Achieving California's Land Use and Transportation Greenhouse Gas Emission Targets Under AB 32: An Exploration of Potential Policy Processes and Mechanisms

A Report for the California Air Resources Board and the California Department of Transportation

Susan A. Shaheen, Ph.D.
Honda Distinguished Scholar in Transportation, University of California, Davis, &
Co-Director, Transportation Sustainability Research Center (TSRC)
University of California, Berkeley
1301 S. 46th Street. Bldg 190; Richmond, CA 94804-4648
510-665-3483 (O); 510-665-2183 (F); sashaheen@tsrc.berkeley.edu; sashaheen@ucdavis.edu

Jade Benjamin-Chung
Graduate Student Researcher
University of California, Berkeley
1301 S. 46th Street. Bldg 190; Richmond, CA 94804-4648
jadebc@gmail.com

Denise Allen
Research Analyst
Transportation Sustainability Research Center (TSRC)
University of California, Berkeley
1301 S. 46th Street. Bldg 190; Richmond, CA 94804-4648
dallen@tsrc.berkeley.edu

Linda Howe-Steiger, Ph.D.
Research Associate
Technology Transfer
University of California, Berkeley
1301 S. 46th Street. Bldg 155; Richmond, CA 94804-4648
University of California Berkeley
steigerl@comcast.net

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ABSTRACT

Continuing its role as a leader in air pollution policymaking, California led the nation by passing the first global warming legislation in the U.S.: the Global Warming Solutions Act or Assembly Bill 32 (AB 32). The legislation requires California to decrease greenhouse gas (GHG) emissions to 1990 levels by 2020 (approximately a 27 percent reduction) using an enforceable statewide target to be phased in beginning in 2012. In addition, in 2005 Governor Schwarzenegger issued Executive Order S-3-05, which charges California with the task of reducing GHG emissions to 2000 levels by 2010, reducing emissions to 1990 levels by 2020, and reducing emissions to 80 percent below 1990 levels by 2050. This report represents a body of work conducted to assist the State of California in its efforts to develop a plan to achieve the emission targets set forth by AB 32. This research includes a literature review, expert interviews, and regional stakeholder workshops to identify and explore possible policy processes (e.g., cap and trade, budgets, feebates, etc.), mechanisms (e.g., smart growth and ITS), and strategies that could be employed to meet AB 32's GHG reduction goals.

EXECUTIVE SUMMARY

Photographs of melting glaciers and forecasts of rising sea levels, along with hotter average global temperatures and more severe storm and drought events, have focused public interest on the issue of climate change in recent years. It has become an issue that state and federal governments acknowledge they must address to avoid major environmental consequences in the future. Transportation is a major contributor of carbon dioxide (CO_2) and other greenhouse gas emissions (GHG) from human activity, accounting for approximately 14 percent of total anthropogenic emissions globally and about 27 percent in the U.S.

Continuing its role as a leader in air pollution policymaking, California led the nation by passing the first global warming legislation in the U.S: the Global Warming Solutions Act or Assembly Bill 32 (AB 32). The legislation requires California to decrease GHG emissions to 1990 levels by 2020 (approximately a 27 percent reduction) using an enforceable statewide target to be phased in beginning in 2012. In addition, in 2005 Governor Schwarzenegger issued Executive Order S-3-05, which charges California with the task of reducing GHG emissions to 2000 levels by 2010, reducing emissions to 1990 levels by 2020, and reducing emissions to 80 percent below 1990 levels by 2050. The California Air Resources Board (ARB), which is charged with implementing the target, must adhere to the following principles: 1) equitable distribution of costs and benefits; 2) no direct, indirect, or cumulative air pollution increases in local communities; 3) protection of entities that have made efforts to curb emissions prior to AB 32; and 4) coordination of emission reduction efforts with other states and countries. ARB was required to adopt the legislation by January 1, 2008, and to develop a plan for reducing emissions by January 1, 2009. Those actions that can be enforced early will be adopted in 2010, and the rest of the measures will be adopted in 2011.

This report represents a body of work conducted to assist the State of California in its efforts to develop a plan to achieve the emission targets set forth by AB 32. This research includes a literature review, expert interviews, and regional stakeholder workshops to identify and explore possible policy processes (e.g., cap and trade, budgets, feebates, etc.), mechanisms (e.g., smart growth and ITS), and strategies that could be employed to meet AB 32's GHG reduction goals.

LITERATURE REVIEW

Global warming mitigation is of increasing concern worldwide, and more and more policymakers have drafted and passed legislation that will commit states and countries to reduce GHG emissions. Despite its economic prowess, the U.S. has failed to adopt GHG reduction policies at the national level in as aggressive a fashion as other countries with a similar per capita gross domestic product. By passing AB 32, California has committed itself to becoming a leader in GHG emission reductions in the U.S., and the policies implemented in California will likely shape decisions made at the national level regarding global warming mitigation. The literature review summarizes the key transportation and land use-related policy approaches, possible policy mechanisms, and strategies that could be employed to meet AB 32's GHG reduction goals. A variety of policy approaches are available on a spectrum ranging from voluntary to regulatory; while regulatory approaches have traditionally been used in environmental policy in the U.S., market-based approaches have become increasingly popular due to concerns about the

cost of GHG reduction. Due to the wide range of policies needed to meet AB 32 goals, a mix of policy approaches is likely to be adopted.

To implement AB 32, several policy mechanisms are available. Regional emission targets will be set by ARB in consultation with local governments. Cap and trade is a major policy mechanism that is already underway in the European Union (EU). While the EU examples do not directly target transportation, some have proposed a variety of potential cap-and-trade mechanisms that could be implemented in the transportation sector. The Scoping Plan does not directly specify a cap-and-trade mechanism to address the transportation and land use connection. However, this area may be eligible for California cap-and-trade revenues, which could be used as an incentive for local governments in promoting better land use planning.

Within a given policy approach and policy mechanism, there are numerous potential strategies that may be employed to reach AB 32 goals, which range from easy to implement strategies, such as park-and-ride facilities, to much more politically and administratively challenging approaches, such as congestion pricing. Such breadth of potential strategies is useful, as the State will likely need to introduce multiple strategies in tandem to be as effective as possible.

The Land Use Subgroup of the Climate Action Team (LUSCAT) as well as the Economic and Technology Advancement Advisory Committee (ETAAC) both provided recommendations for AB 32 implementation. While their recommendations differed in some details, general themes emerged from both including the implementation of a suite of policies in conjunction with new funding mechanisms, coordination between the public and private sector, and engagement of citizens and consumers through education and information. The Scoping Plan adopted many of the approaches mentioned by both advisory groups with several under further development.

EXPERT INTERVIEWS

Between February and July 2008, researchers completed 15, two-hour (on average) expert interviews with 24 participants who represented various perspectives on the problems and solutions for meeting the emission reduction targets mandated by AB 32 and Executive Order S-3-05. Experts were interviewed from a range of stakeholder groups, including state and local transportation agencies, local government, elected officials, builders and developers, regional agencies, environmental advocates, and business groups. Most experts were from California and had over 20 years experience in their field.

Experts were first asked to consider various GHG emission reduction strategies including land use, mobility management, pricing, intelligent transportation systems (ITS), and behavioral change. There was near consensus among experts that a reduction in vehicle miles traveled (VMT) should be the highest priority for meeting AB 32 requirements. The strategies most commonly cited by experts to reduce VMT included smart growth, transit-oriented development (TOD), pricing, and encouraging the development of “best practice” blueprint planning. Pricing and improving public transit were viewed as short-term strategies (although funding and political support may be challenging), while land use changes were cited by nearly every expert as the most important approach for meeting the 2050 target. Experts also discussed how to overcome barriers that may prevent the implementation of GHG reduction strategies. Experts identified behavioral change, pricing, reducing VMT, and smart growth as the strategies that are the most

difficult to implement.

The experts were also asked to consider which of the policy approaches (i.e., voluntary, regulatory, market based) or combination of approaches would be the most effective at achieving GHG emission reductions in the transportation sector. The majority endorsed a mix of voluntary, regulatory, and market-based approaches. A mixed voluntary and market-based approach was considered best for personal behavioral change and compliance with land use policies and targets. Regulatory approaches were coupled with voluntary or market-based approaches.

Next, experts were asked how the 2020/2050 GHG reduction targets should be achieved for transportation and VMT/vehicle use in particular and why. The majority of experts identified increased housing density as the method to achieve targets for transportation and VMT. Carbon dioxide emissions were the measure that most experts thought should be used to evaluate reductions.

There was consensus that to set meaningful VMT targets, better models need to be developed for quantifying the emission benefit resulting from reduced VMT. The majority of experts favored absolute targets that were tailored to each region's characteristics, although a minority of experts did favor a per capita approach.

The experts also were asked to comment on what type of educational outreach is necessary to inform the public about ways to reduce GHG emissions from transportation and if they were aware of any existing efforts/campaigns by other organizations that could serve as an effective model. The majority of experts agreed that public education was integral to achieving AB 32 goals. However, one expert thought that growing a "green and organic" culture in California would be more effective at changing behavior than educational campaigns. The main methods of public outreach included media partnerships, marketing, and training programs.

Finally, experts were asked to restate the most important points of their interview and offer any final comments. Funding and targets were cited as the most important take-home points across all stakeholder groups. Interestingly, many stakeholder groups wanted to emphasize many of the same key points: 1) a combination of strategies are needed (found across all stakeholder groups); 2) pricing is needed but is challenging to implement (found across all stakeholder groups); 3) regulatory reforms (e.g., California Environmental Quality Act (CEQA)) are needed to streamline "smart" land use practices and infill development (found across all stakeholder groups); 4) emphasize behavioral change (found across all stakeholder groups); and 5) targets must consider regional differences (i.e., urban cores vs. agricultural centers) (found across all stakeholder groups).

STAKEHOLDER WORKSHOPS INTERVIEWS

Between March and April 2008, researchers conducted five regional one-day AB 32 workshops on the land use and transportation connection. The five regions included: Oakland/Bay Area, Sacramento, San Diego, Los Angeles, and Fresno/San Joaquin Valley. Between seven and 15 individuals participated in each of the workshops. Participants represented a range of stakeholder groups, including state and local transportation agencies, local government, elected officials, builders and developers, regional agencies, environmental advocates, and business groups.

The most significant outcome from the five regional workshops is the general consensus across the regions and stakeholder groups regarding the long-term effectiveness of changing land use patterns from the dominant 20th century pattern of single use, automobile dependent development (more sprawling) towards a new paradigm for the 21st century. This new paradigm reflects denser, smaller-sized homes; supports more walkable development forms; mixed residential, commercial, and retail land uses; "clean" jobs; and public transit and other modes that are convenient and accessible. The co-benefits of this approach are perceived across both the regions and stakeholder groups as being notable in promoting individual health and general environmental sustainability.

Pricing strategies were also viewed across the region as critical success factors. Pricing should be used to send economic signals that discourage use of single occupant gasoline-powered vehicles and encourage public transit and low/non-emitting alternatives, including bicycling and walking.

Behavioral change, which included public education campaigns to promote and encourage individuals towards making low carbon choices, was viewed by most panelists as "good" or "right," with one exception (i.e., in San Diego many panelists considered the public ready to make the right choice immediately). This was the third most effective strategy across the State. All regions believed these messages needed to personalize the problem of climate change for each region and to focus on encouraging individuals to make specific choices that were available. All panels recommended close coordination between public campaign messages and the availability of low carbon options. Many recommended the use of highly professional marketing strategies, making use of California's home grown entertainment industry to make low carbon lifestyles trendy.

ITS and mobility management were considered by most as lower profile but still effective strategies that should be implemented and supported for their real, although marginal, impacts.

A constant theme of all discussions on reduction strategies involved the need for strong clear messages and assistance, including technical and financial assistance to local governments and implementing agencies. Many specific strategies were suggested, including more effective land use planning and zoning assistance from the State and statewide pricing guidelines or regulations to ensure consistency of approach across the regions. At the same time, all regions wanted to customize and target their approaches, particularly with regards to public marketing and education campaigns.

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CHAPTER 1: LITERATURE REVIEW

There is overwhelming scientific consensus and growing political consensus that it is time to create policies to address global warming (MacCracken, 2002). Greenhouse gases (GHG) include carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), and halocarbons (HCFCs); all of these gases naturally exist in the atmosphere, but in recent years their concentrations have increased at an unnatural rate due to human activity, such as fossil fuel use (MacCracken, 2002). A major source of fossil fuel use is transportation. In the United States (U.S.), transportation results in over 27 percent of anthropogenic GHG emissions, and in California, 41 percent of GHG emissions are due to transportation (Shaheen and Lipman, 2007; ETAAC, 2008). Transportation uses over half of California's oil supply (McManus, 2007). Meanwhile, the average fuel economy of new vehicles has decreased due to increased proportions of light-duty trucks and sport utility vehicle (SUV) purchases (duVair *et al*., 2002). In California, the rate of vehicle miles traveled (VMT) growth proportionately exceeds population growth (LUSCAT, 2008). Improved standards of living increase the demand for vehicle ownership and for international trade, which increases freight transportation in California (ETAAC, 2008). Longer commute distances also have contributed to increases in VMT, while congestion has continued to increase; both factors contribute to GHG emissions (ETAAC, 2008). These trends indicate that if action is not taken that achieves significant long-term emission reductions, climate change will continue and its effects will worsen (MacCracken, 2002). This paper discusses potential transportation- and land use-related policy approaches, mechanisms, and strategies to reduce GHG emissions in California under the landmark legislation of Assembly Bill (AB) 32—the California Global Warming Solutions Act.

The factors determining GHG emissions due to transportation are numerous and diverse, including the type of fuel used, the fuel efficiency of the vehicle, mode choice, land use, and travel behavior. The burning of fossil fuels results in GHG emissions, so cleaner fuels, such as ethanol mixtures or biofuels, could provide a promising alternative to petroleum-based fuels. The technology and size of the vehicle itself determines the amount of fuel used per mile as well, and thus affects GHG emissions. In addition, mode choice that minimizes car use, such as buses and trains, can contribute to decreased GHG emissions by reducing the number of trips taken in passenger cars and light-duty trucks. The less obvious factor, which is more challenging to address, is the connection between land use and transportation. The density of developments; the mix between housing, commercial, and institutional use; accessibility of destinations; and connectivity to nearby regions all determine driving behavior. Generally, when land use focuses on density, as in urban areas, the accessibility and diversity of transportation modes is higher, reducing the need for an automobile. On the other hand, suburban and rural areas often have fewer transportation options and destinations are more spread apart, making automobile use a necessity (Litman, 2008).

The consequences of increased global warming are serious and affect almost all sectors, including agriculture, forestry, public health, transportation, and energy supply. In an analysis of the potential consequences of climate change in California, the most dramatic scenario included more frequent and severe heat waves, wildfires, floods, and air pollution (Cayan, 2006). Rising temperatures decrease the amount of snow in the Sierras and threaten the State's water supply (McManus, 2007). The 1,100 miles of coastline in California and the communities along the coast are also particularly vulnerable to increasing sea levels due to global warming (McManus,

2007). California agriculture, in particular, is the sector most likely to experience the negative effects of climate change (Cayan, 2006). In the U.S., California is the largest agricultural producer, generating $68 billion in California, employing over one million workers, and accounting for 13 percent of agricultural sales nationwide (Cayan, 2006). As temperatures and CO2 concentrations rise, changes in water supply and pests may threaten agricultural production.

