

Boosting the Benefits

Improving Air Quality and Health by Reducing Global Warming Pollution in California

Lead Authors

Diane Bailey
Kim Knowlton
Miriam Rotkin-Ellman
Natural Resources Defense Council

Contributing Authors

Harris Epstein
Natural Resources Defense Council

Andrew Hoerner
Redefining Progress

Gina Solomon
Natural Resources Defense Council



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NRDC Marketing and Operations Director: Alexandra Kenneough
NRDC Publications Manager: Lisa Goffredi
NRDC Publications Editor: Anthony Clark
Production: Tanja Bos, tanja@bospoint.com

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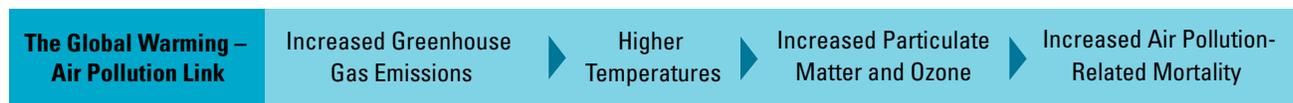
Boosting the Benefits: Improving Air Quality and Health by Reducing Global Warming Pollution in California

The California Global Warming Solutions Act (AB 32) provides a significant opportunity to improve air quality and public health in the state. Our new analysis shows that many strategies for combating global warming will reduce air pollution, which lowers health risks. In fact, measures being considered for implementation under AB 32 could prevent more than 700 premature deaths and thousands of other negative health impacts annually, saving \$3.2 to \$5.0 billion¹ in health costs in the year 2020 alone. New evidence of increased health impacts from exposure to particulate matter (PM) suggests that these health benefits and savings may be even greater than estimated here.² California should adopt these measures to reduce global warming pollution and provide tremendous short- and long-term health “co-benefits” by improving air quality and combating global warming at the same time.

Global Warming Worsens Air Pollution

Global warming will continue to have enormous impacts on air quality as temperatures rise, weather patterns change, background pollutant levels increase, and wildfires become more common.³ Because every degree of warming is expected to lead to about a 3 percent increase in energy use per capita, hotter temperatures will also increase unhealthy emissions from power plants.⁴

Research also shows that hotter temperatures will lead to higher emissions of smog- and soot-forming gases such as nitrogen oxides (NO_x), while also accelerating the formation of ozone smog. Together, the increased emissions of precursors and stepped up formation of smog and soot create a feedback loop since both of these pollutants contribute significantly to further global warming (see sidebar on page 10: *Addressing the Warming Impacts of Smog and Soot*). In addition to the global warming pollution emitted in California itself, the ozone problem will be exacerbated by pollution that travels with air currents from Asia to the west coast of the United States. One estimate shows that ozone levels throughout California are expected to exceed the state standard by the end of this century due to pollution stemming from Asia alone.⁵



Addressing the Warming Impacts of Smog and Soot

Although they are not always considered greenhouse gases, black carbon “soot” and ozone pollution both contribute significantly to global warming. In addition to their myriad adverse health impacts. Although these pollutants have relatively short atmospheric lifetimes, reduction programs of smog and soot—in combination with reductions of the six greenhouse gases explicitly called out by AB 32—could play an instrumental role in arresting climate change in the short term.

The global warming impacts of ozone from human activities have already had a measurable impact on climate, causing roughly a 0.5 degree Celsius increase in winter temperatures in the Arctic for the period between 1900 and 2000 (Shindell 2006). The Intergovernmental Panel on Climate Change notes a small effect from fossil fuel–based black carbon, but some researchers have suggested that the impact has been underestimated (Hansen and Nazarenko 2004; Jacobson 2001). According to Hansen and Nazarenko, “indirect soot-driven warming may have contributed to global warming of the past century, including the trend toward early springs in the Northern Hemisphere, thinning Arctic sea ice, and melting land ice and permafrost.” Other work suggests that if all black carbon emissions were eliminated, net warming could be reduced by 20 to 45 percent within 3 to 5 years (Jacobson 2002 and 2005).

In the United States, toxic diesel emissions are responsible for more than half of the black carbon soot released (CARB, 2007). A recent report funded in part by the California Energy Commission concluded that “black carbon pollution, which scientists blame for the premature deaths of more than a million people, is one of the major contributors to the retreat of the Himalayan glaciers.” The potential role of black carbon in moving the earth toward a climate tipping point related to melting of glaciers or ice sheets requires serious attention.

A reduction in soot and smog would therefore augment efforts to mitigate climate change by regulating the six major greenhouse gases called out in AB 32; such a reduction would also drastically improve air quality, with significant impacts on human health. Addressing soot and smog in conjunction with AB 32 is a win-win strategy.

