility providing energy efficiency services statewide. Efficiency Vermont has a proven track record of implementing cost-effective energy efficiency programs for commercial and residential energy consumers. In 2009, Efficiency Vermont's programs resulted in incremental energy savings of more than 85,000 megawatt-hours and generated an estimated $65.3 million in lifetime economic benefits for the state of Vermont.[76] In 2009, Efficiency Vermont's residential and commercial programs generated $2.4 in benefits for every dollar invested.[77]

Programs currently supported by CO_2 allowance proceeds include the Vermont Community Energy Mobilization (VCEM) Project, a volunteer-based program to install simple, cost-effective energy-saving measures in homes across the state, and the Home Performance with ENERGY STAR service, a program to provide incentives of up to $2,500 for comprehensive retrofits that address both electric and non-electric energy efficiency needs.

In 2009, Vermont also invested CO_2 allowance proceeds to provide improved incentives for energy efficiency retrofits for lower- and middle-income consumers.

Administration

Vermont may use CO_2 allowance proceeds to cover costs associated with administering the CO_2 Budget Trading Program and associated consumer benefit programs. Through December 2010, approximately 2 percent of the state's total CO_2 allowance proceeds have been used for this purpose.

Endnotes

[1] Commonwealth of Massachusetts, Massachusetts Winter Energy Task Force, *Winter Energy Costs Task Force Report,* 2008, pp. 14-15.

[2] Derek Murrow and Peter Shattuck, *Economy-Wide Benefits of RGGI: Economic Growth through Energy Efficiency,* Environment Northeast, December 2010, p. 2; Tyler Comings, Jamie Howland, Derek Murrow, and Lisa Petraglia, *Energy Efficiency: An Engine for Economic Growth,* Environment Northeast and Economic Development Research Group, Inc., October 2009, pp. 26-28.

[3] George Sterzinger, et al., *Component Manufacturing: Michigan's Future in the Renewable Energy Industry*, Renewable Energy Policy Project, November 2006, p. 4.

[4] Multiple sources, including:

- Connecticut Energy Efficiency Fund, *Report on the Energy Conservation Management Board Year 2010 Programs and Operations*, forthcoming March 2011, p. 1.
- Matthew Magnusson and Cameron Wake, *NH Greenhouse Gas Emissions Reduction Fund Year 1 (July 2009 – June 2010) Evaluation*, Carbon Solutions New England and University of New Hampshire, February 2011, pp. 3-4.
- Commonwealth of Massachusetts, Executive Office of Energy and Environmental Affairs, *A Summary of Electric Efficiency Programs Funded by Ratepayers between 2003 and 2005*, Massachusetts Division of Energy Resources, April 2, 2007, p. 1.
- Efficiency Maine, *Efficiency Maine 2010 Annual Report*, December 2010, p. 3.
- New York State, New York State Energy Research Development Authority, *New York's System Benefits Charge Program Evaluation and Status Report: Quarterly Report to the Public Service Commission, Quarter Ending March 31, 2010,* May 2010, pp. 2-13.
- Bruce Biewald, Max Chang, Lucy Johnston and David White, *Electricity Energy Efficiency Benefits of RGGI Proceeds: An Initial Analysis*, Synapse Economics, October 5, 2010, pp. 4, 13.

[5] New York State, New York State Energy Planning Board, *2009 State Energy Plan, Volume I*, December 2009, pp. 49-50; Comings, Howland, Murrow and Petraglia, *Energy Efficiency: Engine of Economic Growth; A Macroeconomic Modeling Assessment, supra* note 2, pp. 23-30.

[6] State of Maryland, Maryland Energy Administration, *Maryland State Energy Investment Fund: Clean Energy Accomplishments, FY 2009 and FY 2010*, January 2011, pp. 23, 24, 28, 32.

[7] Magnusson and Wake, *NH Greenhouse Gas Emissions Reduction Fund Year 1 (July 2009 – June 2010) Evaluation*, *supra* note 4, pp. 1-2.

[8] *Ibid*, pp. 1-2.

[9] Telephone Interview with Christopher Sherry, Research Scientist, New Jersey Department of Environmental Protection (January 21, 2011).

[10] *Report on the Energy Conservation Management Board Year 2010 Programs and Operations*, *supra* note 4, p. 24.

[11] *Report on the Energy Conservation Management Board Year 2010 Programs and Operations*, *supra* note 4, p. 29.

[12] Energize Delaware, Appliance Rebate Program, Web, accessed January 10, 2010.
<http://www.energizedelaware.org/residential/appliance-rebate-program/ >

[13] *Efficiency Maine 2010 Annual Report*, *supra* note 4, pp. 2-3.