In addition, increased temperatures result in higher levels of ground-level ozone and particulate matter (PM), making it more difficult to meet existing ambient air quality standards (duVair *et al*., 2002). Reduced air quality not only threatens the environment but also public health. Currently, 90 percent of the California population already lives in regions that violate the State's air quality standards for ground-level ozone or airborne PM (Luers, 2006). As the levels of these pollutants increase, so will the risk of asthma, acute respiratory disease, cardiovascular disease, and decreased lung function. In addition, higher temperatures will increase the risk of death from dehydration, heat stroke, and heart attacks (Luers, 2006).

Population and transportation trends in California paint a dismal picture for GHG mitigation without extensive policy changes. It is projected that California's population will grow by 12 million people over the next 20 years to a level of 45 million (duVair *et al*., 2002). Nationally, VMT has increased more quickly than highway capacity, population growth, and the economy, and it is expected to increase at double the population growth rate in the future (Handy, 2005-lit; duVair *et al*., 2002). Despite these trends, until recently U.S. policymakers have not focused on policies to reduce GHG emissions. The Energy Policy and Conservation Act of 1975 created Corporate Average Fuel Economy (I) standards to improve the energy efficiency of passenger cars or light trucks (Greene *et al.*, 2005). In December 2007, President George W. Bush signed the Energy Independence and Security Act, which aims to improve fuel economy and decrease dependence on foreign oil. This legislation will achieve these goals by setting the national fuel economy standard to 35 miles per gallon by 2020 and by creating a mandatory Renewable Fuel Standard (RFS), which requires fuel producers to use at least 36 billion gallons of biofuel in 2022 (Office of the Press Secretary, 2007). The Clean Air Act and related policies have focused on reducing air pollution but not specifically GHG emissions.

Continuing its role as a leader in air pollution policymaking, the California legislature recently passed the most extensive policy at the US state level to decrease GHG emissions—AB 32. The legislation requires California to decrease GHG emissions to 1990 levels by 2020 (approximately a 27 percent reduction) using an enforceable statewide cap to be phased out beginning in 2012. In addition, in 2005 Governor Schwarzenegger issued Executive Order S-3-05, which charges California with the task of reducing GHG emissions to 2000 levels by 2010, reducing emissions to 1990 levels by 2020, and reducing emissions to 80 percent below 1990 levels by 2050. The California Air Resources Board (ARB), which is charged with implementing the cap, must adhere to the following principles: 1) equitable distribution of costs and benefits; 2) no direct, indirect, or cumulative air pollution increases in local communities; 3) protection of entities that have made efforts to curb emissions prior to AB 32; and 4) coordination of emission reduction efforts with other states and countries. ARB was required to adopt the legislation by January 1, 2008, and a plan for reducing emissions by January 1, 2009. Those actions that can be enforced early will be adopted in 2010, and the rest of the measures will be adopted in 2011.

The ARB is also charged with developing a Scoping Plan, which outlines the GHG reduction activities to be conducted in the State under AB 32. The measures in the Scoping Plan were

available for public comment in four workshops held between November 30, 2007 and April 17, 2008. The Draft Scoping Plan became available for public review on June 28, 2008. The proposed Scoping Plan was released on October 15, 2008; it was adopted by the Board on December 12, 2008. This paper discusses potential policy approaches, mechanisms, and strategies for GHG mitigation in California that ARB might consider.

Significant contributions to the Draft and Final Scoping Plan have been made by the Climate Action Team (CAT), which is comprised of representatives from state agencies and departments convened in working subgroups. The Land Use Subgroup of the Climate Action Team, or LUSCAT, reviewed thousands of policy proposals for AB 32 and made policy recommendations to the ARB in April 2008. It also was responsible for developing strategies for the 2008 Climate Action Team (CAT) Report and 2009 ARB Scoping Plan, as outlined in AB 32 and Governor Schwarzenegger's Executive Order S-3-05. LUSCAT was comprised of individuals from the California Energy Commission (CEC), California Environmental Protection Agency (Cal/EPA), ARB, the California Department of Transportation, and other agencies; representatives of land use, local government, the environmental community, housing, environmental justice, and the utility and building industry representatives; public transit operators; regional and local governments; non-governmental organizations; and developers. They had to design policies relevant to all sectors since land use influences affordable housing, transportation, air quality, economic development, water supply, agriculture, environmental quality, and health, among other sectors.

LUSCAT adhered to a long-term land use vision as they crafted their policy recommendations. These included identifying planning strategies and processes at all levels of government to reduce GHG emissions and having the State articulate land use decisions that reduce GHG emissions. Policies should build upon existing models for improved planning capability; be comprehensive but flexible to adapt as circumstances change; and coordinate planning across Federal, State, regional, and local agencies. LUSCAT prioritized policies that: 1) address current financial disincentives to planning that reduce GHGs; 2) include utilities in infrastructure planning; and 3) create incentives for planning that improve quality of life, including resource and housing conservation; and 4) consider life-cycle costs and assessment. Finally, LUSCAT was committed to considering the impacts of planning decisions on population growth and distribution.

To develop their policy recommendations, LUSCAT prioritized the over 180 proposals they received and selected those that could provide feasible reductions or build a foundation for future reductions. The strategies LUSCAT recommended should have a net cost of zero through 2020 by leveraging and redistributing existing funding revenues for land use and transportation activities. However, they also stated that direct investment of State funds was needed and mentioned the need for tax policy reform to allow local and regional governments to adopt their recommendations. The authors include LUSCAT's recommendations in each section of the discussion that follows.

In addition, the Economic and Technical Advancement Advisory Committee (ETAAC) was created under AB 32 to advise ARB on activities, policies, funding opportunities, and new technology and research needed to achieve GHG reduction goals. The committee submitted policy recommendations to ARB in February 2008. Recommendations from the ETAAC report also are referenced throughout this analysis.

This chapter includes a review of the climate change and environmental policy literature pertinent to the transportation and land use connection in reducing GHG emissions. It also reflects key issues pertinent to AB 32 implementation, which were identified during transportation/land use stakeholder workshops and interviews conducted by University of California, Berkeley and Davis researchers in Spring 2008. The first section provides an overview of policy approaches – regulatory, voluntary, and market-based – with relevant examples drawn from the environmental policy literature. Next, policy mechanisms are discussed, including the use of emission targets, cap-and-trade mechanisms, and potential barriers to implementing AB 32. This section relies heavily on examples from the Kyoto Protocol and the European Union Emission Trading Scheme, which are models in the field of cap-and-trade for GHG emissions. The third section outlines policy strategies for GHG emission reductions that fall within the policy approaches discussed in the first section. Because AB 32's goals will likely require a suite of policies at multiple levels, the effect of combining policies is discussed where applicable. Finally, the authors summarize the AB 32 Final Scoping Plan, as well as key findings from this literature review.

POLICY OVERVIEW

The policy approaches for achieving reductions in GHG emissions fall into three main categories: voluntary, regulatory, and market based. While each is more effective under certain political or economic conditions, they also are frequently used in tandem. There are a variety of reasons to regulate in the context of environmental policies; most commonly, environmental regulation is implemented because the market is not able to efficiently allocate resources. As a result, public goods are insufficient, externalities pervasive and persistent, natural monopolies form, and there is imperfect information (Portney, 2000).

Traditionally, most U.S. environmental protection has used a regulatory approach, often called "command and control," which mandates environmental standards through legislation and enforces policies through litigation, sanctions, and penalties. These policies have been criticized because they are time consuming to enforce, threaten industry profits, do not always promote technological innovation, and are often manipulated for political purposes (Portney, 2000; Khanna, 2002). Policymakers have increasingly turned to voluntary or market-based policies, which are less stringent for industry and rely on more industry initiative and cooperation. However, these policies have also raised concerns, primarily among environmental groups, that the goals of legislation may be severely diluted due to more flexible approaches and industry influence. Policymakers must reach a balance between the imperfect market and imperfect policies. This section discusses all three policy mechanisms and provides examples of each in the context of environmental regulation and GHG mitigation.

Regulatory Policies

Regulatory policy mechanisms are defined through legislation that mandates certain targets or emission reduction systems and enforces the mandate through penalties, litigation, or sanctions. This policy mechanism has dominated U.S. environmental legislation until recently (Portney, 2000). Current regulatory policies require that manufacturers certify new vehicles and model

types to meet emission limits for nitrous oxides (NOX), carbon monoxide (CO), hydrocarbons (HC), diesel, and PM – but not GHG gases (CO2, CH4, N2O).

Within the category of regulatory policies, there are three main approaches relevant to environmental regulation: 1) the zero-risk approach, 2) the technology-based approach, and 3) the balancing approach. To illustrate the variability in costs associated with regulatory policies, "one survey of eight empirical studies of air pollution control found that the ratio of actual aggregate costs of the conventional command-and-control approach to the aggregate costs of least-cost benchmarks ranged from 1.07 for sulfate emissions in the L[os] A[ngeles] area to 22.0 for hydrocarbon emissions at all domestic DuPont plants" (Portney, 2000, p. 32). This finding indicates that the impact of different types of regulatory measures varies greatly and must be considered when choosing between the following regulatory approaches.

The **zero-based approach** is a commonly used policy mechanism that sets environmental targets needed to reach certain goals, such as to prevent disease or slow climate change. Industries are required to decrease emission levels to meet these targets and are penalized if they do not. These policies can often be unrealistic and infeasible because even if all U.S. industries complied perfectly, other states' or countries' emissions could contribute to emission levels, making it impossible to reach targets. In addition, there are no trade-offs between the cost of protection and the benefits of the stated goals. As a result, it may be necessary for industry and consumers to incur greater costs to meet standards within the defined timeframe. The original Clean Air Act (CAA), which passed in 1963 and 1970, is an example of a zero-risk "command-and-control" policy. The legislation set ambient environmental standards for air pollution prevention and control for both stationary and moving sources (Portney, 2000).

Next, the **technology-based approach** creates policies that only permit pollution after sources have implemented the best available technology to reduce emissions. A major challenge of this type of policy is determining which technology to mandate; emissions can almost always be reduced with additional expenditures. In addition, while more flexible than the zero-risk approach, it is inflexible about the control means and thus also may require sources to incur high costs. Rigid technology mandates could hinder improvements in efficiency over time. Examples of policies employing this approach include the Clean Water Act, the Resource Conservation and Recovery Act, the Safe Drinking Water Act, and parts of the CAA (Portney, 2000).

Finally, the **balancing approach** weighs competing emission sources. Regulators set standards to protect health or the environment while also considering the potential costs and consequences of the regulation. Such an approach requires that regulators and administrators make difficult decisions, particularly when there is insufficient accurate information about costs and benefits. A balancing approach was used with the 1997 Safe Drinking Water Act in which U.S. Environmental Protection Agency (EPA) administrators were required to balance the health risk reductions with additional costs associated with more stringent standards (Portney, 2000).

A variety of environmental "command-and-control" policies have been created around the world, as shown in Table 1 (below). In theory, such policies could be cost effective, but to create policies that are not prohibitively costly, policymakers would need detailed information about the compliance costs firms face to set different standards for each pollution source (Stavins, 2001). Generally, such information is unavailable, and such policies have become less appealing. The new trend in environmental regulation has prioritized cost effectiveness and efficiency over strict environmental standards.

Table 1 Regulatory Policies to Reduce GHG Emissions

Policy Focus	Examples
Passenger car fuel	Canada ▪ Motor Vehicle Fuel Consumption: replication of the I program in the U.S. but standards are not binding China ▪ Weight-based fuel economy standards Japan ▪ Energy Conservation Law: fuel efficiency standards for passenger vehicles ▪ Energy Saving Act: large transportation companies must submit strategic plans and reports on energy consumption; transportation companies and manufacturers must collaborate to reduce CO2 emissions and may face penalties for not doing so U.S. ▪ Corporate Average Fuel Economy (I) legislation: regulates CO2 emissions from passenger cars; the policy includes some intra-company trading instruments ▪ California's Low Carbon Fuel Standard
Technology	California ▪ Zero Emission Vehicle (ZEV) Program: mandates manufacturers to introduce low- or zero-emission vehicles to the market in California Brazil and Tokyo, Japan ▪ Diesel vehicles banned, increases in bioethanol fuels in Brazil and liquefied petroleum gas or LPG taxis in Tokyo
Fuel	Brazil ▪ Brazilian National Alcohol Programme: supports production and use of biofuels made from sugarcane Europe ▪ European Directive on promotion of biofuels and other renewable fuels for transport: states must ensure that the minimum percent of biofuels and other renewable fuels to reach markets is two percent by 2005 and 5.75 percent by 2010 U.S. ▪ Legislation that promotes ethanol production for motor fuel ▪ 1990 Clean Air Act – oxygenated fuel program: in CO non-attainment areas, gasoline must contain 2.7 percent oxygen
GHG emissions from passenger cars	California ▪ Proposal to regulate GHG emissions from passenger cars in 2009 Europe ▪ European Commission announcement that legislation will be passed to regulate CO2 emissions from passenger cars

Successful California Policy Models

A number of environmental and health policies that passed in California since the late-1980s can serve as policy models for AB 32, including tobacco legislation, the Landscaping Water Conservation Act (AB 325), legislation to promote recycling and create the California Integrated Waste Management Board (AB 939), and energy efficiency regulations (Title 24).

In 1998, California became the leader in tobacco control by passing Proposition 99, which was coupled with increasing public awareness of the public health effects of tobacco smoking. This proposition increased the cigarette excise tax by 25 cents per pack to discourage purchases and used tax revenue for tobacco education and research, media campaigns, and public health services (Jacobson, 1997). Following this successful legislation, in 1994, California passed AB 13 (California Smoke-free Workplace Law) to ban smoking in enclosed workplaces and also passed the Stop Tobacco Access to Kids Enforcement (STAKE) Act, which aimed to reduce teens' cigarette access. STAKE requires retailers to check the ID of anyone who appears under age 18 that attempts to purchase a tobacco product and to post signs that state that it is illegal to sell to minors. Finally, STAKE banned the sales of tobacco products in most vending machines.

The legislation received immense public support that continued for many years (Jacobson, 1997). In 1996, public support for such legislation was high: 88 percent of Californians supported higher criminal penalties for retailers that sold cigarettes to minors; 86 percent supported smoke-free indoor workplaces; and 85 percent supported smoking bans in restaurants (Jacobson, 1997). Since 1988, cigarette consumption, the prevalence of smoking, and secondhand smoke exposure has decreased in California (Tobacco Education and Research Oversight Committee, 2003). The success of these policies and continued public support demonstrate that it is possible to reduce tobacco consumption dramatically despite aggressive attacks on this legislation by the tobacco industry and the heavy marketing of tobacco products (Tobacco Education and Research Oversight Committee, 2003).

During the same time period, recycling legislation also was passed in the context of mounting recognition of the waste crisis in California. In 1988, each California resident disposed of 1,500 pounds of waste on average; this amount was greater than in any other state in the U.S. (AB 939 – California Public Resources Code Section 40000 et seq). At this time, the State lacked a coherent policy to manage solid waste effectively and in an environmentally sound manner. Nationally, there was a crisis in diminishing landfill capacity; meanwhile the public increasingly accepted the need to reuse and recycle (CIWMB, 2007). AB 939, which passed in 1989 with unprecedented political consensus, required local jurisdictions to divert waste to recycling by 25 percent in 1995 and 50 percent in 2000. The legislation also created a framework for program implementation, solid waste planning, and solid waste facility and landfill compliance and established the California Integrated Waste Management Board (CIWMB, 2007), which oversees progress towards diversion goals and generally provides regulatory oversight. Today, landfill capacity is no longer a State crisis, and numerous other local recycling initiatives have been launched in California.