Sources: CARB, *Health Effects of Diesel Exhaust Particulate Matter*, 2007; Hansen, J. and Nazarenko, L., “Soot Climate Forcing via Snow and Ice Albedos,” *PNAS*, 101, 423-428, 2004; Jacobson, M.Z., “Strong Radiative Heating due to the Mixing State of Black Carbon in Atmospheric Aerosols,” *Nature*, 409, 695-697, 2001; Jacobson, M.Z., “Control of Fossil-Fuel Particulate Black Carbon and Organic Matter, Possibly the Most Effective Method of Slowing Global Warming,” *JGR*, 107, 2002; Jacobson, M.Z., “Correction to ‘Control of Fossil-Fuel Particulate Black Carbon and Organic Matter, Possibly the Most Effective Method of Slowing Global Warming,’” *JGR*, 110, 2005; McConnell, J.R., et. al., “20th-Century Industrial Black Carbon Emissions Altered Arctic Climate Forcing,” *Science*, 317, 1381-1384, 2007; Shindell, D., et. al., “Role of Tropospheric Ozone Increases in 20th-Century Climate Change,” *JGR*, 111, 2006; Abdollah, Tami, “Soot May Play Big Role in Climate Change,” *LA Times*, March 25, 2008.

Air Pollution Harms Californians’ Health

As home to five of the 10 smoggiest cities in the United States, California is already suffering a staggering health toll from air pollution, including up to 24,000 premature deaths each year and tens of thousands of illnesses.⁶

Ozone precursors such as NO_x, particulate matter (PM), and a variety of other pollutants are emitted primarily by fossil-fuel combustion from transportation, power plants, and other industries. These sources also emit greenhouse gases (GHGs), whose long-term effect is to increase global temperatures. Ground-level ozone and PM have been linked to respiratory hospital admissions and emergency room visits, decreased lung function, and increased mortality related to cardiovascular and respiratory illness.⁷

One recent study concluded that global warming pollution emissions from human activities may already be causing an additional 1,000 air pollution–related deaths and 20 to 30 additional cancers annually for each 1 degree Celsius rise in temperature in the United States; 300 of these deaths occur in California.⁸ Policies limiting emissions from fossil-fuel burning, therefore, offer the double benefit of reduced global warming pollution and improved air quality.

Immediate and Comprehensive Action Under AB 32 is Needed

The California Global Warming Solutions Act of 2006 (AB 32) calls for reduction of global warming emissions to 1990 levels by 2020, and the governor has set a target of 80 percent below 1990 levels by 2050. AB 32 also calls for regulation of the major sources of global warming pollution (see Figures 1 and 2). While the exact list of regulatory measures that will move forward under AB 32 is yet to be determined, the Climate Action Team (CAT)—an interagency working group tasked with crafting policies for helping California meet its global warming reduction targets—has vetted a package of promising measures that would achieve reductions in all of the major sectors contributing to global warming pollution in California.

With quick action, these regulatory measures can bring significant environmental and health benefits, including the prevention of emissions totaling 109 million metric tons of CO₂ equivalents (MMT CO₂e) by 2020—approximately two-thirds of the reductions needed to meet the 2020 limit. Projected reductions in fuel and energy consumption for these measures, as well as avoided NO_x and PM emissions, are derived directly from the most recent update of the CAT report. The potential health impacts of these reductions were evaluated according to the health risk assessment methodology established by the California Air Resources Board (CARB) Goods Movement Emission Reduction Plan (GMERP); health costs were similarly estimated according to the CARB GMERP.⁹ For more information on the methodology used in this report, see *Appendix A: Technical Notes and Methods*.

Figure 1: Sources of Global Warming Pollution Emissions by Sector in California, 2004

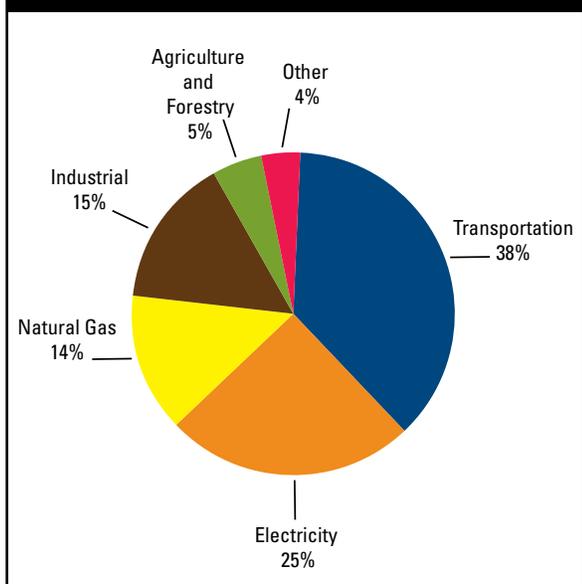
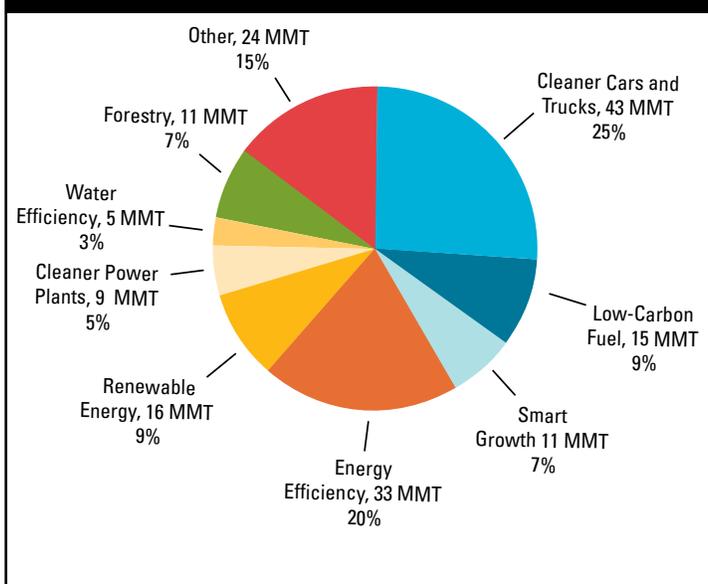