[14] Commonwealth of Massachusetts, Department of Energy Resources, *Energy Efficiency: Our First Fuel,* March 2010, p. 1.

[15] National Grid, NSTAR, Unitil, and Western Massachusetts Electric, *Massachusetts Joint Statewide Three-Year Electric Energy Efficiency Plan: 2010-2012*, submitted to the Commonwealth of Massachusetts, Department of Public Utilities on October 29, 2009, p. 22, 28.

[16] *Ibid*, p. 55.

[17] New York State Energy Research and Development Authority, *Green Jobs-Green New York Annual Report*, October 2010.

[18] New York State, New York State Energy Research Development Authority, *Operating Plan for Investments in New York under the CO_2 Budget Trading Program and CO_2 Allowance Auction Program*, June 2010, p. 1.

[19] 2009 Results: Efficiency Vermont, *Final Report – Vermont Community Energy Mobilization Project*, October 2009, p. 2. 2010 Results: Telephone Interview with George Twigg, Deputy Policy Director, Efficiency Vermont, January 24, 2011.

[20] National Grid, "National Grid Energy Efficiency Programs 2010: Preliminary 4th Quarter Report," RI PUC Docket No. 4116.

[21] Katherine Friedrich, et al., *Saving Energy Cost Effectively: A National Review of the Cost of Energy Saved through Utility-Sector Energy Efficiency Programs*, American Council for an Energy-Efficient Economy, September 2009, p. 15.

[22] *Winter Energy Costs Task Force Report*, *supra* note 1, pp. 14-15.

[23] United States Department of Energy, *Weatherization Assistance Program Fact Sheet*, National Renewable Energy Laboratory, Office of Energy Efficiency and Renewable Energy, May 2009, p. 2.

[24] *Ibid,* p. 5.

[25] *Report on the Energy Conservation Management Board Year 2010 Programs and Operations*, supra note 4, p. 29.

[26] Commonwealth of Massachusetts, Department of Community Housing and Development, *Final Report/2009 RGGI Funds in HeartWAP*, August 2009, p.1.

[27] Jennifer Thorne Amann, et al., "Consumer Guide to Home Energy Savings: Condensed Online Version," American Council for an Energy Efficient Economy, Web, accessed January 14, 2010. <http://www.aceee.org/consumerguide/intro.htm>

[28] United States Department of Energy and United States Environmental Protection Agency, "Compact Fluorescent Light Bulbs for Consumers," Energy Star, Web, accessed January 14, 2010. <http://www.energystar.gov/index.cfm?fuseaction=find_a_product.showProductGroup&pgw_code=LB>

[29] *Report on the Energy Conservation Management Board Year 2010 Programs and Operations*, *supra* note 4, p. 10.

[30] *Ibid,* p. 29.

[31] *Efficiency Maine 2010 Annual Report, supra* note 4, p. 3.

[32] National Grid, *Energy Star Air Conditioner Savings*, October 2010, p. 1.

[33] Energize Delaware Appliance Rebate Program, *supra* note 12.

[34] New Hampshire Business Finance Authority, "Greenhouse Gas Emissions Reduction Fund Quarterly Progress Report Form – Q4 2010," September 2010, p. 1.

[35] *Report on the Energy Conservation Management Board Year 2010 Programs and Operations*, *supra* note 4, p. 17.

[36] *Efficiency Maine 2010 Annual Report*, *supra* note 4, p. 6.

[37] Joseph Laquatra, et al., "The Consumer Education Program for Residential Energy Efficiency," *Journal of Extension* 47:6, December 2006, p. 4.

[38] *Ibid,* p. 4.

[39] 2009 Results: *Final Report – Vermont Community Energy Mobilization Project*, *supra* note 19, p. 2. 2010 Results: Telephone Interview with George Twigg, Deputy Policy Director, Efficiency Vermont, January 24, 2011.

[40] *Final Report – Vermont Community Energy Mobilization Project*, *supra* note 19, p. 2.

[41] *Maryland State Energy Investment Fund: Clean Energy Accomplishments*, *FY 2009 and FY 2010*, *supra* note 6, pp. 34-35.

[42] United States Energy Information Administration, *Annual Energy Review 2009,* August 2010, p. 38.

[43] Hannah Choi Grande, et al. *Unlocking Energy Efficiency in the U.S. Economy*, McKinsey & Company, July 2009, p. 4.

[44] 2009 Results: David Littell and Thomas Teitenberg, Letter to Barry Hobbins, Senator, State of Maine, and Jon Hinck, Representative, Maine State Legislature, March 10, 2010, p. 7. 2010 Results: Telephone Interview with John Quartararo, Chief Operating Officer, Efficiency Maine, December 1, 2010.