Both tobacco and recycling legislation in California arose in a similar context to that of GHG emissions and global warming today – public awareness of the need for policies is rising, yet institutional structures remain barriers. However, learning from the experience of tobacco and recycling policies in California, AB 32 policies might capitalize on public support in a timely fashion to help reduce GHG emissions. Other effective policies that have been passed during a time of crisis in California include the 2005 Building Energy Efficiency Standards (Title 24) and the Water Efficient Landscape Ordinance (AB 325). Title 24 was designed to improve energy efficiency and delivery, reduce energy bills, and to encourage the adoption of energy efficiency research findings in California. AB 325 required the California Department of Water Resources to generate a model water efficient landscape ordinance that would lead to improved water-use efficiency.

Voluntary Policies

There are a growing number of business-led initiatives that encourage production decisions that protect the environment. These actions have been spurred by the often high costs of "command-and-control" policies as well as inflexible technology-related regulations (Khanna, 2002). In addition, as public awareness of industries' role in environmental problems mounts, the threat of liability for environmental damages increases. Thus, shareholders have begun to include environmental impacts in their investment decisions, and firms have begun to proactively seek voluntary agreements with governments — often to avoid legislation (Khanna, 2002).

Voluntary policy approaches consist of commitments made by corporations—either unilaterally or through negotiation—to reach environmental goals. In the context of environmental policy, corporations generally agree to change their practices to achieve a desired environmental change, but the agreement is not enforceable through litigation or sanctions (Welch et al., 2000). There are three main reasons why corporations adopt voluntary agreements: 1) changing their behavior to achieve environmental goals may allow them to influence, manipulate, or eschew the enforcement or establishment of government regulations; 2) changes in practices may yield both environmental gains and improvements in economic efficiency, often due to improved technology; 3) consumers and investors may favor products from and investments in companies engaging in voluntary environmental improvements; and 4) corporations may benevolently desire to invest in public goods (Welch *et al*., 2000). In addition to these benefits, there also may be costs to corporations of making voluntary agreements; these include having to acquire new technologies, improve skills, and hire public affairs specialists, legal experts, and lobbyists (Welch *et al*., 2000).

While there are numerous potential benefits of voluntary agreements for corporations, there are fewer for governments and citizens. In general, the literature analyzing the policy implications of voluntary agreements presents voluntary agreements as ineffectual relative to other policy mechanisms. One author interpreted voluntary agreements as "barter transactions in which the business community imposes an obligation on itself to act in a certain manner, and government in return refrains from enforcing the desired conduct" (Rennings *et al*., 1997, p. 246). Oftentimes, governments use the threat of regulation to create an incentive for corporations to make voluntary agreements. However, in the process of defining the agreement, the original desired change becomes diluted (Rennings *et al*., 1997). Another main disadvantage is the lack of transparency and public involvement in the formation of agreements, particularly because agreements are made much more quickly than legislation (Ryan and Turton, 2007).

Most voluntary agreements fall into three categories: 1) unilateral, 2) public agreements, or 3) negotiated agreements. In unilateral agreements, corporations initiate in the absence of government intervention and then communicate their goals to employees, customers, shareholders, and other stakeholders. Frequently, such agreements are made when abatement activities are profitable for firms, and the main purpose of them is to improve the public image of the firm (Ryan and Turton, 2007).

Alternatively, governments can request that firms meet environmental goals through public agreements, which are not mandated by legislation. Generally, these agreements are made when governmental agencies lack the authority to pass legislation to reach environmental goals.

Agreements are often accompanied by research and development subsidies and technical assistance (Ryan and Turton, 2007). Examples include the U.S. Climate Change Action Plan of 1993, which was comprised of several public agreements, such as Green Lights, Climate Wise, Motor Challenge, and Energy Star Buildings. Because these agreements have helped introduce cost-effective technologies that improve energy efficiency, they have been considered successful. Another national example is the Bush administration's pledge to decrease the ratio of GHG emissions to total economic output by 18 percent between 2002 and 2012 (Ryan and Turton, 2007). In addition to requesting corporations to decrease emissions, the administration provided firms with early reduction credits that they could use against future emission regulations. While not as stringent as potential legislation, these agreements may have helped reduce political opposition to future mandatory policies (Ryan and Turton, 2007). Finally, in negotiated agreements, commitments to reach environmental goals are agreed to by both parties. Such agreements are popular in transportation policy (Ryan and Turton, 2007).

Examples of such agreements support the concern that voluntary agreements are ineffectual. Following the United Framework Convention on Climate Change (UFCCC) in 1992, many European countries quickly adopted voluntary agreements to reduce GHG emissions. Chidiak (2002) presents a case study of two of the seven voluntary agreements to reduce GHG emissions adopted in France at the time. A French aluminum company and the packaging glass industry association both made agreements to reach specific emission targets. For these companies, public image and concurrent negotiations about other environmental regulations were significant motivations to make voluntary agreements. Chidiak (2002) argues that the targets in the agreements were not ambitious due to a "lack of policy co-ordination towards the related goals of energy efficiency improvement and GHG reduction, as well as from internal differences at the Ministry of the Environment, in charge of negotiating the voluntary agreements" (Chidiak, 2002, p. 122). As a result, the targets in the voluntary agreements did not require actions beyond those needed to generate profit and comply with existing environmental legislation (Chidiak, 2002). The companies did keep their commitments without enforcement, but it was likely because it was not necessary to change their "business as usual" operations. The aluminum company achieved its objective by 1997, but the glass industry did not due to greater than expected increases in production during the same period (Chidiak, 2002).

Rennings *et al.* (1997) performed a similar analysis of cases in voluntary agreements in 1991 and 1995 to reduce CO2 emissions and also concluded that agreements did not require action beyond "business as usual;" in addition, agreements did not set reference and target years, making it difficult to assess achievement of objectives (Rennings *et al*., 1997). These examples highlight the reasons for the general consensus that voluntary mechanisms are feasible policy instruments when political resistance prevents implementation of mandatory or regulatory mechanisms, but that otherwise they are not as effective as other types of policies.

Market-Based Policies

Market-based policies use incentives to encourage desired practices to reduce emissions without making explicit requirements to control emission levels (Portney, 2000). The main advantages of such an approach are that they are cost effective and create incentives for technological innovation. In theory, these types of policies are flexible in how industries meet environmental goals, and this flexibility allows them to achieve these goals at a lower cost to industry and

society. A common criticism of these policies, often made by environmental groups, is that progress towards environmental and public health goals may be hindered or never fully achieved (Portney, 2000). While they have not been used commonly in previous U.S. environmental policy, frustrations with the rigidity of command-and-control approaches and questions about the effectiveness of voluntary approaches have made market-based policies increasingly attractive to policymakers. This section discusses the various examples of market-based policies relevant to reducing GHG emissions.

Taxes and charges create fees or taxes for each unit of pollution generated. Passenger car taxes/charges are typically intended to increase revenue and have no environmental targets. Such taxes can be levied when vehicles are acquired or registered, periodically during ownership, or when fuel is purchased. Such a tax could either be increased or restructured to decrease the demand for passenger cars and induce GHG emission reductions. Taxes could be applied in the form of vehicle acquisition (registration taxes), circulation taxes for periodic ownership, or fuel taxes. One of the disadvantages of this approach is that it can be very politically difficult to determine the appropriate level for such taxes, particularly because GHG emissions are a global problem that transcends state and national borders. In addition, depending on the amount of the tax, drivers may decrease use, which could result in reduced tax revenues (Ryan and Turton, 2007). Congestion charges are an increasingly popular example that has been implemented in Stockholm and London and proposed for New York and San Francisco.

Tradable permits, or cap-and-trade systems, define an acceptable level of pollution and distributes the total amount among sources using permits. These can be divided into three categories: 1) downstream mechanisms, which target transport users; 2) midstream mechanisms, which target vehicle manufacturers and service providers; and 3) upstream mechanisms, which focus on fuel suppliers, including refineries, fuel trading companies, and importers (Ryan and Turton, 2007).

Examples include the leaded gas phase-down, water quality permit trading, chlorofluorocarbon trading, the sulfur dioxide allowance system, and the Regional Clean Air Incentives Market (RECLAIM) program in Los Angeles (Portney, 2000). In addition, the 1974 an 1977 CAA legislation included an emission trading program that awarded firms that reduced emissions below a set level credits that they could use against future higher emissions or trade with other sources within their firm or between firms. States have not been required to adopt the legislation, so participation has been limited, but one source estimated that the program has resulted in a savings of $5 to $12 billion (Portney, 2000). Some consider CO2 emission trading systems, which address all stages of the vehicle life cycle, to be the more effective than policies that focus on manufacturing alone (Ryan and Turton, 2007).

Market barrier reductions create markets, liability rules, and information programs to facilitate emission reductions. These policies include those to restructure electricity generation and transmission, legislation holding firms responsible for the environmental damages of their practices, and educational programs to provide consumers with information about goods with negative environmental impacts. An example is the Energy Policy and Conservation Act of 1975 that requires that producers place labels on certain appliances and equipment detailing their energy efficiency and costs (Portney, 2000).

Government subsidy reductions decrease or remove subsidies for products or services that are economically inefficient or environmentally unsound. For instance, fossil fuel energy subsidies,

which cost the U.S. Federal government $17 billion each year, could be reduced to decrease the purchase and use of such fuels (Portney, 2000).

Information, in the form of labels, allows consumers to incorporate emission and fuel consumption information into their purchasing decisions. Around the world, labeling has been used to provide information about the energy use of refrigerators, washing machines, dishwashers, and other domestic products. Seals of approval or grading systems can be used and are often easier to understand, but they also can bias consumers' decisions. In general, product information is most effective when the government is involved in the development of the label to increase customer confidence. The European labeling directive requires that member states create a guide with fuel consumption information for all vehicle models. In the U.S., the Department of Energy and the EPA are jointly responsible for www.fueleconomy.gov, which provides similar information. In addition, ARB maintains a list of low- and zero-emission vehicles on their website (Ryan and Turton, 2007).

As Table 2 (below) shows, numerous market-based GHG reduction policies have been implemented around the world.

Table 2 Market-Based Policies to Reduce GHG Emissions

Taxes and charges	Passenger car tax/charge	Policies
	Tax on vehicle acquisition	▪ European Union (EU): registration taxes ▪ Netherlands: reduced registration tax for fuel-efficient passenger cars ▪ Portugal: reduced registration tax for vehicles exclusively using liquefied petroleum gas or natural gas ▪ Japan: reduced taxes on fuel-efficient vehicles ▪ U.S.: tax reduction for new hybrid and electric vehicles
	Tax on vehicle ownership	▪ EU: most member states – periodic circulation tax ▪ United Kingdom (UK): CO2-based annual circulation tax ▪ Japan: reduced circulation tax for low-emission vehicles
	Taxes on fuel	▪ Belgium, Denmark, Finland, France, Italy, Luxembourg, the Netherlands, Norway, Sweden: carbon taxes ▪ UK: fuel tax elevator
	Tax reductions and credits for alternative fuels	▪ EU: member states allowed to decrease or abolish taxes on alternative fuels; many countries have excise duty exemption for biofuels ▪ U.S.: decreased tax on bioethanol fuel; E85 blends eligible for tax credit or reduction ▪ Australia: excise duty exemption on domestically produced biofuels
	Congestion charging	▪ Singapore: Electronic Road Pricing (ERP) ▪ Scandinavian cities (Trondheim, Oslo, Bergen): pricing reform ▪ London: pricing reform ▪ Stockholm: pricing reform
	Pay-as-you-drive insurance/fees	▪ Israel ▪ U.S. (Texas, Philadelphia, Oregon) ▪ The Netherlands ▪ South Africa ▪ UK
	Cap and trade	▪ Kyoto Protocol Emissions Trading Mechanism ▪ EU Emissions Trading Scheme ▪ Japan: Japan's Voluntary Emissions Trading Scheme 2006-7
Market barrier reductions		▪ U.S. Energy Policy and Conservation Act of 1975
Government subsidy reductions		▪ Fossil fuel energy subsidies in the U.S.
Information		▪ Japan: New Energy and Industrial Technology Development Organization (NEDO) created the 'CEV Eco Delivery Label' for goods delivered in a clean energy vehicle ▪ EU: European Directive on labeling in 1999—for fuel economy, CO2 emissions, car dealerships

While market-based policies are increasingly popular, they have faced resistance from environmental groups, which has raised concerns that such policies will sacrifice environmental protection for cost savings and efficiency. In addition, industries have not strongly promoted them because they are hesitant to support any potential regulation, even if it is more cost effective or flexible than command-and-control approaches. Finally, public resistance also has made such policies less common; while prices increase due to command-and-control policies, it is difficult for the public to associate price increases directly with such policies. Nevertheless, an advantage of market-based policies is that they make environmental costs somewhat more transparent (Portney, 2000).

Policy Approaches Recommended By LUSCAT

LUSCAT recommends both market-based and voluntary policies. Their voluntary policy recommendation is to use incentives to promote the protection of natural resources and agricultural land. In addition, they recommend market-based approaches including parking pricing, parking maxima/caps, shared parking, unbundled parking costs, parking cash out, and employer outreach to change parking policies. They also recommend exploring tax incentives to reduce GHG emissions, such as tax incentives for employers providing public transit benefits to employees (LUSCAT, 2008).

Evaluation of Policy Instruments

Ryan and Turton (2007) define the following as tools to evaluate different policy instruments: 1) static economic efficiency (e.g., minimum cost), 2) dynamic economic efficiency (e.g., continuing incentives to improve technology), 3) equitable distribution, 4) administrative and political feasibility, and 5) environmental effectiveness (Ryan and Turton, 2007). Not surprisingly, the way a policy instrument is designed affects its effectiveness more than the choice of the instrument itself.

There are certain challenges that are relevant to all of the policies discussed above. GHGs are a global problem that cannot only be solved locally – the cooperation of many countries is necessary to reduce GHG emissions. In addition, the consequences of GHG emissions on climate change are difficult to notice in the short run, making public acceptability lower than for other types of emissions and environmental pollutants. Finally, cars are a major non-point source of emissions; many individuals drive vehicles, and cars have a long-life cycle, making it unlikely that grandfathering and phase-in approaches will have any impact in the near future (Ryan and Turton, 2007).

POLICY MECHANISMS

Policies to reduce emissions generally employ two mechanisms: 1) emission targets and 2) emission trading. Emission targets can be implemented on their own, often through a regulatory or voluntary policy. However, they also can serve as the “cap” in cap-and-trade systems. This section discusses the multiple types of targets, cap-and-trade systems and their advantages and disadvantages, and offsets. First, examples of cap-and-trade from the European Union and the

U.S. are examined. Second, offset literature is presented—largely from forestry. Next, the authors discuss potential policy mechanisms and barriers to reducing GHG emissions with a specific focus on pre-existing legislation in California that could affect AB 32 policies. These include the California Environmental Quality Act (CEQA), Regional Housing Needs Allocation (RHNA), Indirect Source Rules (ISR), and Local Agency Formation Committees (LAFCos). This section closes with a description of LUSCAT recommendations relevant to possible policy mechanisms and implementation barriers.

Emission Targets

Targets of any kind can be implemented at the firm, sector, national, or international level. In theory, targets should be chosen to achieve the greatest difference in GHG emissions from those based on business-as-usual projections (Strachan, 2007). There are several variations in the type of target that could achieve such goals depending on the state of the economy. The most straightforward form of emission reductions are absolute emission targets or "caps," which specify the total amount of reductions that are recommended or mandated to decrease emissions relative to an historical baseline. The classic example of a policy with emission targets is the Kyoto Protocol. In the original negotiations in 1997, the Protocol proposed that developed countries reduce their annual emissions by about five percent on average during 2008-2012 (or back to 1990 emission levels).