Figure 2: Summary of Global Warming Pollution Emission Reductions Identified* to Contribute to AB 32's 2020 Limit



California Air Resources Board Inventory, 2007, *Updated Macroeconomic Analysis of Climate Strategies Presented in the March 2006 Climate Action Team Report*, Final Report, October 2007; CARB, Expanded list of early action measures to reduce greenhouse gas emissions in California recommended for board consideration, October 2007; NRDC and other Recommendations for Policies to Reduce Global Warming Pollution for the AB 32 Scoping Plan, October 1, 2007.

*Emissions reductions as identified by the Climate Action Team, CARB, and NRDC. Note: The first number listed in Figure 2 after each category of measures represents million metric tons (MMT) of CO₂-equivalent emission reductions, totalling 167 MMT CO₂e.

Reductions in Pollution Bring Health and Economic Co-Benefits

Our analysis shows that the measures that reduce the greatest amounts of global warming pollution—cleaner cars and trucks, energy efficiency, renewable energy, and smart growth—also contribute to significant reductions in the NO_x and PM emissions that lead to health problems.¹⁰ In addition, these measures are likely to produce many other improvements to air quality and public health, including reductions in carcinogens that can be byproducts of burning fossil fuel.

This package of CAT measures is projected to reduce NO_x emissions in 2020 by 86,000 tons. More than three-quarters of the NO_x reduction is from the cleaner car and truck measures, which also reduce emissions in communities along transportation and goods-movement corridors where air quality is particularly poor. Energy efficiency is the single largest contributor to the 3,000 tons of PM reductions from this package, with smart growth, renewable energy, and cleaner cars and trucks providing additional major reductions. It is worth noting that smart growth measures also provide significant public health benefits in the form of enabling a more active lifestyle, which can curb obesity rates, leading to lowered risk of diabetes and heart disease.¹¹

In this analysis, energy efficiency and renewable energy measures contribute little to estimated reductions in NO_x because of the conservative assumption that all displaced power generation would have been met with new natural gas combined-cycle plants. To the extent that energy efficiency and renewable energy displace existing power generation, we can expect further decreases in NO_x and improvements in air quality than estimated in our analysis. It is expected that some dirty, natural gas power plants may come off-line or be utilized significantly less by 2020, and retiring or replacing these plants with new natural-gas plants could significantly decrease NO_x. Since NO_x is a precursor to smog and fine particulate matter, NO_x reductions will improve regional and local air quality.

Reducing Other Health Threats from Global Warming

Existing levels of greenhouse gases are predicted to result in significant changes to California's climate, which can negatively impact public health. Substantial reductions in global greenhouse gas emissions can slow or reduce the degree of warming experienced, thereby preventing or modulating the following health threats linked to global warming:

