

City Carbon Budgets: Aligning Incentives for Climate-Friendly Communities

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SUMMARY

City carbon budgets are a proposed policy mechanism to link state (and national) greenhouse gas reduction goals to local prerogatives regarding land-use, zoning, transport programs and investments, and building codes. Under this proposal, cities and counties would be responsible for reducing their carbon footprint. Key elements and principles of this proposal are:

- The point of regulation is local governments because they have responsibility for land use and they are closer to actual land use and transportation decisionmaking than regional entities. Counties would be responsible for unincorporated areas.
- Regional entities would play an important role in managing transportation investments for the region, designing overarching strategies for regions, coordinating policies and actions across cities and counties, and providing technical support to cities and counties. Regional entities would also coordinate closely with the overseeing state agencies.
- The carbon targets would be based only on activities that cities and counties could strongly influence: VMT and building energy use. Large stationary sources are excluded (addressed with a cap and trade program or other mechanism).
- Carbon targets would be specified in terms of greenhouse gas emissions per capita, based on vehicle miles traveled and building energy use. The target would be a specified percent reduction per capita. Each local government would begin with their current emissions per capita. The net effect is to not discourage growth, and to encourage all entities to continually reduce their emissions (per capita) over time.
- A founding principle for this proposal is the use of a simple and transparent metric, as we describe above. The policy mechanism should constitute a permanent, durable framework.
- Local governments would have substantial temporal flexibility in achieving emission reductions. This is important because many land use initiatives will not yield emission reductions immediately, but have the potential to yield large reductions in the medium- and long-term.
- The principal thrust is to offer carrots and not wield a stick. The focus is on use of incentives to encourage attainment of targets. One large incentive is state and federal transportation funding, which could be used to reward those who attain their targets. Another source of incentives might be a carbon trust fund created from the auctioning of carbon allowances in a cap and trade program. To address environmental justice concerns, some portion of the total available funding could be focused on localities with fewer resources. The intent is not to create an unfunded mandate.
- Mobile source emissions, based on VMT, might be measured using odometer readings (from smog tests or vehicle registrations) and building emissions can be calculated from the energy use information collected by the electricity, natural gas, and home heating oil industries. These annual base emissions inventories would be compared to the predetermined per capita carbon budget to determine whether the locality is on track to meet its obligation under this policy.
- An analytical method can be used to allocate VMT from “indirect sources” to surrounding cities.
- In addition to reducing VMT and energy use in buildings, local governments should get credit for actions they take to reduce emissions in other areas.

By partnering with local governments to reach climate goals, the state would empower local governments and invite solutions tailored to the communities where they will be implemented. Diversity in local solutions is both expected and encouraged, as this diversity in approach should stem from real differences between communities in the costs, emissions benefits, and co-benefits of different strategies.

1. INTRODUCTION

In this paper, we identify a climate policy instrument that fills two gaps in the current strategies to reduce greenhouse gas emissions. First, it targets behavioral change to reduce energy demand. Second, it focuses on cities instead of targeting large industry.

Carbon cap and trade programs, as being implemented in Europe and the U.S., target only large stationary sources and only weakly and indirectly encourage energy efficiency. They ignore more diffuse sectors such as agriculture and transport. Another set of instruments are performance standards for appliances, vehicles, and fuels. Stringent performance standards could achieve emissions reductions of 80 percent or more through dramatic energy efficiency improvements with commercial, residential, and consumer technologies and by decarbonizing energy supplies. However, it would be extremely costly to do so. A more cost-effective approach would be to address usage along with technology performance and carbon content of fuels, and this paper suggests a way to do this.

More specifically, the focus here is on energy use in cities. Many cities have adopted climate action plans, but these plans are mostly premised on voluntary actions. They rarely contain firm requirements or even substantive incentives. An exception is London's imposition of a carbon tax regime on top of its traffic congestion tax. Higher authorities are reluctant to intervene because they do not want to be seen as intervening in land use powers and other prerogatives of local governments.

This paper suggests a policy instrument that addresses both behavioral change and local governments: city carbon budgets. It would make local governments accountable for greenhouse gas emissions in their jurisdictions and empower them to take responsibility for greenhouse gases resulting from energy use, since that is where they have the most influence. This approach places the urban sector – and the process of urbanization – front and center in the search for effective mitigation of greenhouse gas emissions. It will have the dual effect of highlighting the link between lifestyle choices and the environment and assuring greenhouse gas emission reductions are made in a manner most appropriate to local circumstances.

Local governments can and do have a big effect on carbon emissions, and are particularly influential in the processes by which patterns of carbon emissions are locked into household's day-to-day activities, through land-use planning and zoning, transport infrastructure choices, traffic impact "mitigation" measures, building permitting, and the transportation alternatives offered. Their planning and zoning ordinances influence the amount of travel that occurs, the modes used, the square footage that is climate-controlled, the energy efficiency of buildings, and energy used in building materials and construction methods.

The potential for emissions reduction from all of these aspects of urban life traditionally under the purview of local governments is substantial. The research literature provides a range of estimates for potential greenhouse gas emissions reductions from land use change. All of them indicate that the effect of land use on greenhouse gas emissions is large – the low end of the

range is a 20 percent emissions reduction, while the high end is on the order of a 50 percent emissions reduction – though it takes many years to realize those impacts. Local initiatives to reduce emissions *given the existing land use* can happen much more quickly. Examples range from transport demand management to building energy retrofits.

City carbon budgets is a policy mechanism for harmonizing local-level policies that affect transport and buildings energy use – including, but not limited to land use regulation – with larger-scale greenhouse gas emissions reduction strategies. The goal is to empower local governments to devise effective initiative packages to reduce greenhouse gas emissions in their communities by providing both technical and financial help, and demanding environmental results. We note that the greatest benefits of a carbon budget policy will likely not be greenhouse gas reductions. The largest benefits are likely to be a more efficient transport system and more livable communities. We anticipate the outcomes of a carbon budget policy to be consistent with good economic, social, and environmental principles. City carbon budgets, enacted under broader climate legislation, would be the legal and regulatory tool to help achieve much of what good planners are already trying to achieve.

This paper lays out the basic logic of a city carbon budgets program, and examines some of the logistical and technical issues that would need to be resolved in the development and implementation of such a program. We begin in Section 2 with a description of the problem and a discussion of what local governments can do, providing a brief literature review for support. Section 3 describes the city carbon budgets policy concept, discussing the logistical and technical details that would need to be worked out in order for the program to be both technically successful and also meet with public acceptance. Section 4 identifies both costs and non-climate co-benefits that are likely to be associated with city carbon budgets. Section 5 discusses incentives to support compliance, including market mechanisms. Section 6 concludes the paper.