Internationally, a major challenge to using emission targets has been that for countries that are experiencing rapid economic growth, particularly developing countries, emission reduction requirements can be so costly that they impede growth. Another disadvantage is that it is difficult to estimate the baseline scenario upon which to base future success. Achievement of fixed emission targets is much easier when economic growth is lower than when it is proceeding rapidly (Herzog *et al.,* 2006). In addition, the cost of implementing such targets could vary greatly depending on the economic conditions at the time.

Intensity Targets

One potential solution to the threat of economic disadvantage is to use intensity targets. In contrast to an absolute target, intensity targets define emission reductions in relation to productivity or economic output (e.g., tons of CO2 per million dollars of gross domestic product (GDP)). Intensity indicators are a factor of both the quantity of energy used per unit of GDP and the carbon content of the energy in use (Herzog *et al*., 2006). An example of such standards is the I standards, which created minimum vehicle performance levels for the number of miles driven per gas gallon (Herzog *et al*., 2006). Such intensity targets can take on a wide variety of forms, including linear formulas between GHG and economic output as well as more complex forms.

An advantage of intensity targets is that they can adjust to economic changes and do not penalize fast economic growth; for this reason, they are seen as preferable for developing countries. Additionally, intensity targets do not necessarily imply a declining rate of emissions as absolute targets do (Pizer, 2005). Such flexibility may ease the process of adopting new environmental policies for industry. While it may seem as if intensity targets are less stringent than absolute

targets in terms of their environmental impacts, if economic growth is greater than expected, emission reductions may be higher and even surpass reductions under absolute targets, assuming full compliance (Herzog *et al*., 2006). Finally, intensity targets remove the need for baseline estimation, which can be difficult; a performance rate is the goal rather than a total emissions amount compared to a previous time period (Strachan, 2007). However, a major disadvantage is that it is not possible to predict the amount of future emission reductions under intensity targets because it depends on economic output. In addition, it is generally concluded that public understanding of intensity targets is lower than absolute targets because they are more difficult to communicate. Misunderstandings can obstruct effective policy implementation. Generally, intensity targets and absolute targets are not correlated, but both can effectively achieve environmental goals if targets are set with enough stringency so that they are met (Herzog *et al*., 2006).

Both developed and developing countries have proposed or experimented with intensity targets. After withdrawing from the Kyoto Protocol in 2001, the Bush Administration created a climate policy in 2002 that set goals to decrease GHG emissions intensity in the U.S. by 18 percent by 2012 (Herzog *et al*., 2006). A common criticism of this policy is that emission intensity tends to decrease over time in major economies regardless of intensity policies; such "natural" decreases are a result of economic incentives to improve efficiency (Herzog *et al*., 2006). The emission intensity was forecasted to decrease by 14 percent with no intensity policy, making the Bush Administration's policy only require an additional four percent decrease in emission intensity (Strachan, 2007). Nevertheless, it was claimed that only a four percent decrease would yield a savings of an additional 106 million tons of carbon by 2012 (Strachan, 2007). Kolstad criticizes the Bush policy for failing to stipulate mechanisms to actually achieve such reductions. He states that reducing GHG emissions intensity requires a change in the structure of production away from industries that heavily emit GHGs and adopting proactive reduction measures, such as reducing VMT (Kolstad, 2005).

Argentina implemented an intensity target in the hopes that other countries that signed the Kyoto Protocol would do so as well. At first, the target was voluntary, but it was intended to become legally binding if taken on by the Climate Convention (Herzog *et al*., 2006). The intensity target was adjusted by the square root of Argentina's GDP. The plan was eventually abandoned because other developing countries did not adopt similar policies, and there was no opportunity to adopt the policy under the Kyoto Protocol (Herzog *et al*., 2006). In the United Kingdom (UK), the Climate Change Levy Agreements (CCLA) included intensity targets for energy-intense industrial sectors. Industries were given an 80 percent rebate on levies if they adopted targets, with the choice of GHG emission reduction targets, energy use targets, or intensity targets (Herzog *et al*., 2006). Firms also could choose to participate in the UK Emissions Trading Scheme (ETS) before 2007.

Cap-and-Trade Systems

The most well-known and common market-based mechanism to decrease GHG emissions is cap and trade. Under a cap-and-trade system, a central authority, such as a governmental agency, sets a cap for the maximum amount of GHGs that may be emitted. GHG emitters, such as companies, are allocated a certain fixed amount of permits and must also hold an equivalent number of credits that represent the amount to which they are allowed to emit. Companies and other entities

holding permits must emit under the amount set by the cap. If they emit greater than that amount, they must purchase or trade credits from other entities that emit fewer GHGs. Permit buyers pay for the excess GHGs they emit, and permit sellers are rewarded for emitting the amount under the cap. Cap-and-trade mechanisms are increasingly popular because they can potentially result in lower economic costs and allow firms greater flexibility than command-and-control measures. However, some environmental groups argue that they do not result in the same environmental performance as more stringent, traditional measures. Ellerman (2003) argues that pre-existing cap-and-trade initiatives demonstrate that cap-and-trade programs are more environmentally effective and economically efficient than regulatory approaches (Ellerman, 2003).

The allocation of allowances in cap-and-trade systems is usually the most challenging yet important component. Essentially, the way in which allocations are made and the magnitude of allocations determines the significance of the entire system, including its environmental effectiveness and political feasibility (Grubb *et al*., 2005). The three types of allocation are: 1) grandfathering, 2) benchmarking, and 3) auctioning of permits. The grandfathering scheme has been used the most frequently to date because it is the most politically palatable. A central authority determines the volume and distribution of permits, which is often subject to heavy lobbying from relevant industries. Permits are often distributed for free and are made according to each participating entity's historical emissions. Thus, the entities that have emitted the greatest amounts in the past receive the greatest number of permits to emit in the future. Such an approach is commonly criticized for creating market distortions. Companies that receive a larger number of permits may pass on the marginal cost of emissions to consumers, generating additional, or "windfall" profits (Betz *et al*., 2006).

In contrast, benchmarking determines the allocation using specific emission values per production unit for groups of products or corporations (Betz *et al*., 2006). Allowances are determined by multiplying benchmarks by past or projected emission rates for individual entities (Betz *et al*., 2006). There are three main ways that benchmarks can be calculated: 1) average benchmarks are calculated using the average of emission values weighted for the activity by group, using the average technology installed; 2) benchmarks could be based on the best technology available; and 3) benchmarks also can apply uniformly across all participating entities in a group (Betz *et al*., 2006). Most benchmarks are average benchmarks that assume average technology. In comparison to conventional grandfathering approaches, benchmarking is often considered to be more fair and efficient. An advantage of benchmarking is that it would allow for comparison across participating countries or states and would allow for streamlined and harmonized allocation between countries and states. However, for such an allocation approach to be effective, a large amount of data must be collected and analyzed.

In addition to benchmarking, from an economic perspective, auctioning permits is considered preferable to conventional grandfathering allocation because it prevents market distortions (Betz *et al*., 2006). Competitive bidding under such a system would allow permits to be sold at their market price. In addition, they are considered to be more equitable because "the polluter pays" principle would be in effect (Betz *et al.*, 2006). Governments can use revenues generated from auctions to decrease other market distortions (Grubb *et al*., 2005). The disadvantage of auctioning is that firms that are in international markets would face adverse impacts on their competitiveness. Although some analyses have concluded that concerns about competitiveness are exaggerated, mixed allocation methods are often the most realistic (Grubb *et al*., 2005).

Most emission caps are absolute targets based on historical, current, or projected future emissions, but recently relative targets have been explored as an alternative (Gielen *et al*., 2002). The UK has implemented trading schemes using flexible targets, and the Netherlands has proposed their use (Gielen *et al*., 2002). Relative targets are often considered to be easier to combine with existing policies and are more politically feasible. According to Gielen *et al.* (2002), cap-and-trade systems with relative caps are less economically efficient and involve greater uncertainty than those with absolute caps. Another disadvantage is that relative caps implicitly must be grandfathered and cannot be auctioned. As a result, no additional revenue can be raised, which can be used to adjust for distortions in taxation and monitoring costs (Gielen *et al*., 2002).

Cap and Trade Under the Kyoto Protocol

The Kyoto Protocol contains three "flexibility mechanisms" that are designed to decrease the total cost of reaching emission targets. These mechanisms recognize that the cost of reducing emissions varies greatly by region. They include the Clean Development Mechanism (CDM), Joint Implementation (JI), and Emissions Trading (ET). The CDM allows for developed countries (Annex I Parties) to conduct GHG emission reduction or carbon absorption activities in developing countries (non-Annex I Parties). Essentially, it provides the developing world with a subsidy to achieve decreased GHG emissions (Wara, 2006). The Joint Implementation mechanism allows developed countries to conduct emission reduction projects in other developed countries but use the reduction to meet its Kyoto target. Finally, the Kyoto Protocol specifies an Emissions Trading mechanism, which allows developed countries to trade units of emission allowances with each other. The CDM and JI mechanism differ from Emissions Trading in that they do not require participating entities to purchase permits if they do not decrease emissions. Rather, on a project basis, a baseline is set based on business-as-usual, and reductions below the baseline generate credits. While these credits may be purchased by other entities, there is no obligation to purchase them. On the other hand, ET does mandate the purchase of permits if emissions exceed targets (Wara, 2006).

European Union Emissions Trading Scheme (ETS)

By far the most developed and largest cap-and-trade system focusing on CO2 at the company level is the European Union Emissions Trading Scheme (ETS), which is now a major influence in the growing global carbon market. The system was designed to allow companies in EU Member States to allocate permits in their own country and trade them across the EU to meet Kyoto Protocol emission reduction goals at a cost of under 0.1 percent of GDP. The EU has set a goal to reduce emissions to 30 percent under 1990 levels by 2020, as long as other developed countries commit to similar reductions during the period after 2012. Phase I lasted from 2005 to 2007 and focused on large emitters of CO2 in the power and heat generation industries as well as other energy-intensive industrial sectors. In the ETS, an allowance equals the tradable right to emit one ton of CO2. Permits determine requirements for monitoring and reporting of emissions for each participating company or "installation." These allowances are held in electronic registries in each Member State. Several organized exchanges have been created in Europe to allow for permit trading, and the price of permits for sale or trade is determined by supply and

demand. In the first year of the ETS, over 270 million permits worth €5 billion were traded, and in the second year, 800 million permits were traded (European Commission, 2007). In response to the growth of this carbon market, traders, financial specialists, management specialists, auditors, and verifiers all focusing on carbon have emerged.

The European Commission has designed a mandatory emission monitoring and reporting process to maximize compliance to the ETS. At the end of each calendar year, installations are required to surrender the amount of allowances that equals their verified CO2 emissions in that year. Independent verifiers must check installations' reports to ensure that they meet the criteria specified by ETS legislation. To prevent re-use of allowances, they are then cancelled, and installations with left over allowances may sell or save them. The penalty for emitting more than allowances permit was €40 per ton emitted from 2005 to 2007, and this has increased to €100 as of 2008 (European Commission, 2007).

Member States are responsible for designing national allocation plans (NAPs), and currently most plans distribute allocations free of charge based on historical emissions (grandfathering). Although the European Commission has the ability to challenge NAPs under certain conditions, to date most NAPs have been solely created by the Member States. In Phase I in 2005, most allocations allowed for emissions over the amount already emitted and equivalent to business-as-usual projections (Grubb *et al*., 2005). Across all Member States, the increase in allocation ranged from three to five percent, even though the Kyoto Protocol goals would imply a decrease of three percent by 2006 (Grubb *et al*., 2005). Permit allocations that do not challenge installations to reduce emissions could threaten the ETS' stability and "undermine the market-based nature of the Kyoto Protocol and [. . .] the international cohesion behind it" (Grubb *et al*., 2005, p. 133). In addition, there was perceived a differential permit allocation among Member States, which caused industries to become concerned about a "competitive race-to-the-bottom" in determining allocations (Grubb et al., 2005, p. 136).

The cap-and-trade literature reports similar challenges in the allocation of permits in Phase II of the ETS. Generally, the Member States used the same allocation methods in Phase II as in Phase I. Averaging across Member States, the total amount of permits in each period, or the emission budget, for Phase II is only 2.6 percent lower than the historical emissions in 2005 and 3.1 percent lower than Phase I budgets (Betz *et al*., 2006). There has been minimal progress in implementing consistent and harmonized rules across Member States, partly because of the use of such allocation policies (Betz *et al*., 2006). Thus, there is still great room for improvement in environmental effectiveness and economic efficiency in permit allocation in the ETS (Betz *et al*., 2006).

In the U.S., six different types of emission trading systems were used by 1998, and their performance has been mixed (Solomon, 1999). These included two intra-state airsheds, two national systems, one international system, and one watershed (Solomon, 1999). The two most well known examples of these are the Sulfur Allowance and Trading (SAT) program and the Regional Clean Air Incentives Market (RECLAIM) program in southern California. The strengths and weaknesses of each program provide important lessons for future cap-and-trade programs to be implemented in the U.S.

The Sulfur Allowance Trading (SAT) Program

The SAT program was created during the Clean Air Act amendments of 1990, the goal being to minimize and reduce damages from sulfur dioxide (SO2) emissions. The program resulted from ten years of political debate between politicians and environmental groups about regulatory versus market-based policy approaches (Schwarze *et al*., 2000). The goal of SAT was to reduce emissions by 50 percent. Permits were issued to emitters of SO2, which were mainly stationary sources, such as power plants, and permit holders were allowed to emit one ton of SO2 per year. Bonus allowances were given to participating entities that switched to renewable energy sources, used advanced clean coal technology, or conducted early emission reduction efforts. An accurate and expensive system was developed to evaluate emissions from participating sources (Schwarze *et al*., 2000). Between 1995 and 1999, under 15 percent of sources were mandated, but from 2000 on, all utilities were included in the program. The staggered implementation schedule provided regions that had the highest compliance costs more flexibility in adjusting to the policy change. Each year, the average annual emissions are standardized to the economic output over a three-year period.

The policy required individual sources to report to the U.S. EPA about the extent of emissions, and the EPA reported an emission inventory to the public. However, besides allocating and tracking allowances, issuing permits, and serving as a monitoring and enforcement agent, the EPA's and state air agencies' roles were intended to be minimal (Solomon, 1999). After a slow start, a private market developed successfully (Solomon, 1999). The public was involved through the Acid Rain Advisory Committee, which contained representatives of utility, coal, natural gas industries, environmental organizations, consumer interest groups, and academia. The public also could participate in the process by purchasing permits at auctions; environmental and student groups purchased "allowance retirements," which held symbolic value and provided concerned individuals with the opportunity to pay for a better environment and in theory limit the number of permits available to firms to purchase if they exceeded emission caps (Schwartz *et al*., 2000). This program is generally considered to be the most successful trading program because of its low transaction costs and lack of monitoring difficulties (Solomon, 1999). In addition, a large decrease in emissions was experienced relatively quickly, and there were no exemptions, exceptions, or relaxations of the original requirements (Ellerman, 2003). It was initially feared hot spots in which emissions greatly exceeded caps would develop; however, these never appeared (Ellerman, 2003). Nevertheless, trading levels and cost savings of the SAT program have been modest (Solomon, 1999).