[45] Telephone Interview with Christopher Sherry, Research Scientist, New Jersey Department of Environmental Protection, January 21, 2011.

[46] Commonwealth of Massachusetts, Office of Energy and Environmental Affairs, "Eighteen New Green Community Designations," Web, accessed December 16, 2010. <http://www.mass.gov/Eoeea/docs/doer/green_communities/grant_program/gc-towns-Dec16-2010.pdf>

[47] TRC, Inc. "Greenhouse Gas Emissions Reduction Fund Quarterly Progress Report Form – Q4 2010," December 2010, p. 1.

[48] New York State, New York State Energy Research Development Authority, *New York's RGGI-Funded Programs: Status Report, Quarter Ending September 30, 2010,* December 2010, p. 2-4.

[49] Murrow and Shattuck, *Economy-Wide Benefits of RGGI: Economic Growth through Energy Efficiency, supra* note 2, p. 2; Comings, Howland, Murrow, Lisa Petraglia, *Energy Efficiency: An Engine for Economic Growth, supra* note 2 pp. 26-28.

[50] George Sterzinger, et al., *Component Manufacturing: Michigan's Future in the Renewable Energy Industry*, Renewable Energy Policy Project, November 2006, p. 4.

[51] New Hampshire, Department of Resources and Economic Development, Division of Economic Development, "Expanded Energy Efficiency and Renewable Energy Program Proposal," February 4, 2011.

[52] Telephone Interview with Andrew Duncan, Energy Trainings Manager, Lakes Region Community College, January 26, 2011.

[53] Duncan, Andy "Lakes Region Community College BPI Training Alumni Survey – Narrative Report," August 2010, p. 2.

[54] *Maryland State Energy Investment Fund: Clean Energy Accomplishments, FY 2009 and FY 2010*, *supra* note 6, p. 28.

[55] *New York's RGGI-Funded Programs: Status Report, Quarter Ending September 30, 2010*, *supra* note 48, p. 4-6.

[56] Telephone Interview with Emily Smith, Chief of Staff and Managing Director, External Affairs, Connecticut Innovations, January 27, 2011.

[57] *Maryland State Energy Investment Fund: Clean Energy Accomplishments, FY 2009 and FY 2010*, *supra* note 6, p. 32.

[58] Telephone Interview with Christopher Sherry, Research Scientist, New Jersey Department of Environmental Protection, January 21, 2011.

[59] *Maryland State Energy Investment Fund: Clean Energy Accomplishments, FY 2009 and FY 2010*, *supra* note 6, p. 48.

[60] *Report on the Energy Conservation Management Board Year 2010 Programs and Operations*, *supra* note 4, p. 1. (for 2008 and 2009 results, equivalent reports issued in 2008 and 2009)

[61] Navigant Consulting, Connecticut Renewable Energy/Energy Efficiency Economy Baseline Study - Phase I Deliverable, March 27, 2009, p. 9.

[62] *Ibid,* p. 9.

[63] *Ibid,* p. 9.

[64] *Report on the Energy Conservation Management Board Year 2010 Programs and Operations*, *supra* note 4, p. 7.

[65] Connecticut Clean Energy Fund, *2008 Annual Report*, March 2009, p. 2.

[66] Telephone Interview with Emily Smith, Chief of Staff and Managing Director, External Affairs, Connecticut Innovations, January 27, 2011.

[67] *Efficiency Maine 2010 Annual Report*, *supra* note 4, p. 2.

[68] *Ibid,* p. 3.

[69] 2009 Results: Littell and Teitenberg, *supra* note 44, p. 7. 2010 Results: Telephone Interview with John Quartararo, Chief Operating Officer, Efficiency Maine, December 1, 2010.

[70] *Massachusetts Joint Statewide Three-Year Electric Energy Efficiency Plan: 2010-2012*, *supra* note 15, p. 22, 28.

[71] Commonwealth of Massachusetts, Executive Office of Energy and Environmental Affairs, “Patrick-Murray Administration Announces Final Approval of Nation-Leading Energy Efficiency Plans,” January 29, 2010.

[72] *NH Greenhouse Gas Emissions Reduction Fund Year 1 (July 2009 – June 2010) Evaluation*, *supra* note 4, pp. 1-2.

[73] *Ibid*, pp. 1-2.

[74] *Ibid,* p. 1.

[75] Telephone interview with Joseph Fontaine, Trading Programs Manager, New Hampshire Department of Environmental Services, January 27, 2011.

[76] Efficiency Vermont, *Annual Report 2009*, November 2010, p. 1.

[77] *Ibid,* p. 2.