2. THE EMISSIONS REDUCTION CHALLENGE AND THE POTENTIAL OF CITY CARBON BUDGETS

Aggressive greenhouse gas emission reduction goals can be achieved by decarbonizing energy supplies. But decarbonization will prove both difficult and expensive if energy usage continues to increase.

Take the state of California as an example. California passed a law requiring that greenhouse gas emissions be returned to 1990 levels by 2020 – a 28 percent reduction from the business-as-usual forecast; the emissions target for 2050 is an ambitious 80 percent *below* 1990 levels. Meeting these targets will be a challenge, but California will not be alone. These emission reduction targets approximate the emission reductions being suggested by climate scientists. Similar targets are being debated in a number of European nations (e.g. the U.K.), and are being seriously considered both by the U.S. federal government (WRI 2007) and by a number of other states within the U.S. The Pew Center on Global Climate Change provides a summary of these targets on their website.

To reduce the climate impact of its transport sector, California has simultaneously enacted an aggressive law to reduce greenhouse gas emissions from vehicles and is working to regulate the carbon content of fuels. Optimistic forecasts estimate that these policies could reduce transport-

related greenhouse gas emissions by 21 percent in 2020.¹ If transportation is expected to meet the same 28 percent reduction as other sectors, then at least an additional 7 percent reduction will be needed. This additional reduction could come from trucks, planes, pipelines, and ships, but reducing greenhouse gas emissions is expected to be far more difficult with these other modes than with light duty vehicles.²

And thus, for California's transport sector to meet its goals for 2020, substantial reductions in use of vehicles are needed. The shortfall of fuel and vehicle technology strategies is likely to be far greater in meeting the 2050 target. It will be difficult and costly to meet the 2020 and 2050 targets with vehicle efficiency and fuel decarbonization alone, especially since vehicle use is projected to more than double in California (and the U.S.) by 2050. Even the most conservative transportation stakeholders, such as the American Association of State and Highway Officials, agree that VMT growth needs to be restrained (AASHTO 2007).

The story in the buildings sector is similar. Both state and national governments have adopted performance standards that apply to new buildings and appliances, but these address neither energy use in existing building nor any of the behavioral components of building energy use.

It is worth noting here that part of the reason that greenhouse gas emissions from the transport and buildings sectors remain high is that two powerful financial forces are at work at the local level that often run counter the goals of climate policy, favoring sprawled development over compact development. One is local taxation practices. Cities seek to maximize the taxes and fees that they collect, and they tend to collect more property and sales taxes from large commercial facilities than from housing or mixed-use style development. Second, because greenfield, low density development is often easier for developers – there is less likelihood of neighbor objections and land costs are lower – developers apply strong pressure to cities and counties to approve and support such development. A city carbon budgets policy would provide a countervailing force, pushing for densification, mixed-use, and infill development.

2.1 What can local governments do?

City carbon budgets target those greenhouse gas emissions that are under the direct or indirect control of local governments. Emissions sources under direct municipal control include buildings and vehicles owned or managed by local governments, such as those associated with police, fire and other government services, local government fleet vehicles, and buses and other transit vehicles. Emissions sources indirectly controlled by localities include private vehicle travel and energy consumed by non-municipal buildings; indirect emissions far exceed those under direct control. Local and regional governments can influence these emissions through investments in transport infrastructure, zoning decisions, building codes, pricing policies, and education. These tools have the potential to cut emissions even as population and economic growth continue.

¹ The vehicle standard (known as Assembly Bill 1493 or the Pavley Act) requires a 30 percent reduction by 2016 in new vehicles, and deeper cuts thereafter. It would reduce total emissions by an estimated 27 million metric tons of CO₂-equivalent (MMTCO₂-eq) by 2020. The low carbon fuel standard currently in rulemaking is expected to require a 10 percent reduction in lifecycle greenhouse gas emissions by 2020, resulting in a projected reduction of another 10-20 MMTCO₂-eq. Thus, these two aggressive policies, if fully implemented, would reduce emissions 37-47 MMTCO₂-eq.

² Other modes are projected to account for 30 percent of total transport emissions in 2020, 23 percent from heavy duty trucks.

General and specific area plans are revisable documents used to shape future growth patterns of cities and counties. General plans determine the overall future development framework, while specific area plans are used to define a more detailed strategy for certain parts of a city or county, and often include urban design guidelines. Zoning ordinances, as set forth by a general plan, are the central mechanism local governments use to regulate land use. Traditionally, zoning ordinances define allowable land uses, density maximums, allowable building forms and the building envelope, and parking requirements. To facilitate communitywide greenhouse gas emission reductions, local governments could restructure zoning ordinances to stipulate off-street parking maximums rather than minimums, density minimums rather than maximums, reduced building setbacks, and relaxed building envelopes to more efficiently use space. In addition, overlay zones, such as mixed-use zoning and planned unit developments, and alternative zoning code structures, such as performance- or form-based codes, provide increased flexibility for local governments to promote climate-friendly land use patterns. Mixed-use zoning allows for a variety of land uses to be located in close proximity, while planned unit developments allow for increased government oversight in the development process, supporting more creative and efficient land use. These tools can be used to encourage mixed-use, dense, and walkable developments that naturally minimize vehicle miles traveled and thus greenhouse gas emissions generated.

Large reductions in building energy use are also possible, both for new construction and for existing buildings. Factors that affect the energy efficiency of new construction that are under the control of local governments include the size and density of buildings, as well as orientation and solar access. Communities could also influence the technical efficiency of new buildings by enforcing compliance with current state and national standards, or by adopting the more holistic environmental performance standards laid out in the U.S. Green Building Council's LEED certification system. Options for reducing energy use in existing buildings include mandatory building retrofits upon resale or transfer and special partnerships with utilities, NGOs, and weatherization agencies. Common retrofits include attic insulation, energy efficient lighting, and water conservation devices. Mandatory retrofits are chosen to have reliable energy savings and rapid investment payback. Special partnerships can encourage energy savings through accelerated replacement of inefficient appliances and improved building weatherization.

Pricing of both parking and roads is another important area for local government action that has the potential to promote land use patterns that more efficiently utilize public infrastructure and decrease vehicle emissions. In many communities today, vehicle parking policies lead to inefficient use of public infrastructure through sprawling land use patterns. Examples of these include free or low-cost parking and high minimum parking requirements for residential and commercial developments. Similarly, historically free use of roads constitutes a large subsidy encouraging private car use. Parking and road pricing and more appropriate parking requirements represent areas of tremendous leverage for reducing automobile use and enabling denser, more walkable, and transit-oriented development. Revenues generated from these pricing policies may be used as a source of funding for municipal programs or services, such as public transit or car sharing, which can then reduce vehicle ownership and further reduce vehicle miles traveled. Cost savings from decreased parking requirements in housing developments can make affordable housing projects more profitable for developers.