The RECLAIM Program

Another well-known cap-and-trade example designed after the SAT initiative is the RECLAIM program in the South Coast Air Quality Management District (Solomon, 1999). The goal was to create a policy that would allow the regional air shed to comply with ambient ozone and particulate matter standards after over two decades of non-compliance. In contrast with the SAT program, the policy resulted from fewer than five years of debate (Schwarze *et al*., 2000). After so many years of failure, it was clear that proceeding with command-and-control programs would have been too costly and politically impractical (Ellerman, 2003). The program aimed to reduce NOX emissions by 75 percent and sulfur oxide (SOX) emissions by 60 percent. The

program engaged 10 percent of NOX and SOX sources in the area; most emissions were due to small stationary and mobile sources (Schwarze *et al*., 2000).

Because of the mixed nature of the pollutants, there were two zones with limited direction in which permits could be bought and sold, and no inter-temporal trading was allowed. These rules were designed to prevent hot spots in the zones where it was most difficult to decrease emissions. The most accurate technology for emission evaluation was only mandated for two thirds of participating facilities, and reporting requirements were the same as for SAT (Schwarze *et al*., 2000). The baseline was set based on the maximum annual emissions for each participating entity over a four-year historic period. In 2001, both NOX and SOX emissions were reduced by approximately 40 percent from 1994 levels; when the program was fully phased-in in 2003, the reduction over pre-program emission levels was estimated to be 50 percent (Ellerman, 2003). Each year since the program started, the SOX cap has been met, but NOX emissions exceeded the cap in 2000 and 2001 due to the electricity market problems in California at that time (Ellerman, 2003).

Schwarze *et al.* (2000) compare and contrast the SAT and RECLAIM programs. Both programs included demanding environmental targets that would have required very costly programs to achieve reductions, if not through a market-based approach. Conflicts about how to distribute permits arose in both programs; SAT experienced regional conflicts about whether or not to grandfather permits or adopt them immediately, and RECLAIM experienced tensions between environmental growth and protection. In the end, both used grandfathering, which provided historical emitters with free permits during the initial allocation and provided newcomers with special access. In each program, some permits were traded for political instead of economic reasons. The tracking of permit ownership and transactions was similar for both programs. Finally, both programs employ absolute and historical baselines (Schwarze *et al*., 2000).

Adapting Cap and Trade to the Transportation Sector

Most market-based mechanisms involving cap and trade have involved stationary emitters (Millard-Ball, 2008). Cap-and-trade systems that focus on transportation have the potential to lead to enormous GHG emission reductions as well (Millard-Ball, 2008). There are four main approaches to cap-and-trade systems for the transportation sector. First, **upstream trading** would target refineries or importers of fuels. These entities would hold permits that limit the total amount of carbon content and output from all of their products and processes. The challenge to such approach would be determining how refineries could decrease emissions; one of their only options may be to decrease the carbon composition of gas by adding ethanol or other substances (Millard-Ball, 2008). Refiners would likely pass on the costs of such a system to the price of fuel, which would potentially affect consumers' choices of fuel and vehicle type. However, the overall impact would be small because vehicle travel has inelastic demand. In addition, there would be minimal to no benefits for congestion and air quality improvements. Nevertheless, this form of cap and trade for transportation is the most popular among analysts, partly because it allows for broad coverage and has minimal administrative costs (Millard-Ball, 2008; Winkelman *et al*., 2000). In addition, such a system would be most effective when implemented in tandem with carbon-efficiency standards (Millard-Ball, 2008).

Next, **downstream trading** would target individual motorists who would receive a free allowance of permits initially and could purchase additional permits later. Such permits could be held on a smartcard, at fuel pumps, or through banks. The cap would be for the amount of fuel consumers could use in a given time period. Alternatively, the number of cars, VMT, or parking spaces could be capped, and permits for each item could be traded between individuals.

Vehicle manufacturers could also be targeted in a cap-and-trade program. While they are not directly in the chain of fuel supply, manufacturers influence the fuel efficiency of the vehicles in the market. Manufacturers would purchase permits for emissions attributed to their vehicles. Such a system would require the accurate setting of imputed emissions from different vehicles. It would have to be determined whether manufacturers would be responsible for the emissions of all the vehicles on the road or the lifetime emissions from all new vehicle sales. The advantage of this approach is that it avoids changing fuel prices, which is politically sensitive, has low administrative costs since there are few manufacturers, and would affect the type of fuel and vehicle purchases. The California Climate Action Team considers this approach to be the most practical method of including the transportation sector in cap-and-trade systems. It is estimated that such a system could decrease emissions by 25 to 38 percent over a 15-year period (Millard-Ball, 2008).

Finally, a **hybrid system** could be used that divides responsibility between vehicle manufacturers and fuel producers. Such a system would both improve the carbon content of fuel and the fuel efficiency of vehicles. Such a system would be complex both politically and administratively because of the numerous players involved (Winkelman *et al*., 2000). Although such a system would not directly affect land use and transportation infrastructure, a portion of revenue from carbon allowance auctions could be allocated for such activities (Winkelman *et al*., 2000).

Millard-Ball (2008) proposes a new type of trading system called the "municipal mobility manager" in which municipalities buy allowances in the same amount as the emissions they manage. The program would include emissions from urban transport and potentially residential and commercial buildings too. Incentives would be created to encourage managers to reduce emissions. The idea is that the differences in emissions due to land use, transportation investments, and related policies would lead to differential emission levels across municipalities. A trading system focusing on municipality managers would inherently encourage long-term planning, such as land use planning, which is difficult for other cap-and-trade systems to affect. The price signals from carbon trading between municipalities would likely cause managers to create less carbon intensive programs and policies.

The program could either be implemented at the municipality level or at the regional level through Metropolitan Planning Organizations (MPOs), which have more control over large investment decisions. It would have to be determined whether municipalities would be responsible for emissions from all of their residents' trips, for all vehicle travel on municipal streets, or for emissions from trips ending in their jurisdiction. Using the latter method would decrease incentives to reduce through traffic. In addition, VMT would need to be calculated accurately, either based on VMT and speeds or using a representative sample of roads that represented the vehicle fleet composition of the region. A disadvantage of this system is that policies and plans made in the past, such as land use policies, would affect current emissions but could not be reversed, making the system potentially inequitable and politically difficult to

implement. To avoid such inequity, fees could be levied on new development that account for the estimated future emissions; alternatively, counties could receive additional permits annually depending on population changes (Millard-Ball, 2008).

Current U.S. Legislation on Emission Targets and Cap and Trade

In 2007, four senate bills (i.e., Sanders-Boxer, Kerry-Snowe, McCain-Lieberman, and Bingaman-Specter) were proposed to create mandatory GHG emission caps across the economy, and one (Feinstein-Carper) was proposed to create a cap for the electricity sector. All of the bills mandate such caps, and some also mandate or recommend cap-and-trade permit systems for CO2. In addition, all of the bills apply these mandates to all six GHGs: CO2, CH4, N2O, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride (Kopp and Pizer, 2007). Some bills recommend upstream regulations, which apply to refiners and importers of petroleum, whereas downstream regulations target electric utilities, power generators, and other sources.

Table 3 presents these four bills and compares their regulation level, permit allocation, and emission targets.

Table 3 Proposed Legislation Related to GHG Emissions Targets

	Sanders-Boxer	Kerry-Snowe	McCain-Lieberman	Bingaman-Specter	Feinstein-Carper
Level of Regulation	EPA decides	EPA decides	Downstream: Electric utilities and large sources; Upstream: petroleum importer and refiner	Upstream: all sources	Downstream: electric power generators
2020 Emission Reduction Targets	42.0 percent	42.0 percent	39.0 percent	25.0 percent	7.6 percent
2030 Emission Reduction Targets	63.0 percent	61.0 percent	59.0 percent	45.0 percent	21.9 percent
Permit Allocation	EPA decides	EPA decides	EPA decides	Initial auction of 10 percent of permits; gradual increase to 65 percent	Auction of 15 percent of permits in 2011, gradual increase to 100 percent in 2036

Source: Kopp and Pizer, 2007

LUSCAT's Recommendations on Targets and Cap and Trade

LUSCAT recommends that ARB define GHG emission reduction targets specific to transportation and land use sectors at the State and regional level. Creating targets at these levels will "most effectively balance the needs of population growth, housing, resource protection, and integrated transportation infrastructure" (LUSCAT, 2008, p. 53). In addition, MPOs and Regional Transportation Planning Associations (RTPAs) already estimate transportation activity and emissions regionally. The targets should be designed to meet both 2020 and 2050 goals, as outlined in Governor Schwarzenegger's Executive Order S-3-05. LUSCAT recommends the use of the best available modeling techniques for transportation and land use emissions to set the target levels. Once the target is set, the State should provide local governments with a GHG quantification protocol and guidance on best practices. ARB should regularly track measurements of transportation and land use GHG emissions in State inventories. LUSCAT does not further specify the type of target to be used—absolute versus intensity.

In addition, LUSCAT recommends using a cap-and-trade market auction system and earmarking part of the proceeds for compact development, brownfield development, and improvements to existing infrastructure; protection of working and natural landscapes with high sequestration value; and investments in urban forestry, urban parks, and urban farming programs (LUSCAT, 2008). They do not specify how such a system would be implemented.

Offsets

In December 1997, the Kyoto Protocol was created and approved by the Conference of Parties to the United Nations Framework Convention on Climate Change (UNFCCC). Under this protocol, 39 industrialized (Annex I) nations and developing (non-Annex I) nations are obligated to reduce their GHG emissions by about five percent below the 1990 levels by the end of the first time period (2008 to 2012) (Bloomfield and Pearson, 2000; Moura-Costa, 2001; Osborne and Kiker, 2005). These countries can fulfill their commitment through carbon offsets, whereby Annex I countries purchase carbon credits from non-Annex I countries by investing in their GHG emission reduction projects (Bloomfield and Pearson, 2000; Osborne and Kiker, 2005).

"A carbon offset negates or 'neutralizes' a ton of CO2e (carbon dioxide equivalent) emitted in one place by avoiding the release of a ton of CO2e elsewhere or absorbing/sequestering a ton of CO2e that would have otherwise remained in the atmosphere. It can also offset other greenhouse gases such as methane and hydrofluorocarbons" (Taiyab, 2006). For a project to be considered a real carbon offset it must have 'additionality,' meaning that the emission reductions in the project must be beyond what would have taken place in a 'business as usual' situation (Chomitz, 1999; Moura-Costa, 2001; Tucker, 2001; Taiyab, 2006). Companies, organizations, or individuals can offset their GHG emissions either through a compliance or voluntary reduction regime. Compliance groups are comprised of companies and organizations that are required by law and regulated to reduce their GHG emissions (Taiyab, 2006; de Steiguer, 2008). Voluntary reduction groups are mostly comprised of private organizations and individuals who "simply want to reduce their 'carbon footprint,' not by law, but to promote a carbon-neutral lifestyle" (de Steiguer, 2008).

The groups in both the compliance and voluntary markets can reduce their GHG emissions by investing in two main types of projects: 1) land use and 2) energy (Cutright, 1996). Land use involves: 1) "protecting existing forests or afforestation (avoidance of deforestation)" (Brown and Adger, 1994); and 2) "carbon sequestration underground or in soils and forests (the storage of carbon in the soil, trees, plantations, etc.)" (Taiyab, 2006); and 3) the "disposal of animal waste and methane" (de Steiguer, 2008). Energy projects involve "renewable energy, energy efficiency, destruction of various industrial gases," (Taiyab, 2006) and fuel switching (Cutright, 1996).

Some researchers believe land use change and forestry (LUCF) projects are seen as less credible than energy projects. Some reasons given are: "(1) It is impossible to guarantee that the trees will not be burned or otherwise destroyed at some point in the future, thus releasing the carbon dioxide back into the atmosphere, (2) Forestry projects will distract attention from the real problem, which is the world's fossil-fuel based energy system, (3) Difficulty in accurately measuring carbon sequestration from trees, (4) Negative environmental effects and displacement of local populations that have been caused by large mono-culture plantation projects in the past and, (5) Some providers are selling their offsets from tree planting projects that were already subsidized by government grants, and therefore it's additionality is questionable" (Taiyab, 2006). However, Chomitz (1999) believes that LUCF and energy projects cannot be compared, and therefore, energy projects cannot be considered superior. Interestingly, Chomitz also mentions that LUCF projects hold the distinction of being at "risk [for] accidentally or deliberately reversing the carbon sequestration" (1999). Also, LUCF projects, specifically agricultural and forestry (AF) technologies, tend to have a finite life because truly permanent sequestration is not likely (Wilman and Mahendrarajah, 2002), which is why energy projects, such as fuel switching and energy efficiency improvements, are so important (McCarl and Sands, 2007).

Finally, offsets are discussed as an additional measure under consideration for AB 32 implementation in ARB's Draft Scoping Plan (see Draft Scoping Plan synopsis below), as well in the ETAAC report. According to ETAAC, "Offsets allow a capped entity to claim credit or emissions reductions achieved outside of the cap and trade system….ETACC agrees that a standards-based approach to offsets is preferable to case-by-case review since this approach reduces transaction costs as well as increases predictability, both of which encourage early action, innovation, and clear price signals" (ETAAC, 2008, p. 9-5). Further, ETAAC suggests that offsets can play a key role in a voluntary market, particularly if a California Carbon Trust is established. The Carbon Trust would allocate incentive funds generated from allowance revenues to encourage GHG reductions inside and outside of the cap. This Trust could act as a buyer in a voluntary market and generate additional capital in the market. Offset limits may be advisable to encourage progress in particular segments. Limits, however, could increase cap-and-trade compliance costs and should be used cautiously depending upon the sector (ETACC, 2008).

Potential Barriers to AB 32 Land Use and Transportation Policy Implementation and SB 375

Several existing California policies that promote environmental protection could pose potential barriers to the implementation of AB 32 policies. These include the California Environmental Quality Act (CEQA), the Regional Housing Needs Allocation (RHNA), Local Agency

Formation Committees (LAFCos), and potentially Indirect Source Rules (ISRs). However, Senate Bill (SB) 375, which mandates "sustainable growth" plans, promises to address the CEQA and RHNA barriers. Governor Schwarzenegger signed SB 375 on September 30, 2008. It is described in more detail below, following a discussion of CEQA, RHNA, LAFCos, and ISRs.

California Environmental Quality Act (CEQA)

CEQA requirements to evaluate environmental impacts of all proposed projects impose an additional step upon developers that may slow the process of sustainable development. In addition, the RHNA policy requires a level of investigation that could potentially slow the process of sustainable development. This section discusses the potential impact of both policy measures upon AB 32 policies as well SB 375, which is expected to curb the effects of the pre-existing legislation for AB 32.

It has been posited that CEQA both presents a risk and a potential benefit to GHG emission reduction efforts. It seems counterintuitive that legislation intended to protect the environment could hamper GHG reductions. The goal of CEQA is to make environmental considerations central to State and local agency decisions. Any project proposed by the State or local agency that could potentially have environmental effects must be evaluated for such impacts, and the agency must report any potentially adverse environmental effects, identify possible measures to reduce such adverse effects, and must adopt such measures if they can feasibly reduce negative environmental effects. Once the project is implemented, the agency that proposed it is required to monitor its environmental impacts. There is no central agency that oversees the whole process; rather, compliance is generally assessed through discretionary initiatives run by professional non-profits, citizens' groups, and State or local government. CEQA's strength is that it has broad coverage and allows for feasible and flexible compliance; however, the cost in dollars and time of compliance usually greatly exceeds the benefits received by the agency. To date, the California courts have enforced CEQA rigorously and have highlighted the need for analysis of cumulative impacts (Owen, forthcoming). However, the intersection between GHG emissions and CEQA is new enough that there have been no published legal decisions on how agencies should comply with both (Owen, forthcoming).