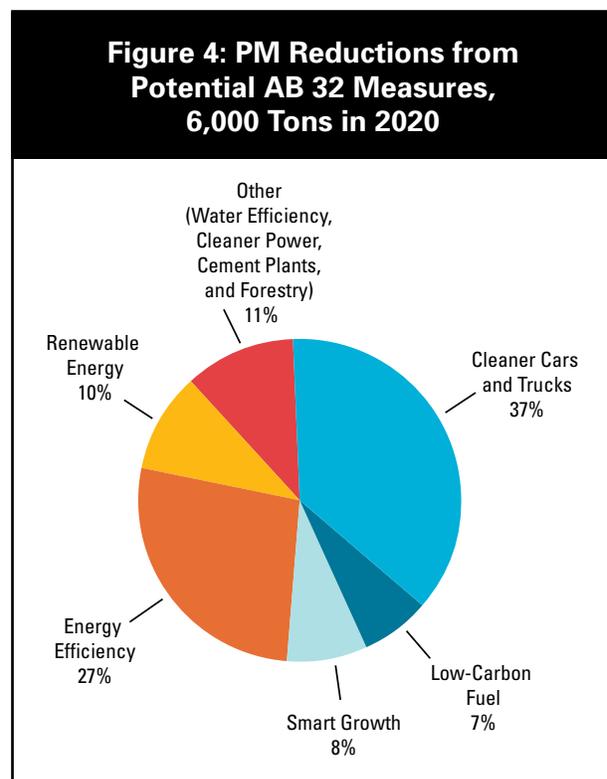
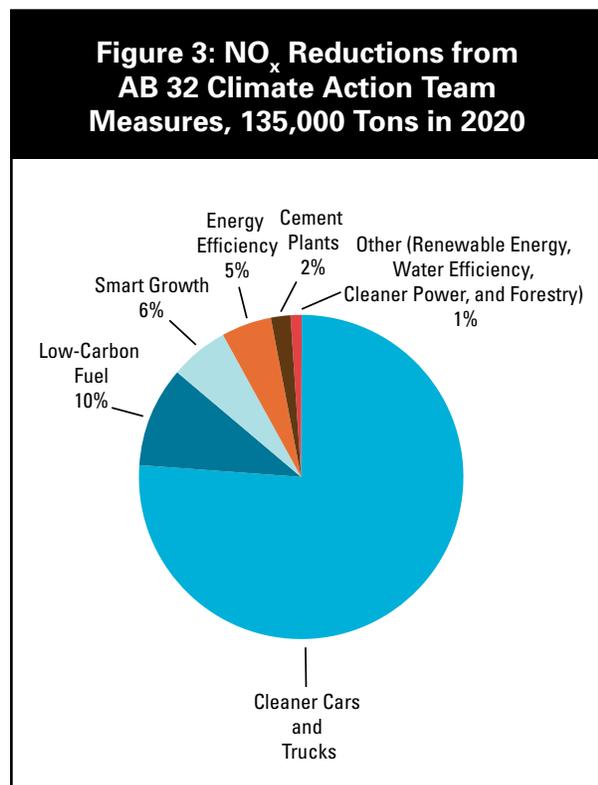
- ▶ **Heat Waves and Extreme Heat:** The frequency of heat wave days in some parts of California is projected to double by 2050, and heat-related deaths are expected to quadruple by 2100.
- ▶ **Extreme Precipitation Events:** Storms are expected to become more frequent, intense, longer, and larger, resulting in flooding, infrastructure damage, and population displacement.
- ▶ **Mosquito, Flea, and Tick-Borne Diseases:** Diseases spread by mosquitoes, ticks, and fleas (including malaria, West Nile virus, dengue fever, Lyme disease, and the plague) are expected to increase as the climate becomes more favorable for many of these insects.
- ▶ **Pollen and Allergy:** In a warmer environment with more carbon dioxide, ragweed produces significantly more pollen. Many weeds and allergenic plants will produce pollen earlier, for a longer time, and in more copious quantities, resulting in increased seasonal allergies and triggers for asthma sufferers.
- ▶ **Food and Water Supply:** Droughts are expected to afflict many regions of the world and threaten drinking water supplies. In addition, as the climate changes, agricultural pests already spreading into new areas will be harder to control.

Sources: California Climate Change Center, *Our Changing Climate: Assessing the Risks to California*, July 2006, CEC-500-2006-077; K. Hayhoe, et al., "Emissions Pathways, Climate Change, and Impacts on California," *PNAS* 2004;101:12422-7; NRDC Fact Sheet, "Global Warming Can Affect Our Health: Protecting Against the Most Serious Health Impacts of Climate Change," May 2008, www.nrdc.org/policy.

The reductions in PM and NO_x from the CAT measures are estimated to prevent more than 300 premature deaths associated with air pollution and thousands of additional hospitalizations and illnesses. And the benefits quantified here would save a total of \$1.4 to \$2.3 billion in avoided health costs in 2020. These projections are likely to underestimate the total health benefits of this climate package, since many viable global warming pollution measures were not included and many benefits to public health, such as reduced cancer risk, were not quantified.¹²

Additional Global Warming Measures and Proposals

CARB's implementation plan for AB 32 will also include the Early Action Measures (EAMs) and 35 other measures adopted in October 2007, estimated to produce reductions of an additional 35 million metric tons of carbon dioxide equivalents (MMT CO₂e).¹³ Further measures proposed to CARB for consideration during the scoping plan process for AB 32 could contribute reductions of up to 39 MMT CO₂e more.¹⁴ The EAMs that are not part of the Climate Action Team report, together with the additional proposed measures, if adopted, would avoid more than 52,000 tons of NO_x and PM pollution, would avert roughly 250 additional premature deaths and thousands of cases of asthma and respiratory symptoms, and would save \$1.1 to \$1.8 billion in health costs in 2020. The NO_x and PM reductions from all of the potential types of AB 32 measures (CAT, EAM, and additional measures) are shown in Figures 3 and 4. The specific air quality benefits and health benefits rankings of each individual measure within the CAT package, EAMs, and additional proposed measures are summarized in Table 1.



Source: Updated Macroeconomic Analysis of Climate Strategies Presented in the March 2006 CAT Report, Final Report, October 2007; CARB, Expanded list of EAMs, October 2007; and NRDC and other Recommendations for Policies to Reduce Global Warming Pollution for the AB 32 Scoping Plan, October 1, 2007.