Education of both the public and elected officials regarding the need to reduce greenhouse gas emissions and fossil fuel consumption will be extremely important for broad-based acceptance

and support of a city carbon budgets program. Local governments are in a unique position to provide a wealth of information to residents about the energy-efficient operation of buildings and available alternative transportation options. Because land use decisions made today will dictate land use patterns into the future indefinitely, elected officials serving as the ultimate authority over these decisions must understand these implications and act accordingly. Educating other stakeholders, such as developers, will also be critical to the success of this program. Streamlined review processes are a way to reward forward-thinking development proposals.

As localities strive to minimize greenhouse gas emissions, compact, mixed-use, and transit-oriented development which promotes walking, bicycling, and mass transit use will naturally become more viable. Reduced trip distances will make these alternative modes less burdensome and better able to compete with the automobile, which will in turn help to increase equity in mobility among residents. The tools available to local governments to reduce greenhouse gas emissions, in the form of zoning ordinances, building codes, pricing policies, public education, and investment decisions, are many and can be utilized to great effect.

2.2 Potential magnitude of emission reductions

The potential for greenhouse gas emissions reduction through reducing vehicle miles traveled and buildings energy use is substantial. It is clear that per capita emissions vary dramatically with neighborhood type. Researchers estimated that per capita greenhouse gas emissions of urban neighborhoods in Adelaide, Australia were approximately two-thirds those from suburban neighborhoods (Perkins and Hamnett, 2002). In metropolitan Toronto, Ontario, one study found that per capita greenhouse gas emissions from transport activity were estimated to be twice as high in suburban as in urban districts (VandeWeghe and Kennedy, 2007), and a second found that total lifecycle emissions of greenhouse gases differed by a factor of 2.5 (Norman, MacLean, and Kennedy, 2006). For sake of comparison, the difference in greenhouse gas emissions between an SUV and the average passenger car in the United States is on the order of 25 percent.

Although these greenhouse gas emission differences across existing development patterns are impressive, the real policy question is left unanswered: What would be the impact be of *changes* in existing neighborhoods on greenhouse gas emissions? Unfortunately, there has not been a definitive study to address this question. The following two sections review the related literature that identifies the impact of policies and investments on vehicle miles traveled and building energy use.

2.2.1 Reducing vehicle miles traveled (VMT)

Focusing on the vehicle travel component of metropolitan emissions, one can identify two relevant types of research for addressing greenhouse gas emissions reduction from local government action. The first uses statistical methods on existing data to predict what the effect of a change in the land use-transport system might be on people's choices of how much to travel and which modes to use. These studies generally isolate a single factor – density or transit or road pricing – rather than estimating the effect of policy and investment packages. The second takes direction from some of these results, using them to simulate multiple coordinated policies and investments and to estimate the resulting effect on choices. Both lines of research are illuminating, but both also have severe enough limitations that the uncertainty is large surrounding the likely effect of any particular local initiative package.

Estimates of the effect of pricing on VMT are varied, but consistently show that raising the price of driving reduces VMT. Graham and Glaister (2004) and Goodwin, Dargay, and Hanly (2004) provide reviews of international estimates of elasticities of vehicle miles traveled with respect to price. Estimates from both studies of the long-run elasticity of vehicle miles traveled with respect to fuel prices had a mean of approximately -0.30, with the full range of estimates from -0.10 to -0.69. This means that a 10 percent increase in the cost of fuel should decrease vehicle miles traveled by approximately 3 percent in the long-run. The short-run elasticity estimates were smaller in magnitude, and it was noted that these elasticities appeared to be smaller in the U.S. than in Europe. There is some more recent evidence that the fuel price effect could be even smaller (Small and Van Dender 2007, and Hughes et. al. 2008). To take one of the few real-world urban examples of road pricing, London's congestion pricing scheme is estimated to have reduced vehicle miles traveled by 1.7 percent and fuel use by 2.8 percent when charging £5 per day for driving downtown (Transport for London 2007).³

The main finding of the reviews of the literature on the relationship between urban form and travel is that the methodologies used in this literature do not adequately account for the complexity of this relationship (Badoe and Miller 2000, Crane 2000, Handy 2005). Beyond this sweeping critique of the literature, each of these papers also provides the authors' summary of the literature's main findings. Indicative of the authors' lack of confidence in the collective findings, these reviews document only the direction and statistical significance of the effect of land use on travel, including almost no information about the estimated magnitude of these relationships.

Badoe and Miller (2000) highlight the point that land use near employment centers is consistently found to be a significant indicator of transit use, walking, and ridesharing. A second consistent finding in the literature is that higher residential density discourages car ownership, and thereby reduces VMT. However, Badoe and Miller's review finds the evidence on the direct effect of residential density on travel to be less clear. In those studies that do find statistically significant relationships, however, it is encouraging that these relationships are negative – higher density yields lower VMT. One study completed more recently found evidence that the relationship between residential density and travel is nonlinear, and that density becomes an important determinant of travel choices at higher densities (Salon 2006). The author proposes, however, that the estimated strength of this relationship is likely to actually be due to high parking prices in very dense neighborhoods.

Handy (2005) also reviews the related literature on the effect of highway expansion on both development and travel, as well as the effect of light rail transit on urban population density. She finds that each of these infrastructure investments is generally shown to produce the expected effect – highway expansion increases development near the highway and induces more travel, and light rail can lead to higher densities. The evidence of the magnitude of all of these effects, however, is both extremely varied and at least partially dependent on the existence of coordinated policies and investments to support alternatives to car travel.

The small but growing literature on the effect of 'soft' transport policy measures on VMT is more promising. Moser and Bamberg (2008) review and perform a meta-analysis of this literature for the U.K., including measures such as personal travel plans and public education

³ Fuel use is reduced more than VMT because of the fuel economy increases experienced by drivers due to the reduction in traffic congestion.

campaigns. Although they highlight that the great majority of existing studies use a weak quasi-experimental design, they do present the magnitude of their findings. The potential for car use reduction from workplace travel plans is substantial – these planning programs increase the fraction of employees using an alternative commute mode by 12 percentage points. Public education campaigns are found to reduce car use by 5 percentage points. Taylor (2007) reviews the impact of soft transport policy measure programs in Australia. These programs achieved remarkable reductions in car use among participants – approximately 10 percent reduction in vehicle trips – and these reductions in car use appeared to be sustainable. The results achieved by the Australian programs are unlikely to be representative of those achievable for entire populations because the participants in the Australian programs were self-selected to be motivated to make their travel choices more environmentally friendly. However, between 30 and 40 percent of households invited to participate in these programs were in this category.