GHGs that cause climate change are a perfect example of a cumulative environmental impact; despite the difficulty in precisely measuring such cumulative impacts, CEQA requires such an evaluation. AB 32 and CEQA have drastically different legal structures. AB 32 is a centralized policy in which the ARB delegates responsibility to single agencies, while CEQA is highly decentralized with ad hoc and unorganized monitoring and enforcement. From a legal perspective, Owen (forthcoming) argues that usually centralized policies like AB 32 fail to be completely comprehensive, so CEQA's structure can strengthen AB 32 by reaching any areas that AB 32 does not cover. Owen also argues that the flexibility in mitigation measures under CEQA could encourage innovation management at a low cost (Owen, forthcoming).

The idea that CEQA can increase the effectiveness of AB 32 is not espoused by many, however; most members of the environmental policy field argue that CEQA's requirements are too lengthy, complex, and costly and thus hinder sustainable development. In particular, its administration by local agencies can lead to densities that are lower than planned (ULI, 2002). The Urban Land Institute (2002) criticizes CEQA for containing numerous redundancies that

cause delays and increase development costs (ULI, 2002). In addition, it is often claimed that simply conducting obligatory assessment studies does not guarantee environmental improvements (Owen, forthcoming). In particular, AB 32's emphasis on brownfield development could be particularly hindered by CEQA. AB 32 encourages rapid development of such areas, and while already difficult to attract investors to develop such areas, CEQA's requirements make development even less likely (ULI, 2002).

Recently, Attorney General Jerry Brown has brought attention to CEQA by warning that he will crack down on CEQA reviews that do not incorporate GHGs. He has placed pressure upon cities and counties experiencing rapid growth, such as Sacramento and Yuba, to act immediately to mitigate climate change by assessing the environmental effects of proposed development and transportation plans. Between April 2006 and July 2007, he wrote 14 letters to counties and cities demanding that they calculate GHG emissions for their region and take action to curb emissions (Bowman, 2007).

In April 2007, the attorney general's office sued San Bernardino County for failing to completely evaluate and report the potential effects of its general plan upon global warming and for failing to adopt policies and programs that mitigate GHG emissions. The lawsuit was settled in August 2007. The settlement requires that the county: 1) create an inventory of GHG sources that are known or "reasonably discoverable" in the county; 2) develop a GHG inventory for 1990, 2007, and 2020 projects; and 3) develop an emission reduction target attributable to land use decisions and internal government operations in the county (Sacramento Bee, 2007). Considering that San Bernardino is the largest county by land area in the country, even minimal decreases of its carbon footprint could reduce emissions by 10 percent by 2020. Thus, San Bernardino could become a leader in setting targets and adopting policies that reduce GHG emissions at the county level.

While San Bernardino County seems to be pleased with the settlement, Brown's efforts have been met with resistance from counties, legislators, and developers, many of who are concerned that he is against growth (Bowman, 2007). Some have responded by preemptively incorporating GHGs into their CEQA reviews, while others have continued current review processes. Despite this resistance, it is possible that the lawsuit with San Bernardino as well as the pressure Brown has placed upon other counties could allow for quicker implementation of GHG evaluation and mitigation policies in regional blueprints and at the county level.

SB 375 promises the incentive of CEQA streamlining and exemptions for projects that conform to the mandated regional growth plans. Transit-priority projects are eligible for the same streamlined environmental review as residential or mixed-use projects. In addition, some public transit-priority projects will be fully exempt under CEQA.

Regional Housing Needs Allocation (RHNA)

In California, housing element law is designed to increase the supply, choice, and affordability of housing through market-based mechanisms (LUSCAT, 2008). These laws recognize the need for land use plans and local regulation that allow for rather than constrain adequate housing development. California State Housing Law requires that regional housing needs be updated periodically per RHNA. The councils of governments develop the Regional Housing Need Plan

(RHNP), which contains the expected portion of the State's housing needs in cities and counties in the region over an allocation period of about eight years. First, the State Department of Finance determines housing needs across all income levels, and these needs are divided by region. The resulting number is assigned to the councils of governments, which must describe how they will meet housing needs and goals in their region.

The RHNP is intended to encourage increases in the housing supply and mix of housing types, infill development, and intraregional relationships between housing and jobs (LUSCAT, 2008). Infill development is the renovation of existing empty or underused real estate for housing or commercial purposes, contributing to increased density. In creating the RHNP, the councils of governments must balance competing interests with the need for growth and additional housing. Communities use RHNA in planning land use and determining the local resource allocation. Indeed, each city and county is required to adopt a general plan for land use and planning using RHNA. Local governments retain control over the type and quantity of housing, while the private sector has the opportunity to develop additional housing units according to market demand.

RHNA could have presented a barrier to AB 32 implementation. However, this has been addressed by SB 375, which now links housing and planning efforts for the first time. MPOs are required to develop a "Sustainable Communities Strategy" (SCS) that outlines how they will reach their GHG target. The SCS will become part of the MPO's regional transportation plan (RTP) and now must include RHNA.

Local Area Formation Commissions (LAFCOs)

Historically, when California experienced rapid growth, many new local governmental agencies were created simultaneously but were poorly coordinated, resulting in overlapping jurisdictions and poor planning. LAFCos were created to encourage local agencies to form in an orderly fashion to prevent such overlap and inefficiency (CALAFCo, 2008). Fifty-eight LAFCos in California work with almost 3,500 governmental agencies; with multiple agencies, service boundaries often overlap and can result in higher costs to taxpayers and wasted services (CALAFCo, 2008). LAFCos seek to create balanced and efficient services to meet Californians' needs. They coordinate changes in boundaries between local governments and prepare each city and special district's sphere of influence or planning boundary, which extends beyond the legal boundary to designate a future service area. Their role requires them to consider land use policies and service capacities, and they seek to preserve agricultural land resources as well as to discourage urban sprawl. In addition, they consider infill capacity as well as GHG emissions before granting approvals to expand spheres of influence (LUSCAT, 2008). Without the permission of LAFCOs, it is not possible to change zoning. This requirement may pose a barrier to AB 32 implementation by slowing processes that seek to change land use dramatically or develop brownfields (LAFCo and RHNA expert, 2008).

Indirect Source Rule (ISRs)

Indirect Source Rules (ISRs) aim to mitigate pollution created by new development projects, whether commercial, residential, or industrial. They place caps on the amount of allowed

emissions and require developers to reduce or mitigate emissions under these caps. They were originally proposed in the 1970s, when the U.S. EPA was criticized for making state air quality plans but failing to maintain air quality (Environmental Defense Fund (EDF)). The courts proposed ISRs to allow for air quality maintenance and to incorporate air quality into planning, but resistance from the building and development industries succeeded in limiting the U.S. EPA's authority to implement ISRs. In the Clean Air Act Amendments of 1977, states were allowed to implement ISRs, but they were optional. Since the 1990s, most ISRs have been adopted in rural areas and aimed to create impact fee revenues; however, they did not prioritize emission mitigation (EDF, forthcoming). In 2005, the San Joaquin Valleywide Air Pollution Control District (SJV APCD) and the Imperial County Air Pollution Control District in California adopted ISRs, which require that developers decrease or mitigate pollution due to future developments, traffic impacts, and overall land use patterns. With more advanced modeling techniques available than in the past, the SJV APCD has been able to more accurately quantify indirect pollution due to development. Today, the goal of ISRs is to support development that increases density and reduces VMT while simultaneously decreasing emissions.

Not surprisingly, developers—specifically by the California Building Industry Association, have challenged SJV APCD's ISR adoption. In 2006, the California Building Industry Association filed a lawsuit against SJV APCD; they posited that the ISRs were "unauthorized, preempted by state law, and/or constitute an invalid special tax" (Clark, 2008, p. 1). The industry association lost. They plan to file an appeal. Generally, State agencies feel that air districts are capable of implementing ISRs, but many have been cautious due to the potential threat of lawsuits (ISR expert, 2008).

ISRs vary between air districts and states, but in general, they may address vehicle emissions that result from developments, highways, energy needs of homes and businesses, and pollution created during construction of new developments (EDF, forthcoming). Developers are often encouraged to plan buildings that have measures to reduce indirect pollution, such as improved insulation, designs that use natural lighting, landscaping that reduces heat in the summer, and transportation that decreases VMT (EDF, forthcoming). When the pollution exceeds the ISR cap, some regulators charge a mitigation fee, which is used to decrease pollution off site due to the new development. As with other policies and regulations discussed in this section, ISRs have the ability to encourage increased density, improved public transportation, infill development, and increased housing choices, including affordable housing (EDF, forthcoming). However, ISRs' similarities with CEQA and overlaps with RHNA and LAFCos mean that there may be potential inefficiencies in implementation.

Senate Bill (SB) 375

On September 30, 2008, Governor Schwarzenegger signed SB 375 into law. Senator Darrell Steinberg (D-Sacramento) introduced the bill in 2007 to address CEQA and RHNA reform in the context of climate change. Under SB 375, ARB will create GHG reduction targets by region in California after consulting with local governments by September 30, 2010. Each region (with the exception of rural areas) must incorporate that target into their RTP; this will result in a "sustainable communities strategy" (or SCS). Regions unable to achieve the targets through their metropolitan transportation plan (MTP) would still be allowed to adopt the MTP, but they must

submit an Alternative Planning Strategy (APS) that would meet the target. The APS would outline the steps it would take to achieve the target, such as seeking additional funding for public transit operations; however, the region would not be obligated to adopt these measures.

An expedited CEQA review process resulting from SB 375—including an open and transparent public participation process—serves as the key incentive to amend land use plans to conform to a SCS. Transit-priority projects are eligible for the same streamlined environmental review as residential or mixed-use projects. In addition, some public transit-priority projects will be fully exempt under CEQA.

It also includes RHNA reform by changing this process from a five-year schedule to an eight year one, "which would also sync the RHNA process with every other cycle of the MTP process. Local governments would be required to rezone their properties to meet their allocation within 3 years (4 in some circumstances) of the adoption of a housing element. The RHNA allocation would be consistent with the MTP land use element" (or the SCS) (McKeever, 2008, p. 2). Finally, SB 375 requires that the California Transportation Commission (or CTC) work with ARB to maintain transportation demand modeling guidelines to more accurately track the effect of land use choices on transportation in California.

LUSCAT Policy Mechanism Recommendations

LUSCAT recognized that there are many barriers to growth that reduces GHG emissions at all levels of government. Some policies that were designed to protect the environment have been used to block such growth. For instance, CEQA has occasionally been used to prevent infill development (e.g., not-in-my-backyard opponents) when it has been appropriate (LUSCAT, 2008). LUSCAT asserted that the process of securing land use entitlements for developers building housing is "uncertain, lengthy, and costly," particularly for infill housing; this is partly due to the inappropriate use of CEQA (LUSCAT, 2008, p. 37). The approval process for new residential development needs to be streamlined and more certain. Thus, LUSCAT recommended that the State consider reforming CEQA to incorporate analysis of GHG mitigation strategies and impacts (LUSCAT, 2008). In addition, the State should improve CEQA by decreasing the barriers to approving compact developments, infill, and affordable housing. As noted earlier, these recommendations have been adopted through the passage of SB 375.

One of the policies submitted to LUSCAT was to expand ISRs to all air pollution management districts in California. LUSCAT acknowledged that ISRs are similar to other project design elements that local governments, public transit agencies, regional transportation planning associations, air districts, and affordable housing subsidy programs require or recommend. While ISRs do have the potential to strengthen AB 32, they "must be reconciled with other existing and proposed emissions mitigation requirements of general or specific plans, [regional transportation plans) RTPs, [air quality management plans or] AQMPs, and the environmental review documents for these plans and any CEQA mitigation requirements for development applications, of all relevant agencies" (LUSCAT, 2008, p. 48). Redundant policies and mitigation efforts should be avoided, including those that would assess mitigation fees for measures that have already been reviewed by local government permitting processes. To decrease the carbon footprint of transportation, the State could adopt an ISR in which emission mitigation is accomplished through project design or by purchasing off-site reductions (e.g., carbon

sequestration, or renewable energy generation). Alternatively, the ISR could work within CEQA, if emissions exceed caps and trigger an EIR. The State could create a model ISR rule or a model CEQA threshold, which local governments could use to adopt the policy in their jurisdictions (LUSCAT, 2008, p. 70).

REDUCTION STRATEGIES

Within each policy approach outlined above, there are numerous potential strategies for reducing GHGs. Some strategies, such as smart growth, require several large and small policies at the State and local level that fundamentally change the structure of transportation and housing infrastructure. Other approaches are easier to implement, such as ridesharing and intelligent transportation systems (ITS).

Smart Growth and Land Use

Since World War II, the dominant form of growth in the U.S. has been low density and has decoupled employment locations from residential areas (Bento *et al*., 2005). The resulting pattern of land use is commonly characterized as urban sprawl in which new developments spread from urban areas into low-density undeveloped areas; homes, shops, and workplaces are located separately. Accessibility is low and heavily reliant on road networks, and there is a lack of thriving centers of activity, such as downtowns (Ewing *et al.*, 2008). As a result, auto-dependency continues, and as the population grows, VMT increases. In the next 20 years, it is projected that VMT will increase by 100 percent, and traffic congestion will increase 200 percent in California alone (ULI, 2002). Although there have been efforts to improve the technology of vehicles and fuels to reduce GHG emissions, such improvements are likely to be offset by growth in VMT (Ewing *et al*., 2007). Simultaneously, the rate of land consumption for development is almost triple that of population growth (Ewing *et al*., 2007). This type of rapid growth results in sprawl, which is a particular challenge in California. Using an index developed to measure urban sprawl, two regions in California were ranked among the top ten most sprawling metropolitan areas in the U.S.—Riverside, San Bernardino and Oxnard, Ventura (Ewing *et al*., 20078). Such changes can lead to increased environmental externalities, as well as decreased economic competitiveness due to elevated congestion (ULI, 2002).

The connection between transportation and land use seems obvious—urban sprawl means longer commute times and decreased neighborhood walkability. However, in a literature review of papers studying this topic, Handy *et al.* (2005) question the evidence for this connection. This topic was not heavily researched until the 1980s, and recent literature reviews describe more than 70 studies exploring this topic. In Handy (2005), the author specifically examines four assumptions. First, she reviews the literature on the relationship between growth in the number of highways and sprawl. Historically, empirical evidence has supported the conclusion that building freeways contributes to suburbanization. The literature evaluating this subject also supports this relationship, but it does not quantify the extent to which highway building causes sprawl. Not surprisingly, the strength of the relationship depends on local conditions. However, the author found that the literature does not demonstrate the assumption that building more highways results in increased VMT. Third, Handy explored whether investments in light rail

systems can increase densities and found that under the right conditions they can. These conditions include significant regional growth, systems that improve accessibility appreciably, and public sector involvement via supportive land use policies. Finally, the author explored whether auto use can be reduced through "new urbanism" design strategies, including locating activities in walking distance and creating a networks of streets, sidewalks, and paths. This literature review demonstrated that such techniques may decrease automobile use by a small amount (Handy, 2005; Handy *et al*., 2005).

To further explore the connection between land use and transportation, Handy *et al.* (2005) conducted a quasi-longitudinal analysis. Based on their results, they concluded that land-use policies intended to decrease driving are successful and that changing neighborhood design can affect mode change from driving to walking (Handy *et al*., 2005). Bento *et al*. (2005) performed a similar analysis using econometrics to assess how the spatial distribution of population, employment, and public transit networks affects vehicle ownership and VMT by household. Their overall findings confirmed their hypothesis that urban form affects travel demand; households in cities with higher densities are less likely to own cars. For example, an increase of 10 percent of population density decreases the probability that an employee drives to work by one percent, and a 10 percent increase in density decreases annual VMT by 1.5 percent (Bento *et al*., 2005).