Table 1: Co-Benefits of Climate Action Team, Early Action Measures and Additional Proposals

CATEGORY	TYPE	INDIVIDUAL MEASURES	Emission Reductions in 2020 (tons)		Health Benefits Ranking
			NOX	PM	
EAM	Cleaner Cars and Trucks	Diesel Truck Fleet Clean-up	35,405	1,898	1
CAT		Hybrid and Efficient Diesel Trucks	46,915	73	2
CAT		Limited Diesel Idling	18,615	33	5
CAT		Cleaner Cars and Trucks (Pavley)	74	136	17
EAM		Marine Vessel Speed Reduction	667	18	24
CAT		Cleaner Cars and Trucks – New Improvements	14	27	26
CAT/EAM		Fuel Efficient and Inflated Tires	1	1	28
CAT		Cleaner Power	Municipal Utility Program, Emissions Performance Standard	268	256
Proposed	Updates to Building and Appliance Standards (Titles 24 and 20)		3,358	256	7
CAT	Energy Efficiency	Municipal Utility Program	321	307	8
CAT		Investor-Owned Utility, Additional Programs	292	279	9
CAT		Appliance Standards (In Place)	251	239	12
CAT		Investor-Owned Utility Programs	196	187	14
Proposed		Standards for Buildings at Time-of-sale	1,389	106	16
CAT		Building Standards (In Place)	104	99	19
CAT		Green Buildings Initiative	89	85	20
CAT		Stationary Refrigeration and A/C Sources	36	34	23
CAT	Forestry	Urban Forestry	3	3	26
Proposed		Freight Transportation Measures	5,790	196	6
CAT	Low Carbon Fuel	Shore Electrical Power for Marine Vessels	4,700	85	13
EAM		Electrify Large Irrigation Pumps	1,251	89	18
EAM		Truck Stop Electrification	896	39	21
CAT	Other	Cement Manufacturing	2,895	97	15
CAT		Accelerate Renewable Portfolio Standard to 33%	532	508	4
CAT	Renewable Energy	California Solar Initiative	58	56	22
CAT		Smart Growth	Measures to Improve Transport Energy Efficiency, Smart Land Use, and Intelligent Transportation	7,960	476
Proposed	Water Efficiency		Water Efficiency, Additional	273	261
CAT		Water Use Efficiency	32	31	25

CAT – Climate Action Team Measures **EAM** – Early Action Measures **Proposed** – Measures submitted for consideration in the Scoping Plan

Note: Measures lacking quantified fuel or energy savings were excluded from this analysis.

Source: Updated Macroeconomic Analysis of Climate Strategies Presented in the March 2006 CAT Report, Final Report; CARB, Expanded list of EAMs, October 2007; NRDC and other Recommendations for Policies to Reduce Global Warming Pollution for the AB 32 Scoping Plan, October 1, 2007. Health Benefits rankings were determined using the health impacts assessment methodology from the CARB Goods Movement Emissions Reduction Plan, April 2006, as described above.

Setting Air Quality and Health Goals for Other High-Polluting Industries

Some important measures for reducing greenhouse gases to achieve AB 32 goals have yet to be fully defined. For example, potential for greenhouse gas reduction and co-benefits for the petroleum refining, oil and gas extraction, and agriculture sectors have yet to be determined. Also, upgrading highly polluting power plants holds potential for tremendous co-benefits. For example, in 2005, just five old (pre-1980) power plants in California contributed to more than one quarter of the total NO_x emissions from all power plants in the state.¹⁵ These same five plants (which have an average age of 50 years) are also quite carbon-intensive, releasing 1.5 to 3.5 times more CO₂ per megawatt-hour of production than a new natural-gas combined-cycle plant, amounting to roughly 5 percent of the total CO₂ emitted from California power plants in 2007.¹⁶ Repowering or replacing dirtier plants with cleaner technologies, as is currently planned for some of these older plants, can improve air quality and reduce greenhouse gas emissions at the same time.

We estimate that additional global warming pollution control measures in these sectors could yield significant co-benefits, potentially reducing NO_x and PM pollution by 10 percent by 2020, including 3,000 fewer tons of NO_x pollution and 2,000 fewer tons of PM. These reductions would in turn yield significant additional public health benefits, by preventing almost 140 premature deaths and thousands of cases of asthma and respiratory illness. These reductions would also save up to \$1 billion in health costs in 2020. Taken together, these comprehensive reductions—along with the CAT package, early action measures, and scoping plan proposals—would provide enormous public health benefits in 2020 (see Table 2). Note that measures are categorized in order of the highest certainty of implementation and data availability (CAT measures) to the least certain (potential additional measures).

Table 2: Public Health Benefits of Global Warming Pollution Reduction Measures in California in 2020

Avoided Health Impacts in the Year 2020	Climate Action Team Measures	Additional Early Action and Proposed Measures	Potential Additional Measures	Total	Value (in millions of dollars)
Premature Death	330	250	140	710	\$3,200 – 5,000
Hospitalization (respiratory)	70	50	30	140	\$2.7 – 4.2
Hospitalization (cardiovascular)	120	94	50	270	\$6.0 – 9.5
Asthma and other Lower Respiratory Symptoms	8,300	6,400	3,500	18,000	\$0.2 – 0.3
Acute Bronchitis	690	540	290	1,500	\$0.3 – 0.5
Work Loss Days	50,000	39,000	21,000	110,000	\$12 – 18
Minor Restricted Activity Days	290,000	220,000	120,000	630,000	\$18 – 29

Source: Updated Macroeconomic Analysis of Climate Strategies Presented in the March 2006 CAT Report, Final Report; CARB, Expanded list of EAMs, October 2007; and from NRDC and other Recommendations for Policies to Reduce Global Warming Pollution for the AB 32 Scoping Plan, October 1, 2007. Health impacts and values were estimated using the health impacts assessment methodology from the CARB Goods Movement Emissions Reduction Plan, April 2006, as described above.