One major shortcoming of all of this research looking at the effect of single policy changes or infrastructure investments on travel is that it does not take account of the synergies between strategies and feedback effects between them that occur in the real world. It is hardly surprising that densification of development has only a minimal effect on vehicle miles traveled in the *absence* of coordinated policies and investments to support alternatives to the single occupant vehicle. This point is explored explicitly for the case of Toronto (Filion et. al. 2006). Similarly, it is predictable that transit-oriented development will not induce large numbers of people to switch to transit travel in the *absence* of coordinated policies to discourage automobile use.

Urban simulation studies fill this gap. Johnston (2006) summarizes the main findings of recent studies that employ urban simulation techniques in an attempt to predict the effects on VMT of multiple coordinated policies and investments. These studies do not include ‘soft’ transport policy measures, but do include – to various degrees – all of the other measures discussed above. Johnston finds that land use alone is not predicted to have a large effect on VMT. However, when combined with pricing policies and transit investments, land use change can be an important part of an effective package to reduce auto dependence. The magnitude of the net effect of such a policy package on VMT depends on the particular urban area or region. Johnston’s review of simulation studies indicates that reductions ranging from approximately 10 percent to more than 20 percent in both VMT and greenhouse gas emissions from transport are achievable within 20 years.

2.2.2 Reducing energy use in buildings

Residential and commercial buildings are responsible for 35 percent of carbon emissions in the United States through consumption of electricity, natural gas, heating oil, and other fuels (Battles and Burns 2000). Any comprehensive program to address carbon emissions must therefore include policies related to energy conservation in buildings. We focus here on potential reductions from programs implemented at the community scale.

The potential for large energy savings in buildings has been demonstrated through case studies of individual buildings, groups of buildings, and for whole regions. The approaches ranged from simulations and engineering calculations to actual construction, monitoring, and verification. Examples of the different approaches are described here.

A building’s energy consumption depends upon three types of factors:

- technical features: size, efficiency of the building itself, type and number of appliances;

- locational aspects: climate, orientation; and
- operation: schedule, lifestyle, preferences.

Together, differences in these factors produce large variations in building energy consumption. Socolow (1978) observed five-fold differences in energy consumption among seemingly identical townhouses in New Jersey. This finding was attributed to differences in appliances, operating habits, and construction defects.

There have been regular evaluations of conservation potentials in buildings. The earliest was conducted in California in the 1980s (Meier, Wright, and Rosenfeld 1983) and the most recent was in 2002 (Rufo and Coito 2002). In spite of the twenty years separating the California studies, the cost-effective potential savings remained roughly the same at 20-30 percent of current use. National studies, based on less detailed information, found similar savings potentials (McKinsey & Company 2007).

Many countries and regions have undertaken programs to build low-energy homes, which indicate the scope of potential savings in new homes. In the United States, the Building America Program (Building Technologies Program 2008) coordinates projects covering over 20,000 homes. Its eventual goal is a 70 percent reduction in energy use and installation of solar systems intended to supplement the remaining energy use. In Europe, the Passivhaus concept has been demonstrated to reduce space heating energy needs to below 20 percent of current levels, even in cold climates (Hastings 2004). A stricter building code in the Pacific Northwest led to a 40 percent reduction in space heating compared to homes built to normal practice (Meier and Nordman 1988).

Even among existing buildings located in the same community, built the same time, or equipped with the same appliances, the cumulative impact of hundreds of behavioral and operational decisions strongly affects a building's energy consumption (Diamond 1987). The way in which occupants perceive and operate the buildings' thermostats greatly affects energy use (Kempton 1986). Similar variations exist for other energy-intensive activities, such as water heating. In a Michigan community, Kempton (1988) found that per-capita hot water use varied widely; the highest consumption was three times larger than the lowest. The electricity use of a home computer may vary by a factor of five depending on the user's selection of power management features. Stamminger (2004) observed a ten-fold range in water consumed by people washing the same set of dishes. These operational decisions are not fixed and can be revised through education, changing economic conditions, or new technologies.

An increasing body of evidence suggests not only that the potential for energy reduction in buildings exists, but also that this energy reduction is feasible for entire communities. In the Pacific Northwest, the Energy Edge program demonstrated energy savings in existing commercial buildings (Piette et al. 1995). Participating small office buildings used about 30-50 percent less energy than comparable buildings. The state of Upper Austria (Austria) achieved a 20 percent reduction in regional space heating energy use through efficiency improvements and the widespread installation of wood pellet-stoves (European Cluster Observatory 2008).

Region-wide changes in energy use behavior also appear possible. During electricity shortages in Brazil and California, consumers (mostly in buildings) cut their electricity use 20 and 12 percent, respectively (International Energy Agency 2005). Most of these savings were achieved in only a few months by switching off lights, and computers, adjusting thermostat settings, and simply

being more vigilant about energy use. Cities, such as Phoenix, have achieved reductions in electricity consumption of almost 15 percent in only a few days, mostly through simple measures to set back thermostats and switch off lights.

In summary, cities and communities can influence the technical efficiency of buildings, even though many aspects of new buildings and appliances have been pre-empted by state and national authorities. Strictly enforcing building codes and supplementing them with local codes to encourage low-emission fuels and solar are two examples with large energy-saving potential. Cities can have a stronger impact on the energy use of existing buildings. Policies to accelerate retrofits of existing buildings, for example, will affect a larger fraction of buildings and can be tailored to that region's specific conditions. Where large individual variation in behavior exists, cities can have a large impact on energy use through education and encouragement of energy-saving habits.

3. POLICY DESIGN OF CITY CARBON BUDGETS

City carbon budgets provide a link between state level efforts to reduce greenhouse gas emissions and local powers and prerogatives regarding land use, zoning, transport programs and investments, and building codes. The intent is to assign responsibility for reducing the emissions affected by local transport and buildings energy use to localities. Cities and counties in a carbon budgets program would be responsible for reducing their carbon footprint by a predetermined percent over a predetermined time period. In return for taking on this responsibility, local governments would receive both financial and technical assistance from the state (and/or nation).

Annual targets would be set, but we envision a policy with substantial temporal flexibility in achieving emission reductions. This is important because many land use initiatives will not yield emission reductions immediately, but should be strongly encouraged due to their potential to yield large reductions in the medium- and long-term.

By assigning responsibility to local governments to reach climate goals, instead of mandating specific land use policies, the state (or nation) would encourage solutions tailored to the communities where they will be implemented. Different localities will make different local policy and investment choices to reach climate goals. Diversity in local solutions is both expected and encouraged, as this diversity in approach should stem from real differences between communities in the costs and emissions benefits of different strategies. Because communities have the flexibility to tailor solutions to their needs, it is likely that many local initiatives will not only reduce greenhouse gas emissions, but will also make participating localities more attractive places to live and work.