Recognizing the need to change the "system of growth" as a whole rather than focusing on particular causes of these problems, researchers and policymakers have increasingly supported "smart growth." The American Planning Association defines smart growth as "the planning, design, development and revitalization of cities, towns, suburbs and rural areas in order to create and promote social equity, a sense of place and community, and to preserve natural as well as cultural resources" (Handy *et al*., 2005, p. 428). According to the Urban Land Institute (ULI), the principles of smart growth include improving and maintaining quality of life; creating livable communities; investing in transportation integrated into efficient land use; improving housing opportunities; preserving farmland, natural resources, and the environment; addressing regional growth issues; and developing grass roots solutions (ULI, 2002). These principles can be accomplished through a variety of means including mixed-use, infill, and transit-oriented development (TOD); infrastructure that promotes public transit, bicycle use, and walking; preservation of open spaces; affordable housing; non-residential speed limits; etc. (ETAAC, 2008). The U.S. EPA recognizes smart growth as an effective method of improving air quality (Handy *et al*., 2005).

The challenge to implementing smart growth is that land use decisions are made at multiple governance levels, so it is important to target interventions, policies, and programs at all institutional levels (ETAAC, 2008). In this section, the authors review the types of new policies and reforms most commonly mentioned in the smart growth literature.

Transit-Oriented Development (TOD) and Transit Villages

Transit villages are mixed-use zones combining both residential and commercial areas that are within a quarter or half mile of mass transit systems and thus encourage public transit use (ETAAC, 2008). More generally, TODs generate such villages and encourages density near transit hubs. It is estimated that TODs could decrease VMT by 20 to 30 percent in comparison to

conventional development, which has lower density (ETAAC, 2008). According to the California Department of Transportation, an average household in a transit village could emit between 2.5 and 3.7 fewer tons of CO2 each year compared to a traditional household (Shaheen and Lipman, 2007).

An important policy needed for TODs is tax-increment financing (TIF). This form of taxation is commonly used for community development, waste cleanup, or other programs that generate more taxable property. The new tax revenue resulting from such a program is called the "tax increment," and TIF uses the future tax increment to finance current projects. It is often the only way to finance community development projects such as TODs. In the case of smart growth, new housing and commercial units would be created that could cover TOD costs. Current policies only allow TIF in blighted areas; however, TODs generally focus on non-blighted areas near public transit hubs and lines. The ULI recommends revising current laws to allow such non-blighted areas to use TIF (ULI, 2002).

Housing Development Reform

Attached housing, such as condominiums and townhouses, is one of the most economical methods of increasing homeownership while encouraging smart growth in urban areas. Currently, litigation related to construction of attached housing poses a barrier to housing development that increases density (ULI, 2002). Lawsuits regarding construction deficits are so frequent that they have discouraged the construction of attached housing (ULI, 2002). In California, construction of attached housing units decreased from 19,000 to 6,000 units between 1994 and 2001 (ULI, 2002). The ULI recommends developing policies that limit such litigation to spur greater construction of attached housing and in turn smart growth.

In addition, ULI recommends developing fiscal incentives for residential development. The current California tax structure depends on sales taxes, which encourage commercial rather than residential development (ULI, 2002). Allocating part of local property and sales taxes could spur housing production and TODs (ULI, 2002).

Another policy that affects housing development is California's density bonus law, which was passed in 2004 (SB 1818). This law requires that cities and counties provide developers with density bonuses between 25 and 35 percent above the number of units the zoning codes allow if 20 percent of the units are affordable for low-income families, 10 percent are affordable for very-low income households, or 50 percent are reserved for seniors. The number of affordable housing units required to receive the bonus was decreased in the 2004 law and also required local governments to make additional concessions for developers (Kautz, 2005). It has been argued that the law is profoundly anti-planning and undermines zoning laws (Kautz, 2005). Reforming density bonus laws may be an important way to achieve smart growth goals by increasing the availability of affordable housing.

Brownfield Development

Brownfields are land that has been abandoned or under used by industrial and commercial facilities. Development and expansion of such areas is often difficult because of the potential for

environmental contamination. At present, Federal, State, and local policies have different cleanup standards; developers must coordinate among regional water quality control boards, health departments, fire departments, and redevelopment agencies in order to re-develop brownfields. Decreasing the barriers to developing brownfields is an important aspect of smart growth because it often allows for increased density in urban areas (ULI, 2002).

Streamline Review Processes

As discussed, above, CEQA poses barriers to rapid improvements in land use through development. In addition, other review processes, such as housing element updates, the California Water Plan, and storm water plans, are required for local land use planning and development (ETAAC, 2008). Making the environmental review process more streamlined would allow for more efficient and timely improvements in land use to decrease GHG emissions.

Policy Mechanisms for Smart Growth

There are several recommended policy mechanisms to fund and encourage smart growth. First, ULI recommends creating an incentive program that rewards communities that abide to smart growth principles (ULI, 2002). In addition, a pool of competitive transportation funds could be available for communities that plan mixed-use developments near existing public transit lines (ULI, 2002). Regional governments also should develop regional plans for land use that promotes GHG emission reductions. Such plans can be used to monitor progress in smart growth planning practices in the future (ETAAC, 2008). In addition, smart growth blueprint planning can be developed, as has already been done in Sacramento, the San Francisco Bay Area, and Southern California (ETAAC, 2008).

In addition, in their report "Growing Cooler," Ewing *et al.* (2007) of the ULI reviewed the literature and scientific evidence for global warming and mitigation policies and made recommendations for Federal policy change. First, they recommend requiring that regional transportation plans pass CO2 conformity tests for their emission levels. Such an approach would be similar to the testing process for criteria pollutants. Second, they recommend that the next surface transportation bill address environmental performance, climate protection, and green development. A previous bill, the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), was revolutionary in its emphasis on automobile alternatives, community involvement, and environmental goals. A renewed bill emphasizing global warming mitigation would instigate another paradigm shift in national highway policy. Lastly, Ewing *et al.* recommend providing MPOs with funding from the Federal government. Funds should be allocated based on the population size and economy activity of MPOs (Ewing *et al.*, 2007).

Leadership in Energy and Environmental Design Neighborhood Development (LEED-ND) Standards

The U.S. Green Building Council's Leadership in Energy and Environmental Design Neighborhood Development (LEED-ND) standards can be used to evaluate new developments on how well they meet principles of smart growth, new urbanism, and green building.

Developments that meet standards, which promote overall health, the natural environment, and quality of life, can be certified. In 2007, the standards were piloted with 238 projects from 39 states. One potential policy strategy is to formalize the LEED-ND certification system within California.

Intelligent Transportation Systems (ITS)

Since the 1930s, information technology has been used to improve the performance of transportation systems. Today, the use of computers, sensors, and wireless, automated technology to improve the efficiency and safety of transportation systems is generally called ITS. Using ITS, fuel consumption and emissions can be reduced through facilitated route planning and timing, smoothed accelerations and decelerations, decreased congestion, improved pricing and demand management capabilities, increased usability of public transportation, vehicles that are better attuned to road conditions, and increased cooperation between vehicles on the road (Shaheen and Lipman, 2007). Examples of ITS include ramp metering, traffic signal control, automated speed enforcement, and electronic toll collection, among others (Shaheen and Lipman, 2007). The U.S. Federal government has allocated over $100 million to ITS projects annually (Kanninen, 1996). As environmental externalities become an increasingly important problem to policymakers and citizens, the aim of ITS is expanding to include decreased GHG emissions.

ITS is typically divided into the following categories:

- **Advanced Traffic Management Systems (ATMS),** which use video, loop detectors, variable message signs, ramp meters, etc. to decrease traffic and delays.
- **Advanced Travelers Information Systems (ATIS)** provide individual drivers with traffic information to allow them to make informed decisions about their routes and transport modes. Information can be transmitted through electronic panels, the Internet, the radio, or within vehicles.
- **Commercial Vehicles Operation (CVO)** improves companies' ability to manage commercial fleets and control their speed and stop locations.
- **Advanced Public Transportations Systems (APTS)** aim to improve the functioning of public transportation by providing route information, travel schedules, and trip costs in real time to consumers.
- **Advanced Vehicles Control Systems (AVCS)** use sensors and computers to increase drivers' awareness of the vehicles around them while they drive.
- **Advanced Rural Transport Systems (ARTS)** employ technology to improve transportation issues specific to rural areas, such as steep grades, curves, and minimal navigational signs (Figueiredo, 2001).

While these technologies may effectively decrease congestion, they do not necessarily decrease VMT. Providing individuals with more information could decrease the amount of congestion and VMT but could also increase congestion, travel times, and VMT by distributing automobiles

throughout transportation networks during peak hours (Kanninen, 1996). The phenomenon in which additional and unanticipated trips are taken due to changes in routes, modes, or travel times is known as latent demand (Kanninen, 1996). For example, after the Bay Area Rapid Transit (BART) opened, 8,750 trips across the bay were diverted to BART, but 7,000 additional vehicle trips were created as well due to increased road capacity (Kanninen, 1996). The additional trips resulting from latent demand could increase GHG emissions due to some ITS approaches (e.g., traffic management). One researcher concluded that if ATMS and AVCS operated at full capacity, the amount of GHG emissions would increase by 200 percent (Kanninen, 1996). If decreased congestion and GHG emissions are the goal, ITS must be accompanied by other policies to encourage decreased automobile use, such as congestion pricing and improved public transportation systems (Kanninen, 1996).

Mobility Management

Mobility management consists of a variety of policies and programs that help to change drivers' consciousness of their environmental impacts and driving behavior. For policies to be sustainable over time, it is crucial to not only change the infrastructure in which people live and travel, but also transform their perception of their mobility access, choices, and impacts. Mobility management strategies include:

- **Carsharing:** Individuals use vehicles shared with other carsharing members for short periods of time, but they are normally not responsible for maintaining the vehicles. Typically, carsharing is deployed in areas where numerous transportation alternatives to cars are available. It has been documented that carsharing can decrease vehicle ownership and VMT, which in turn leads to decreased GHG emissions (Shaheen *et al*., 2007). Carsharing companies and nonprofits frequently purchase low-emission and hybrid vehicles, which also contribute to GHG emission reductions. Approximately 650,000 individuals worldwide belong to carsharing programs (Shaheen *et al.*, 2009). In the U.S., studies have shown that 11 to 26 percent of participants sold a personal vehicle after beginning carsharing, and 25 to 61 percent delayed a vehicle purchase or decided not to purchase a vehicle (Shaheen *et al*., 2006).
- **Ridesharing:** Also known as carpooling, entails drivers arranging to share vehicle trips. The motivation to do so may be to save money or to take advantage of carpool lanes and thus save time.
- **Park-and-ride facilities:** These facilities allow commuters to leave their vehicles in a parking lot near public transit hubs or ridesharing meeting points. They are most common in suburban areas, where there are often fewer alternative modes available to reach major transit lines.
- **Parking cash out:** Many employers provide parking subsidies to their employees. Parking cash out allows employees to exchange parking subsidies for their cash value, which can be used to cover the cost of alternative transportation modes.
- **Pay-as-you-drive (PAYD) insurance:** The way that most insurance schemes are currently designed requires drivers to pay the same amount for their insurance regardless of how much they drive. Pay-as-you-drive (PAYD) insurance allows drivers to pay an

amount that is based on the amount they drive—usually drivers pay per mile. The goal is to create financial incentives to reduce driving. It is estimated that PAYD could decrease congestion by 10 to 12 percent, and a 10 percent reduction in driving is estimated to result in 17 percent fewer car accidents (EDF, 2006). However, many insurers face barriers to implementing PAYD, including regulatory barriers, start-up costs, mileage verification costs, consumer acceptance of monitoring, and loss of premium dollars from infrequent drivers (ETAAC, 2008). Government support can remove some of these barriers. Since July 2006, auto insurers in California are required to determine insurance rates primarily based upon drivers' safety records, experience, and mileage, with less of an emphasis on where drivers live (EDF, 2007).

- **Smart cards:** Smart cards contain electronic chips that can automate the payment process for public transit, taxis, carpools, parking, and tolls. Stockholm is considering creating smart cards for use in public transit, taxis, and carpools, and Hong Kong and San Francisco are already using smart cards (ETAAC, 2008).
- **Employer-based commute trip reduction:** Employees are increasingly working from remote locations, including their homes, instead of commuting to offices for work (or telecommuting). While commute emission reductions are an obvious benefit, it is possible that lower energy efficiency could result from working offsite and could offset any GHG emission reductions. In addition, employers could create financial incentives to increase public transit usage, allow flexible work schedules to accommodate use of other transportation modes, or create mandatory or voluntary trip reduction programs (ETAAC, 2008).
- **Low-speed modes:** These include both motorized and non-motorized modes, such as bicycles, electric bicycles, Segway Human Transporters, and neighborhood electric vehicles. Most of these modes are powered by human motion and do not use fuel, contributing to GHG emission reductions.
- **Personal rapid transit (PRT):** Consists of a system of small vehicles that operate on elevated tracks or guideways, allowing for automated and on-demand mobility. Individuals reserve the vehicle in advance and travel directly to their destination. PRT improves upon public transportation by allowing personalization and increased flexibility. In Morgantown, West Virginia, a PRT has been operating for over 25 years; London Heathrow airport is also in the process of constructing a PRT (ETAAC, 2008).

Congestion Charging

Almost every urban area today suffers from excessive traffic congestion and delayed travel times. In economic terms, this phenomenon results from distortions of our current market, which lead to excessive mobility that does not reflect consumers' true mobility preferences (Litman, 2007). Economic theory predicts that consumers would drive less, use alternative modes more often, and prefer more accessible destinations in a neutral, efficient market. The causes of market distortions include vehicle travel prices that are too low, planning practices that prioritize short travel time and costly modes over accessibility, and land use oriented around automobiles. The

result is not only increased congestion, but also traffic accidents, environmental damage, insufficient mobility for non-drivers, and costs associated with sprawl (Litman, 2007).

Congestion charging, including charges for roads, tolls, and parking, has been supported by economists to optimize the market for over 30 years yet has only recently been explored in Europe and Japan. Most recent policies and pilot programs, such as those in Singapore, Scandinavian cities, and the UK, have aimed to decrease congestion and emissions. A modeling study conducted in Europe recommended that charges increase in urban areas and on inter-urban routes and decrease for public transportation and rural areas. In addition, parking price changes must occur at the same time as road prices change. While economists tout the potential of these policies, they are challenging to implement due to low public acceptability and challenges in implementation (Ryan and Turton, 2007).

This section covers three cases of congestion charging: the Stockholm congestion charging experiment, charging in London, and plans to implement such charges in New York City and San Francisco. In 2004, the Swedish Parliament passed legislation to create congestion charges in conjunction with expanded public transport in Stockholm, as was suggested by the Stockholm City Council in the previous year. A year after charges were implemented, the city reported that traffic flow decreased more than expected, and the traffic volume was lower in and outside of the zone in which tolls were charged. As a result, travel times improved and became more reliable. Researchers concluded that changes were a result of the charge rather than improved public transportation because the proportion of public transport users in the city was already high. The experiment resulted in an estimated two to three percent decrease in CO2 emissions from traffic and a decrease of 14 percent in the city (Hugosson and Sjöberg, 2006). In addition, it is estimated that for each Swedish krona collected from the congestion charges, the benefits to society in traveling time, increased road safety, and health and environmental effects yielded a profit of 0.90 krona. Despite these benefits, the decision remained quite unpopular with residents, even at the end of the pilot, although approval did increase over the year. At the time the trial started, 51 percent of county inhabitants considered it a "fairly/very bad decision," but this percentage decreased to 42 percent by the end of the year. Similarly, the percentage of individuals reporting serious problems with the tax decreased from 40 to 20 percent after one year. However, all companies voiced criticisms regarding the inconvenience and increased administrative costs due to the new system (Hugosson and Sjöberg, 2006).