The Local Impacts of Large Sources of Carbon, Soot, and Smog-forming Pollutants

Our analysis shows the potential for significant health benefits from measures to reduce global warming pollutants. However, the location of these benefits is just as important as the magnitude of the benefits, especially given that many of California's communities of color and low-income communities have been and continue to be disproportionately impacted by pollution. Health benefits from cleaner car and truck measures will be most pronounced near freeways, freight facilities and high traffic corridors. Communities near stationary sources, such as power plants, would be expected to benefit from reduced emissions from these sources.

The maps in Figures 5 through 7 show the locations of certain facilities in industrial sectors that are known to emit significant quantities of global warming pollution, as well as emitting significant air pollution with the potential to greatly impact local communities: Power plants, cement plants, and petroleum refineries. Although these maps exclude all other sources, including other industries and all mobile sources, they provide a powerful illustration of the areas of the state which would benefit from reduced pollution from these specific facilities. The sectors represented on the maps account for roughly 20 percent of the total global warming pollution emitted in California.

The symbol for each facility on these maps shows the magnitude of CO₂ emissions (by symbol size) and the health risk by color. The health risk "index" represents the relative potential health impacts among the facilities mapped, based on a methodology similar to that used to estimate health co-benefits and based on NO_x and PM emissions. See Appendix A for a description of the methodology and Appendix B for a listing of all facilities included in the maps.

The maps indicate that although there are polluting facilities scattered throughout the state, the Los Angeles area in the southern part of the state and the Carquinez and Richmond areas of the San Francisco Bay Area bear the brunt of pollution-related health impacts from these sources relative to other areas. In addition, the health risks associated with the power plants in Southern California are higher on average than elsewhere in the state due to high levels of air pollutant emissions, large populations living nearby, and poor regional air quality.

Impacts of Power Plant Siting on Local Air Quality

While new power plants are expected to be vastly cleaner than many existing facilities, those utilizing fossil fuel combustion will emit some level of harmful particulates that could have serious impacts at the local level. As a result, from a local perspective, the benefit from reducing particulates depends on where those reductions occur. There is the risk that new natural gas combined-cycle plants will be sited in urbanized areas, especially in communities already burdened with higher-than-average levels of pollution. In those instances, the increases in particulate emissions can have serious public health consequences. For example, the South Coast Air Quality Management District found very significant health impacts from a proposed new natural gas power plant in Vernon, CA, including a potential increase in annual premature mortality of up to four to 12 people.

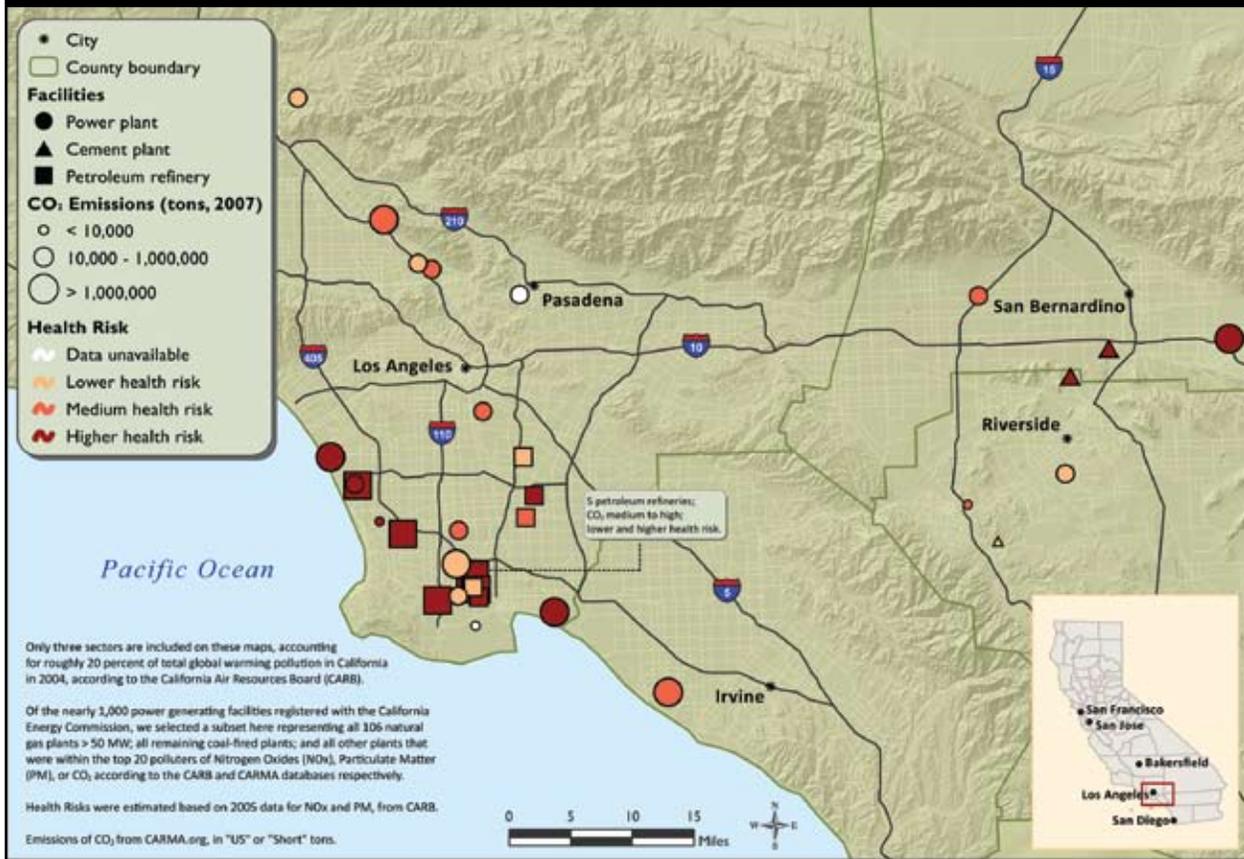
Therefore, while strategically sited new natural gas combined-cycle plants have the potential to provide valuable co-benefits on a regional level, preventing inadvertent injustices at the local level requires prudent siting and planning.