3.1 Point of regulation and institutional structure

The point of regulation for reducing greenhouse gas emissions in the transport and building sectors could be international or national governments, or individuals and companies -- or somewhere in between. When it comes to energy usage, we conclude that the nexus of regulation is most effective when placed on local governments. Higher level governments clearly have an important role in setting performance standards for fuels, vehicles, and buildings, but when it comes to land use and vehicle travel and, to a lesser extent, building energy use, local governments hold much of the decision making power.

One might devolve responsibility for emissions even further, all the way down to the level of the household (Starkey and Anderson 2005). There are clear (and substantial) technical and political challenges to this approach, however, and its effectiveness is not clear. While households could respond to their emissions reduction responsibility by demanding carbon-friendly land zoning in their communities, this may not be the most efficient path to reducing the carbon footprint of physical development.

The main rationale for devolution of emission reduction responsibility to local governments is that physical development patterns have a large effect on greenhouse gas emissions, and higher level governments are in no position to micromanage physical development patterns at the community/neighborhood level.

Another possible set of entities that might be the point of regulation are regional-level governments, such as metropolitan planning organizations (MPOs) and air districts. The argument for this is twofold. Land use planning for emissions reduction should be harmonized across regions, and the regions are already the ones with the technical capacity for land use and emissions modeling needed to devise the best emission reduction strategies. While these are clearly important factors, the political reality is that most MPOs and air districts have little decisionmaking power. It is the local governments of cities and counties that have the authority to make the changes in land use policy that will be necessary to provide the proper incentives for climate-friendly development. It is for this reason that we advocate the devolution of physical development-based emissions reduction responsibility to the cities and counties. Counties would be the point of regulation for all unincorporated areas – those areas not within a city.

An appropriate state or national agency would be responsible for overseeing and managing the program. In California, that agency might be the Air Resources Board, in coordination with the Department of Transportation, and possibly the Energy Commission. These agencies would be responsible for developing standardized measurement protocol and models to predict future emissions, overseeing technical support to local governments in non-urban areas, and working with others on enforcement and incentive funding.

Methodological consistency across localities is crucial to insure the effectiveness of city carbon budgets. To foster this, the state or nation should create standardized methodologies for assigning mobile emissions to localities, measuring all emissions included in the budget, and collecting any necessary data. It should also be the responsibility of the state or nation to provide an information clearinghouse to help localities to identify climate strategies that are best for their local communities. This type of technical assistance for city carbon budgets could be analogous to the agricultural cooperative extensive program, whereby expertise is made available to cities and counties to identify, design, and evaluate effective actions.

Regional governments, either the MPO (responsible for transportation) or Air Quality Management Districts or both working together, would manage the program for their regions. Because most local governments have limited analytical expertise, assistance in modeling transport energy use and greenhouse gas emissions is critical. In larger metropolitan areas, regional governments are in a good position to provide this assistance. They could provide direct technical support to cities and counties, reconcile the roles of entities such as transit agencies that cut across city boundaries, and manage the allocation of incentive funds from the state or national government. The MPOs would also continue to manage the allocation of transportation funding, but now using greenhouse gas emission metrics in addition to other criteria.

3.2 Budget allocation and equity

There is no correct way of allocating carbon budgets to local governments. Several methods are possible. They are analyzed below. We conclude, as indicated below, that the most equitable and politically feasible allocation option is to accept current carbon emissions as a given, and to require per capita emission reductions by a given percent each year according to a predetermined schedule.

One option is to allocate city carbon budgets by auction. Auctions are often promoted as economically efficient mechanisms to allocate responsibility for reducing emissions in seemingly similar situations, but devolution of a portion of emissions regulatory responsibility to lower levels of government is fundamentally different from allocation of emissions reduction responsibility to polluters. Local governments are not the main polluters and they are not – by and large – profiting from presiding over districts with high greenhouse gas emissions. And thus, we reject this approach.

A second option is to allocate the same per capita emission level to all local governments in the state, reducing the level over time according to a predetermined schedule. At first glance, this seems fair – every person is allowed the same emissions level. The problem with this scheme stems from the fact that communities today (and the individuals that comprise them) have made many long-term decisions under a paradigm in which energy was cheap (until recently) and greenhouse gases emissions were costless. They have chosen to live in homes designed without energy efficiency in mind, located in areas accessible only by car, and purchased vehicles with low fuel economy. As a result, current emissions per capita across communities vary widely, and therefore their emission reduction responsibility under a single per capita target would also vary widely. This is politically unworkable, as well as economically inefficient. The inefficiency results from the likelihood that to comply with such a policy, some areas will need to provide incentives for sprawling residential developments to rapidly become more climate-friendly. While this will reduce emissions, the scale of the loss of sunk costs from these developments could be reduced by a strategy of more gradual change.

A third approach would be a phased approach that begins with carbon budgets based on current emissions in each locality and arrives at a single per capita emission level across localities, which could then be lowered over time according to a predetermined schedule. In terms of political feasibility and economic efficiency, this option would clearly be an improvement over simply starting with a single per capita target because the initial allocation would take explicit account of existing conditions. However, this plan would still result in some communities having little or no requirement for emission reduction, while other communities would have much larger requirements. Furthermore, if communities arrived at the same per capita emissions level for transport and buildings, it is likely that there would be far less diversity across communities in terms of lifestyle options. For these reasons, we are not convinced that this plan is politically acceptable.

A fourth allocation method, which we recommend, is to begin with carbon budgets equal to current emissions for each locality, and to reduce these per capita budgets by a given percent each year according to a predetermined schedule. This allocation scheme has the benefit of not penalizing localities for decisions made in the past, and it arguably distributes the emission reduction responsibility most equitably across localities. Under this approach, all localities will have emission reduction responsibility, but localities with larger initial emissions will be

responsible for larger absolute reductions per capita. We find this fourth method most equitable and politically feasible. Because it is based on per capita emission reduction targets, it does not penalize population and economic growth while encouraging steady improvement by all localities.

Whatever the chosen allocation method, it is important that there be a clear, predetermined schedule for what the carbon budgets will be in the future. As we highlighted earlier, many of the local climate initiative choices that must be made in order to comply with city carbon budgets are medium- and long-term decisions. To confidently make these multiyear decisions, local policymakers need to know both their current and future emission reduction responsibility, along with a guarantee that it will not be changed.

3.3 Emissions measurement and assignment to localities

City carbon budgets transfer a portion of the responsibility for greenhouse gas emissions reduction to the local government level – the portion that corresponds to the emissions over which local governments have either direct or indirect control. These emissions include a portion of those from both the transport and buildings sectors as well as those from local government operations. Development of standardized methodologies for both emissions measurement and assignment to localities is necessary. More than one emissions inventory protocol is under development for this purpose (e.g. ICLEI recently completed the public comment period for their draft protocol), but these account for all of the local emissions, and do not separate out the locally-controlled portion.

We envision a city carbon budgets program that bases the emission budgets on a locality-specific inventory of “base” emissions compiled and measured each year by the state or nation to ascertain locality compliance with the policy. This section identifies and evaluates the options for creating such an inventory for the buildings and transport sectors. We focus on the challenge of measuring the locally-controlled portion of emissions with enough precision that incremental emission changes can also be measured, and, in the case of mobile source emissions, how responsibility should be divided between localities.

The results of this evaluation suggest the following. In the buildings sector, electricity and natural gas usage in residential and commercial buildings should determine the buildings base emissions inventory. Electricity use can be converted to greenhouse gas emissions using a standardized regional emission factor. An adjustment could be made in assigning local responsibility for these emissions – the emissions budgets – based on the proportion of the buildings that are constructed after the launch of a city carbon budgets program. On the transport side, amount and mode of travel are the two variables over which local governments have substantial indirect control. As such, the vehicle miles traveled by mode should be collected, and a standardized regional emission factor should be used to convert these VMT into the transport portion of the local greenhouse gas emissions responsibility. Again, we suggest that an emissions budget adjustment be made to account for impact of new nonresidential development on VMT in neighboring localities.

It is certainly true that localities control policy levers that affect greenhouse gas emissions outside of these categories of “base” emissions. A mechanism should be included in a city carbon budgets policy, therefore, that allows localities to request adjustments to their base emissions in the event that they have reduced emissions in another area. Examples of such

actions include local promotion of technologies above and beyond the state or national requirements or of lower carbon footprint (embodied emissions) building materials. For these “extra-base” activities, the burden would be on the locality to measure the actual reduction in emissions, using an approved measurement methodology.

3.3.1 Measuring building emissions

Measuring total energy use and the associated emissions from buildings is straightforward. Electricity, natural gas, and home-heating oil provision are consolidated industries, and usually only a handful of these companies operate in a city or county. This means that although the individual energy use in homes and offices is dispersed, it is tracked centrally, and those central data are easy to transform into a greenhouse gas emissions inventory from end-uses in the buildings sector. The one wrinkle in measuring total building emissions is that the greenhouse gas emission rate per kilowatt-hour of electricity will depend on the mix of power plants supplying power to the grid, and this mix will change hourly. To accomplish the energy-to-emissions transformation for electricity, then, we suggest a standardized regional emissions factor approach using annual average emissions rates for electric supply systems that are routinely tabulated (Energy Information Administration 2000).

The challenge for incorporating emissions from building energy use into a city carbon budgets policy is in devising a way to use these measurements of total building emissions to regulate only that portion of building emissions that local governments can influence. Unfortunately, there is no way to accurately separate building energy use into parts that can and cannot be influenced by local action. This is a potential problem because the portion of building emissions not under local control is in flux as well, and is not changing at the same rate for all localities.

Differences between localities in this background rate of change of building emissions are strongly linked to new building construction. Most technical features related to the energy efficiency of new construction are determined by regulations and codes established at the state or national level. Similarly, the energy efficiency of new appliances is regulated by national standards and is not under the control of localities. These facts have led to a concern that if total building emissions is the metric used to determine compliance with city carbon budgets, fast growing cities might end up reducing local emissions without taking action, at least in their buildings sector. This would happen if there is enough new construction (with associated mandated efficiency levels) that on a per capita basis, average emissions would come down even without local action.

If this effect is large, one possible solution is to add a new construction adjustment to the formula for allocating the buildings portion of the emission budgets. This adjustment would reduce the emission budgets for cities with higher proportions of buildings constructed since the first year of the carbon budgets program, insuring that all localities will have similar incentives to take action to reduce building energy use. Depending on data availability, the adjustment could be according to percent of total floor area that is new or percent of total structures that are new (appreciating that “new” is sometimes a major renovation instead of a new structure).

It is worth reiterating here that there are many actions within the purview of local governments that can substantially reduce building energy use – both for new construction and for existing buildings. More work is needed to ascertain the likely magnitude of the new construction problem identified above.

3.3.2 Measuring base transport emissions and assigning them to localities

In contrast to the buildings sector, it is not hard to separate transport greenhouse gas emissions into parts that can and cannot easily be influenced by local governments. Mode choice and vehicle miles traveled are both clearly under the influence of local government policy. The availability of energy-efficient vehicle technologies and low-carbon fuels are less so. We focus on the challenge of measuring VMT and assigning them to localities. Because emission rates per mile are not largely under local control, we propose to use a standardized average emission factor to convert these VMT into greenhouse gas “base” emissions.

On-road vehicles move freely between localities, emitting greenhouse gases as they go. For this reason, the best method of assigning these emissions to localities is unclear. Table 1 identifies six options for private vehicle miles traveled assignment to localities along with the associated likely methodology for estimating those VMT.

The options laid out in Table 1 are not equal. The ideal VMT assignment methodology should enable precise local VMT measurement, maximize options for local government action to reduce the assigned VMT, and avoid encouraging local policy that might actually increase VMT at a regional level.

Table 1: VMT Assignment Options and Implied Measurement Methodologies

	VMT Assignment Method	VMT Measurement Method
1	VMT in locality	Loop detector data, model
2	VMT by refueling in locality	Fuel sales, average fuel economy
3	VMT by vehicle home locality	Odometer readings
4	½ VMT by vehicle home locality, ½ VMT by vehicles employed in locality	Odometer readings, place of employment survey
5	½ VMT by vehicle origins in locality, ½ VMT by vehicle destinations in locality	Travel survey, model
6	VMT by vehicle home locality, Adjustment according to new nonresidential development	Odometer readings, survey of visitors to new nonresidential developments

Unfortunately, we are not aware of a single methodology for assigning VMT to localities that accomplishes all of this. Options 2 and 3 in Table 1 both enable precise local VMT measurement, but neither maximize opportunities for local government action. Options 4 and 5 both provide ample policy levers for cities to influence their assigned on-road vehicle emissions. This trip-end approach has been identified in the literature by Millard-Ball (2008). The problem with trip-end VMT assignment is that with current measurement capabilities, it is not possible to estimate VMT with enough precision that incremental changes are likely to be detectable.