Source: See Final Program Environmental Assessment, pp. 5-12 to 5-16, <http://www.aqmd.gov/ceqa/documents/2007/aqmd/finalea/1309.1/fpea.html>.

Figure 5: Carbon Dioxide (CO₂) Emissions and Co-pollutant Health Impacts from Selected Industrial Facilities in California



Figure 6: Carbon Dioxide (CO₂) Emissions and Co-pollutant Health Impacts from Selected Industrial Facilities in the Los Angeles Area



Where There's Smoke...

...there's elevated asthma. Smoke from wildfires is laden with particulates, causing respiratory illnesses, eye irritation, and exacerbated asthma. A study of health impacts on children during the 2003 wildfires in California that burned 750,000 acres found that the risk of respiratory and other symptoms, including worsened asthma, increased up to 500 percent from more than six smoky days in a row. Wildfires in California are expected to increase in frequency by 11 percent to 55 percent because of global warming over the course of this century. A 5 percent increase in wildfires in 2020 could increase PM emissions by almost 4,000 tons, leading to more than 6,000 cases of asthma and respiratory symptoms.

Sources: *Our Changing Climate: Assessing the Risks to California* (2006), www.climatechange.ca.gov; Kunzli N, et al., "Health Effects of the 2003 Southern California Wildfires on Children," *Am J Respir Crit Care Med*. 174: 1221-1228, 2006; CARB emissions inventory, 2020, http://www.arb.ca.gov/app/emsinv/emseic1_query.php.

Figure 7: Carbon Dioxide (CO₂) Emissions and Co-pollutant Health Impacts from Selected Industrial Facilities in the San Francisco Bay Area



Stop the Mercury from Rising

Mercury is a heavy metal and neurotoxin that is emitted into the air mostly from cement plants and refineries in California. Mercury settles out of the air into water, where it builds up in fish that are consumed by people. It is estimated that only a teaspoonful of mercury can make the fish in a lake unsafe to eat. Even in low doses, mercury may affect a child's development, delaying walking and talking, shortening attention span and causing learning disabilities.

The California Air Resources Board has the opportunity to simultaneously reduce global warming and mercury pollution from cement plants. Our analysis suggests that the requirement of process changes at cement plants will also reduce mercury emissions by an estimated 35 to 55 percent,¹⁷ avoiding the release of almost 200 pounds of mercury each year from these plants, which currently account for approximately 90 percent of the airborne mercury pollution in California.

Sources: California Environmental Protection Agency, Office of Environmental Health Hazard Assessment, *Methylmercury in Sport Fish: Information for Fish Consumers*, <http://www.oehha.org/fish/hg/index.html>; Michigan Department of Environmental Quality, *Mercury in the Environment*, http://www.michigan.gov/deq/0,1607,7-135-3585_4129_4183-11832-,00.html; Toxics Release Inventory Data, <http://www.epa.gov/tri/>.

Recommendations

Instead of allowing the impacts of global warming to contribute to declining air quality, California must continue to pursue an ambitious set of policies designed to improve air quality and public health while also combating global warming. In order to best realize the full potential environmental and health co-benefits of reducing emissions of global warming pollutants, we recommend the following for California:

- ▶ Study, quantify, and maximize the co-benefits provided by the package of policies used to meet the AB 32 global warming emissions limit.
- ▶ Identify measures to reduce global warming pollution and provide air quality and health co-benefits in highly polluting sectors for which there are currently few specific measures, such as petroleum refining, oil and gas extraction, and agriculture.
- ▶ Make information about co-benefits available to the public to clarify how the state's efforts to reduce global warming pollution will also reduce air pollution and benefit public health.
- ▶ Take into account the global warming benefits of reducing ozone smog and soot when adopting global warming pollutant, air quality, and toxic reduction regulations.