Given these challenges, the best performing is the last method listed in Table 1. This VMT assignment method achieves base emissions measurement precision at the outset and enables local climate-friendly policymaking while avoiding perverse incentives. Here, we describe the method in greater detail. In the first year of the city carbon budgets program, VMT would be assigned according to vehicle home locality. This assignment method has the advantage of a simple methodology for estimating vehicle miles traveled using easy-to-collect odometer data. The problem, though, is that it does not provide sufficient incentive for localities to reduce VMT through actions at trip attraction points. This is where the “adjustment according to new

nonresidential development” comes in. Under this VMT assignment scheme, localities with new nonresidential development would be required to collect data to estimate the net VMT generated by the development as well as the home localities of these VMT. If the development generates net positive VMT that originates outside its boundaries, some portion of those VMT are allocated to neighboring localities through an emission budget adjustment. If the development reduces VMT outside its locality boundaries, the reverse emission budget adjustment is made.

In addition to private vehicle miles traveled, the base transport emissions under a city carbon budgets policy should include VMT for all motorized noncommercial traffic: public transit vehicles, motorcycles, and some corporate fleet vehicles. To assign transit vehicle VMT to localities, it makes sense to use actual route VMT in each locality where the transit vehicles stop. Both two-wheelers and corporate fleet VMT can be assigned to localities using the same method described above for assigning the private VMT.

3.3.3 Other emissions

It is clear that some of the actions taken by local governments will affect total greenhouse gas emissions, but will not change VMT or building energy use. Obvious examples include changes in local government direct emissions and emission reduction through creation of incentives for adopting low-emitting vehicles and fuels. Local governments should be able to get credit for these actions under a city carbon budgets policy. One possibility to enable this is for the state or nation to set up a set of standardized emission measurement methodologies for common actions that might affect these other emissions. Local governments would simply carry out the appropriate measurement methodology, gaining credit for actions they take that reduce these other emissions.

3.4 Timing

Although this paper presents city carbon budgets as a full transfer of greenhouse gas emissions responsibility from the state or nation to the localities, the concept would not have to be implemented in its fullest form all at once. There are three possible stages of emissions responsibility that could be taken on by local governments. The first stage might be voluntary adoption by localities of non-binding carbon budgets. In this case, local governments would receive technical assistance from the state or nation, but would not be eligible for financial implementation assistance because these budgets would be non-binding. The second stage might be voluntary adoption of a legally-binding budget. Local governments would receive both technical and financial assistance, both to support compliance with the budgets and to encourage adoption of budgets. The third stage would be mandatory adoption of budgets by all cities and counties, with accompanying technical and financial assistance from the state or nation.

An attractive aspect of this policy concept is that, if implemented smartly, these stages of local greenhouse gas emissions responsibility could easily be phased in over time. The key to smart implementation is consistent state or nationwide standards for carbon budget determination, emissions responsibility assignment to localities, and emissions measurement.

4. COSTS AND BENEFITS

4.1. How much will this cost?

Costs are highly uncertain and sensitive to the magnitude of the target. Because city carbon budgets aims at local policy changes as opposed to adoption of specific technologies, it is difficult to provide accurate cost estimates. In this section, we outline categories of potential costs to this program along with a discussion of who might pay them.

There are three main categories of costs associated with city carbon budgets: institutional costs, implementation costs, and societal costs and co-benefits. Institutional costs are those of running the program. Implementation costs are the financial outlays necessary for the various local greenhouse gas emission reduction initiatives. Societal costs are any reduction in quality of life that results from city carbon budgets.

Institutional costs can be divided into start-up program costs and ongoing costs of emissions monitoring. The start-up costs of city carbon budgets are likely to include development of institutional capacity for the program at the levels of the state, region, and locality, development of standardized emissions assignment, measurement, and data collection methodologies, and a statewide public education campaign regarding the new program. The ongoing costs are likely to include emissions monitoring costs and the cost of staffing the program at the state, regional, and local governments. It makes sense for the bulk of the start-up costs to be borne by the state. To insure standardization, the state could also assume responsibility for the base emissions monitoring of vehicle miles traveled and natural gas and electricity use across the state. The cost of measuring the emission adjustments in localities with new nonresidential development could be passed on to the developers. Measurement of the emission reductions from local initiatives that do not affect the base emissions should be the responsibility of the locality.

The magnitude of the implementation costs for a city carbon budgets program will fully depend on the particular strategies that localities use to meet their emission reduction responsibilities. Many of the most likely local actions are either implementation cost-free or pay for themselves in energy savings. Examples of such actions include climate-friendly changes to zoning codes, certain building energy retrofits, and converting regular lane-miles to HOV-only. Other local actions – such as installing bicycle and pedestrian infrastructure – do have substantial costs. However, because we see plentiful options for inexpensive action, we would not expect a locality to opt for an expensive strategy unless it brought substantial co-benefits to the community.

Many of the local initiatives to reduce greenhouse gas emissions do not have direct costs of implementation, but instead require political will for implementation. Of course, the reason that political will is required is that some members of the community may perceive that their choice of lifestyle is being constrained, and this perception of constrained choices could be viewed as a societal cost of the program. Indeed, choices and behavior will be affected. Under city carbon budgets, single-occupant vehicle use is likely to become more expensive, while alternatives to the single-occupant vehicle for daily travel will become more abundant and convenient. Permits to develop new, residential-only neighborhoods that are not accessible by transit would likely become difficult to obtain, while mixed neighborhoods with better transit access will become easier and less expensive.

4.2. Co-benefits of city carbon budgets

City carbon budgets are motivated by the need to reduce greenhouse gas emissions, but substantial non-climate benefits could result from actions taken under such a policy. Indeed, those other benefits would likely be very large, probably far larger than the climate benefits. Moreover, local support for this program will happen only if the co-benefits are perceived to be large.

These other benefits include reduced fuel needs for buildings and vehicles, resulting in substantial cost savings, reduced vehicle travel, more livable communities, more efficient use of land, and in a broader sense, increased energy security and lower energy prices. The nature and magnitude of reduced vehicle travel is particularly important and central. The benefits of reduced travel depend on the specific initiatives that the local government puts in place under city carbon budgets.

We expect that the actions taken by cities and counties to reduce both vehicle miles traveled and the energy used in buildings will result in more compact, mixed-use, and transit-oriented development. This style of development has a number of benefits beyond carbon emission reductions. It will reduce the pressure to convert land to urban and suburban developments from their natural state or agriculture, preserving farmland and other open space important as wetland and other natural habitat. It will also slow the extension of suburban land development into forests, leading to lower fire-related risk, an especially important benefit in the western United States, where wildfires are common and highly destructive.

It is likely that by reducing vehicle miles traveled, cities will also be reducing three major externalities of our current transport system: local air pollution, traffic congestion, and road noise. Significant reductions in these externalities would be an extremely large co-benefit of city carbon budgets through reduced incidence of respiratory disease and reduced and/or more reliable travel times. To fully realize these co-benefits, it will be important for cities to provide enhanced transit, bicycle, pedestrian, and rideshare infrastructure to encourage mode shifting and carpooling.

To the extent that local strategies to reduce vehicle miles traveled include provision of transit service as well as bicycle and pedestrian infrastructure, those who cannot drive cars will see enormous improvements in both their mobility options and their safety while traveling. This group includes children, the elderly, and the poor who cannot afford vehicle ownership.

Given these opportunities for co-benefits along with technical and financial assistance from the state in realizing them, it is possible that communities will experience net improvements in their daily lives as a result of city carbon budgets. The likelihood of net local benefits beyond emissions reduction is dependent on the level of flexibility that local governments have under city carbon budgets, as well as the extent of state support for local activities.

5.0 PROVIDING INCENTIVES AND FLEXIBILITY

5.1 Carrots and sticks

Most local governments struggle to provide even basic public services: education, streets, and water and sewage. In general, they have limited financial and technical resources. Limits placed

on property tax increases in California and many other states have exacerbated the challenge. Local governments resist, for good reason, new “unfunded mandates.” They cannot afford expensive new initiatives, nor could they engage in an emissions trading program in which they might have to buy credits. Imposing fines on noncompliant localities would create hostility and political opposition to the carbon budget program. The challenge in designing the city carbon budget program is to create flexibility, and to ground it as much as possible on incentives.

We suggest focusing on rewards and incentives, not fines and other penalties, especially initially. Two funding sources that could be used to provide incentives to local governments are transportation funds and a carbon trust fund. These funding mechanisms could be used to assist cities and counties, rewarding those that are more responsive and effective.

Carbon trust funds can be created from various funding streams, but the most promising is likely to be created from the auctioning of carbon allowances in a carbon cap and trade program imposed on large stationary sources. These funds could then be used to finance some or all of the costs of local investments such as road pricing programs (in which case they could be paid back with the collected fees), climate retrofits for existing buildings, and transit, pedestrian, and bicycle infrastructure. Funds might also be used for analytical purposes – for data collection, and compliance and forecasting models.

Another mechanism to encourage compliance is to allocate state and national transportation funds according to emission reductions by local governments. All local governments might receive some base amount, using current formulas, but those that perform better would be awarded additional funds for infrastructure and activities that lead to reduced emissions.

Whatever the mechanisms chosen to support compliance, it is imperative that local governments be in support of city carbon budgets from the start. Absent an enormous leap forward in low-carbon energy technology, reducing greenhouse gas emissions from the transport and buildings sectors is likely to be extremely challenging. It will require nothing short of a permanent shift in the way millions of people make both their medium- and long-term investments in both housing and vehicles, as well as their daily travel and energy use decisions. Therefore, we strongly believe that for city carbon budgets to be successful, state and local governments need to be partners rather than act as the regulator and the regulated. To foster this partnership, the use of “carrot”-style mechanisms to support compliance should be emphasized far more than the threat of “stick”-style mechanisms to punish noncompliance. Punishing noncompliance will not achieve environmental goals – it is likely only to lead to animosity between local and higher-level governments, making the environmental goals even more difficult to achieve. That being said, having no punishment for grossly noncompliant localities makes the program effectively voluntary, and this is also unacceptable.

5.2 Emissions trading is problematic

Various mechanisms could be used to provide localities with more flexibility in responding to targets. One means of providing flexibility and additional revenue streams, while also increasing the overall economic efficiency of the program is the buying and selling of emission reduction credits. Emissions trading would give communities a choice between reducing emissions within their community and buying emission credits from a community whose greenhouse gas emissions are below its budget. Localities that are able to reduce emissions cheaply could sell credits to cities and counties that find reductions more difficult, creating a revenue stream. Credit

trading leads to reductions in the marginal cost of compliance across all localities involved in the market. While low costs are a clear benefit from trading in well-defined markets, there are significant problems associated with trading, particularly in the context of city carbon budgets.

In practice, markets require sufficient buyers, sellers, and information to function properly. A lack of buyers or sellers can result in liquidity constraints, while incomplete information can result in price swings as information is revealed. None of the conditions for a mature market currently exist in the context of city carbon budgets, making it less likely that credit trading would substantially and equitably reduce costs.

Perhaps more importantly, there are at least two practical issues unique to city carbon budgets that make emissions trading problematic. The first is an equity issue – some communities would find it difficult to raise funds to purchase allowances. This could result in some communities adopting policies that lead to local emission reductions and other communities simply paying their way out or worse yet, rejecting the policy entirely. The second is a timing issue. Although many land use policies have the potential to lead to large emissions reductions, the full effect occurs years after the policy is implemented. It is important to not create an incentive that gives localities an “out” in the form of buying credits to meet their short-term obligations, instead of starting the process of transitioning to climate-friendly land use policies. As such, a full trading system is not appropriate at the onset of this policy.

While we do not recommend that emissions trading be part of the carbon budgets program from the outset, we do support trading as the program matures. At some point, trading could be allowed across cities and counties within the state or country. And after the kinks are worked out of the trading protocols and practices, this local government market could be integrated into a larger carbon markets that includes other activities. This larger market might include large stationary sources subject to a cap and trade program, low carbon fuels, and eventually international trading markets.

While pollution markets are often criticized for creating “hot spots” in low income and politically powerless neighborhoods and regions, it is not clear that this criticism holds in this case. Many of the initiatives that cities and counties can take to reduce vehicle miles traveled and energy use in buildings are a function of political will. They are not expensive and many reductions could have a negative marginal cost. Thus, poorer communities that exercise political will could benefit from this program by generating a revenue stream. Plus, reducing vehicle miles traveled and energy use will lower energy and gasoline bills for residents of those localities.

A related provision that creates more flexibility and that would be compelling initially than trading is credit banking and borrowing. Credit borrowing implies that a community could borrow an allocation from a later year, along as there is a limit on borrowing, since allocations are designed to fall over time and a large “debt” would become difficult to pay back. Under credit banking, a community could save part of its allocation for some later time. Including banking and borrowing provisions in a city carbon budgets policy is especially desirable, as it will reduce disincentives for medium- and long-term policies that have small emissions impacts in early years but lead to large emission reductions in later years.

6. CONCLUSION

Implementation of a city carbon budgets program will not be easy. It will take time and considerable effort. It will require accompanying investments in data collection and tool development. Political and financial forces will push back. Incentives, such as revamped transport funding formulas based on attaining greenhouse gas targets, are necessary for this initiative to gain local support and be effective.

A city carbon budget policy provides a durable and integrating framework for managing greenhouse gas emissions on the local level. It sends a strong signal that greenhouse gas emission reduction is important and must be a continuing factor in all local actions. It empowers local governments to take responsibility for their impact on climate change, and to take action to reduce emissions in a way that is best for their community. It is difficult to imagine a serious effort to reduce VMT and local greenhouse gas emissions without a carbon budget policy or something similar.

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