Endnotes

- 1 In 2007 dollars, based on a discount rate ranging from 3 percent to 7 percent; note that the primary component of health cost savings in the Value of a Statistical Life assigned to each premature death avoided. Uncertainty surrounding health impacts ranges from roughly 15 percent to 75 percent for most health endpoints, according to CARB, Technical Support Documents for the In-Use On-Road Diesel-Fueled Heavy-duty Drayage Trucks at Ports and Intermodal Rail Yard Facilities Regulation, Appendix F, December 2007. Available at: <http://www.arb.ca.gov/regact/2007/drayage07/drayage07.htm>.
- 2 On May 22, 2008, CARB released an extensive updated peer review of the relation between PM2.5 and premature mortality: CARB, *Methodology for Estimating Premature Deaths Associated with Long-term Exposures to Fine Airborne Particulate Matter in California DRAFT Staff Report*, May 22, 2008, <http://www.arb.ca.gov/research/health/pm-mort/pm-mortdraft.pdf>.
- 3 The Rocky Mountain Climate Organization and NRDC, *Hotter and Drier: The West's Changed Climate*, March 2008. California Climate Change Center, *Our Changing Climate: Assessing the Risks to California*, July 2006, CEC-500-2006-077.
- 4 California Climate Change Center, 2006. Degrees refer to degrees Fahrenheit.
- 5 Vingarzan, R., A review of surface ozone background levels and trends. *Atmospheric Environment*, 2004. 38(21): p. 3431-3442.
- 6 According to the American Lung Association in their 2008 State of the Air report, five of the 10 smoggiest cities include Los Angeles, Bakersfield, Visalia, Fresno, and Sacramento. See <http://www.stateoftheair.org/2008/most-polluted/>, CARB 2008.
- 7 M.L. Bell et al., "Ozone and Short-term Mortality in 95 U.S. Urban Communities," *JAMA* (2004), 292:2372-2378. C.A. Pope III and D.W. Dockery, "Health Effects of Fine Particulate Air Pollution: Lines that Connect." *J Air Waste Manag Assoc* (2006) 56:709-742.
- 8 M.Z. Jacobson, "On the Causal Link Between Carbon Dioxide and Air Pollution Mortality," *Geophys Res Let* (2008) 35:L03809, doi:10.1029/2007/GL031101. California statistic obtained from CARB Climate and Health briefing on January 30, 2008.
- 9 CARB, Goods Movement Emission Reduction Plan, April 2006. See: <http://www.arb.ca.gov/planning/gmerp/gmerp.htm>
- 10 We focused on NO_x and PM emission reductions because these two pollutants contribute heavily to adverse health impacts from air pollution. While we were unable to quantify all known health impacts from NO_x and PM, major impacts include onset of asthma, low birth weight, pre-term birth, and reduced lung function growth in children. For more information, see: CARB, Goods Movement Emission Reduction Program, , March 21, 2006, Appendix A.
- 11 Richard J. Jackson, MD, MPH, Chris Kochtitzky, MSP, Centers for Disease Control and Prevention, *Creating A Healthy Environment: The Impact of the Built Environment on Public Health*, available at <http://www.cdc.gov/healthyplaces/articles/Creating%20A%20Healthy%20Environment.pdf>.
- 12 These measures are likely to reduce many other pollutants, including carcinogens such as benzene and formaldehyde; developmental toxicants such as lead and toluene; and neurotoxicants such as mercury and acrolein. However, we were unable to quantify reduced cancer risks or public health benefits from other co-pollutant reductions.
- 13 CARB, Expanded list of early action measures to reduce greenhouse gas emissions in California recommended for board consideration, October 2007, http://www.arb.ca.gov/cc/ceca/meetings/ea_final_report.pdf.
- 14 The analysis is based on proposals from NRDC. All scoping plan proposals submitted to ARB are posted at <http://www.arb.ca.gov/cc/scopingplan/submittals/submittals.htm>.
- 15 This is based on 2005 emissions inventory data from CARB, <http://www.arb.ca.gov/app/emsinv/facinfo/facinfo.php>. Note that the facility with the highest NO_x emissions is likely to be repowered soon (<http://www.energy.ca.gov/sitingcases/humboldt/documents/index.html>). The next top five plants with the highest NO_x emissions in 2005 contributed more than one-fifth of NO_x emissions that year from the remaining power plants. Other plants may also be in the process of being repowered.
- 16 This is based on 2005 power plant data from CEC and 2007 CARMA data on CO₂ emissions from power plants. (<http://www.arb.ca.gov/app/emsinv/facinfo/facinfo.php> http://www.energy.ca.gov/database/POWER_PLANTS.XLS www.CARMA.org.) The emission rate for a new natural gas power plant was taken from the CAT report, referenced above. The five dirtiest power plants include one of the few coal-fired power plants in California, which produce significantly more global warming (accounting for the high end of the range) and NO_x pollution per unit of production than natural gas-fired power plants.
- 17 Percent mercury reduction is calculated based on USEPA estimate that 30 to 45 percent of mercury emissions are due to coal combustion. Note that coal is the primary fuel used at California cement kilns.