London has also implemented congestion charges and has studied the program to assess air quality and congestion changes. The charge was implemented in response to longstanding air quality and traffic congestion in London; specifically, in 2000, London drivers spent 50 percent of their time on the road in queues, and the city lost an estimated £2 to 4 million each week due to congestion. The Mayor pledged to decrease congestion through a multifaceted set of policies including congestion charging in 2002. The charges were implemented in 2003, requiring drivers entering 21 square kilometers of central London between 7 AM and 6 PM to pay £5 (later raised to £8); in February 2007, the charging zone was extended towards the west. It is estimated that traffic flows have been reduced 15 to 22 percent depending on the time of day (Evans, 2007). By 2006, a fifth of the original volume of cars travel on London's roads, and the number of buses has increased 25 percent (Callaway, 2008). When comparing the amount of smog, diesel soot, and carbon monoxide in the air before and after the congestion charge, it was found that there were minimal changes in their concentration. It is possible that this is due to the use of filters on

buses that capture soot but still emit gases. However, the City of London reports a decrease in N20 of eight percent and a 15 percent decrease in PM (Callaway, 2008).

In New York, the Mayor's office has acknowledged that despite significant improvements in the city's public transportation system, millions of workers continue to enter the central business district of Manhattan via personal car. The congestion resulting from this transportation pattern costs the region over $13 billion each year. In an effort to decrease congestion and spur increased public transportation use, the New York Mayor's office proposed an $8 daily fee for passenger vehicles and $21 daily fee for trucks entering or leaving Manhattan below 86th street between 6AM and 6PM. Vehicles driving within the zone below 86th street only would pay half price. Certain vehicle types, including emergency and for-hire vehicles, would not pay the charges. Over 70 percent of New York drivers already use EZ passes, which employ high speed sensors, and the fees would be charged using these passes (City of New York, 2007). It is expected that the charges would result in a 6.3 percent decrease in traffic and a 7.2 increase in speeds in the zone. Approximately 1.4 percent of drivers are expected not to travel into the zone due to the charge. The revenue from the charges would be used to make long-term investments in mass transportation in New York City. When the proposal was sent to the New York State Assembly in April 2008, Democrats would not put the bill to a public vote on the floor. Politicians from Queens, Brooklyn, and the suburbs of New York strongly disapproved of the measure, considering it to be regressive and only beneficial for Manhattan (Confessore, 2008).

Congestion charging also was proposed in San Francisco to support the building of a parkway that strengthens Doyle Drive. Doyle Drive connects San Francisco to counties both north and south of the city. Each day, almost 120,000 vehicles use Doyle Drive (SF County Transportation Agency, 2008). The highway was built in 1936 and currently needs to be renovated to meet seismic, structural, and safety needs. On the Federal Highway Administration's structural safety index, Doyle Drive is rated two out of 100 (Cabanatuan and Gordon, 2008). While this rating does not mean that the road is currently unsafe for drivers, it does indicate that it is a high priority for renovation (Cabanatuan and Gordon, 2008).

The proposed parkway would cost $1.01 billion and would be completed by 2012. In 2007, the Federal government offered $58 million dollars to rebuild Doyle Drive if a toll was implemented to cover construction costs. Tolls would be collected at the Golden Gate Bridge using the existing FasTrak system or could be implemented through a separate electronic system. Alternatively, tolls could be implemented along Doyle Drive using either FasTrak or a pay-by-plate system; either system could vary the tolls depending on the direction of travel or time of day (San Francisco County Transportation Agency, 2008). A toll of $1 to $2 was proposed. North Bay commuters and Marin officials strongly opposed the proposal, arguing that it was unfair since 75 percent of traffic southbound into San Francisco is from North Bay commuters. Over the years, numerous efforts have been made to improve Doyle Drive, but most have received community opposition or have lacked sufficient funding (Cabanatuan and Gordon, 2008). The type of regional opposition faced in San Francisco was similar to that between Manhattan and other New York City boroughs.

In May 2008, bridge directors agreed to consider setting tolls that would put the total toll cost on the Golden Gate Bridge at $7.00 for cash payers during peak traffic hours and $5.50 to $6.00 for FasTrak users. However, in August 2008, transportation official decided to eliminate the proposed bridge congestion toll as part of the Federal Urban Partnership Agreement, and a

variable parking plan was adopted in its place along the route to the bridge (i.e., rates will rise during busiest times to encourage parking turnover and long-term parkers to move to lots/garages) (Cabanatuan, 2008). Nevertheless, the pricing project is still under consideration, but it will need state and local support to move it forward. A study is underway to investigate various implementation scenarios for congestion pricing. Final study results are due in late-2009.

Education and Outreach Campaigns that Influence Travel Behavior

Social marketing (marketing directed at promoting a social good through behavioral change) has the potential to change travel behavior to reduce GHG emissions through marketing and promotional strategies. Examples of the use of social marketing in transportation and energy include the:

- "Spare the Air" campaign in the San Francisco Bay Area, which aims to increase BART system use on poor air quality days;
- "Flex Your Power" campaign, which increased public awareness about the need to conserve energy in California;
- Chicago Transit Authority's New Residents program, which provided individuals moving into new homes in Chicago with public transportation information; and
- The Federal "It all Adds Up to Cleaner Air" campaign, which provides public education as well as a partnership-building initiative organized by Federal agencies to support regional, state, and community efforts to decrease congestion and air pollution.

The "Spare the Air" campaign is especially relevant to AB 32 because it was adopted during a period of growing public concern over the energy crisis. In 2001, policymakers designed a social marketing effort including multi-million dollar campaigns on the radio and television and in print mass media to encourage consumers and businesses to save energy. Over 1,000 businesses and non-profits voluntarily pledged to decrease their energy consumption by 20 percent, and resolutions for 15 percent energy use reductions were signed by hundreds of local governments (Bender *et al*., 2002). At the consumer level, individuals were given energy information on grocery and convenience store bags, and teachers of 4^{th} to 6^{th} graders received lesson materials on energy conservation. The effort was "the largest most aggressive conservation effort ever launched by a single state" (Bender *et al.*, 2002, p. 16). At the time, nine out of ten Californians considered the State's electricity problems to be serious and paid close attention to them (Bender *et al*., 2002). While it is not possible to separate the effect of the campaign on energy use reductions from other possible effects, after the first 10 months of the campaign, peak electricity demand decreased by approximately 6,369 megawatts (Bender *et al*., 2002). The "Flex Your Power" campaign implemented educational outreach concomitantly with other conservation and efficiency improving strategies. Thus, it is a very relevant example of the potential success of educational campaigns implemented in conjunction with other environmental policies and serves as a model for educational outreach for AB 32.

In an analysis of educational transportation campaigns, Sorrel (2005) concluded that campaigns relying on individuals' environmental awareness have less influence on transportation choices because individuals highly value time and convenience. Similarly, campaigns that demonstrate

simple modifications to travel behaviors are beneficial and can spur action (Sorrel, 2005). In addition, choosing the right target audience is important; different age groups, ethnicities, and languages spoken all affect individuals' receptivity and likelihood of changing behavior (Bender *et al*., 2002). Campaigns also need to develop a message that is credible and understandable. The "Flex Your Power" campaign developed 17 different 30-second television spots that were translated into five different languages and tracked to ensure that individuals recognized and remembered the message (Bender *et al*., 2002). Messages also must be able to influence audience beliefs; for instance, the "Flex Your Power" campaign placed logos in partner windows, grocery stores, and on the news to reinforce messages and build credibility. Finally, a social context in which desired behavioral changes can be made is important and can be accomplished using role models and behavioral modeling (Bender *et al*., 2002).

In addition, there are several methods of implementation and evaluation that can serve as best practices. Research is key for transportation-related social marketing programs to be successful. Background research must be conducted before developing the campaign to define the target audience and learning their characteristics. For instance, background research has found that people who exhibit environmentally-friendly behavior are no more likely to consider the environment when choosing transportation modes. This realization was crucial because it implies a shift in the target audience from environmentally-friendly individuals to the general driving public (Sorrel, 2005). Before implementation, research should be conducted to test the campaign's effectiveness. In addition, ongoing feedback via interviews, surveys, or focus groups is necessary to determine whether the tone in which information is portrayed is appropriate and effective (Sorrel, 2005).

LUSCAT: Strategies for Local Governments to Reach Regional Targets

Currently, many barriers exist to implementing policies and programs that allow regions to reach GHG reduction targets. LUSCAT provided recommendations relevant to land use, transportation, housing, water, and energy. This section focuses specifically on their land use and transportation recommendations within the categories already discussed in this section. The bulk of LUSCAT's recommendations involve smart growth and land use.

Smart Growth and Land Use

In the planning phase, LUSCAT recommended that the State guide regional blueprint planners in evaluating how land conservation can sequester carbon and reduce VMT due to land use. In addition, the State should also provide guidance on GHG reduction policies in their general plans wherever there are air quality provisions. The permit process could be streamlined by providing guidance on reducing discretionary approvals for infill and affordable housing developments and making local approval processes more efficient. In addition, sample ordinances that support GHG reduction through land use could be created and potentially funded. The State also should consider the exemption of or credits for the inclusion of affordable housing for GHG emission mitigation.

In designing land use patterns, high transportation carbon footprints should be mitigated. Thus, LUSCAT recommended expanding ridership of public transportation by modernizing transit

facilities, vehicles, systems, and trackways through additional investments by the State. Regional and local policymakers also should explore opportunities to choose locations for schools that are central to existing or planned neighborhoods, decrease transportation distances and costs, support public transit and pedestrian travel, preserve greenfields, and encourage joint use facilities. An important aspect of achieving these goals will be conducting outreach and community education to decrease public opposition to higher density, infill and affordable development.

To fund smart growth and land use that promotes GHG emission reductions, LUSCAT recommended funding TOD planning and public involvement in particular. In addition, improvements to bicycle routes and facilities, incentives that decrease public transit pass costs, and capital investments and operations for feeder service to make the last mile connection to transit should be funded. In general, the funding pool for public transit projects should be expanded. They also recommended expanded financing for mixed use, compact, and other innovative development by working with private lenders. Investments also should be directed towards open space and conservation projects with the potential for high sequestration and co-benefits. To achieve these goals, the State should consider using State funding for local GHG planning efforts. It could potentially tie investments in utility infrastructure to areas of preferred growth.

Mobility Management

LUSCAT recommended promoting programs that decrease driving and congestion, encourage physical activity, and reduce employee commute trips. In addition, they recommended exploring "how support for transit could take into account the costs of transit system shift to clean fuels and efficient vehicles" (LUSCAT, 2008, p. 65).

Congestion Charging

LUSCAT supported the use of congestion pricing and pay-as-you-drive insurance premiums to reduce GHG emissions in California. In addition, investments in public transportation could offset market-based compliance mechanisms. For instance, increasing the availability of public transit could decrease potential negative public reactions to congestion pricing policies.

Travel Behavior

Designing public education programs to promote transportation conservation is another one of LUSCAT's recommendations.

Capacity Building for Policymakers

In addition to these recommendations, LUSCAT recommended a series of additional measures that would increase the capacity of California policymakers, administrators, and regulators to reduce GHG emissions. Two of their recommendations involved revising current guidelines; they recommended developing guidelines for how climate action plans, general plan climate

elements, and other local plans could "consider land conversion and protection of natural and working 'carbon reserves'" (LUSCAT, 2008, p. 62). In addition, they recommended updating RTP guidelines with overt policies that reduce, mitigate, and monitor GHG emissions from regional transportation projects.

Improved technical assistance is another key component of ensuring that GHG reduction policies are successful. LUSCAT recommended that the State provide the technical assistance needed for regional and local land use plans to increase infill development, particularly near public transit stations/stops and employment centers. In addition, it recommended that the State create a coordinated technical assistance program that promotes LEED-ND standards. Rural areas also should receive programs and resources to reduce GHG emissions.

Modeling emissions due to transportation and land use is crucial to determining whether policies are successful and whether participating entities are in compliance. LUSCAT recommended setting standards for transportation simulation modeling and analysis and investing in strategies to model GHG emissions, creating a transparent public process of disseminating results, and assisting local governments in using models to improve planning. In addition, a Statewide GIS system should be developed that supports data from the State, regional, and local models.

Strategies Recommended By Economic And Technology Advancement Advisory Committee (ETAAC)

ETAAC was created under AB 32 to advise ARB on activities, policies, funding opportunities, and new technology and research needed to achieve GHG reduction goals. The committee submitted policy recommendations to ARB in February 2008. Their broad goals are similar to LUSCAT's: enhance research and development and demonstration; encourage private and public investment; coordinate between levels of government and the private sector; increase consumer education and choice; and realize economic, ecological, and environmental justice co-benefits. The specific policy strategies they recommended to ARB include:

- Smart growth and transit villages;
- Pay-as-you-drive (PAYD) insurance;
- Congestion charges;
- Employer-based commute trip reductions;
- New vehicle technology improvements—beyond AB 1493;
- Low carbon fleet standards and procurement policies;
- Vehicle feebates, registration fees, and indexed fuel taxes;
- Air quality incentives programs and standards; and
- Creating markets for green fuels. (ETAAC, 2008).

SCOPING PLAN

The *Climate Change Proposed Scoping Plan: A Framework for Change* was released by ARB on October 15, 2008. The Board approved it on December 12, 2008; policies in the plan may be adopted through regular rulemaking processes, and in certain cases, through legislative action. However, the plan itself does not mandate GHG-related policies for California. Between 2009 and 2010, plan measures will be developed and put in place by January 1, 2012.

Key elements for meeting GHG reduction goals by 2020, which are relevant to this analysis, include: 1) a California cap-and-trade program that links to the Western Climate Initiative to create a regional market system, including allowances, revenues, and offsets; 2) regional and local targets for transportation-related GHG emissions, as well as policies and incentives to reach those targets; 3) supporting measures (i.e., congestion pricing, pay-as-you-drive insurance, indirect source rules, programs to reduce VMT, and public education); 4) high speed rail; and 5) voluntary early actions (ARB, 2008).

California Cap-and-Trade Program

For a cap-and-trade program to begin in 2012, implementing regulations must be developed by January 1, 2011, based upon AB 32 authority. This would involve a public rulemaking process over the next two years (ARB, 2008). As mentioned earlier, LUSCAT recommended using a cap-and-trade market auction system and earmarking part of the proceeds for compact development, brownfield development, and improvements to existing infrastructure; protection of working and natural landscapes with high sequestration value; and investments in urban forestry, urban parks, and urban farming programs (LUSCAT, 2008). They did not specify how such a system could be implemented.

If California "adopts a cap and trade system that includes the auction of emission allowances, ETAAC propose[d] that a California Carbon Trust can direct investments" in R&D and fund pilot programs in disadvantaged communities throughout the State (ETAAC, 2008, p. 1-6). The Carbon Trust would allocate incentive funds generated from allowance revenues to encourage GHG reductions inside and outside of the cap. ETAAC recommended having this in place by 2012.

Allowances and Revenues

ARB plans to assess possible use of allowances and revenues as part of the cap-and-trade program rulemaking process.

> "One approach would be to dedicate a portion of the allowances for such purposes as rewarding early actions to reduce emissions, providing incentives to local governments and others to promote energy efficiency, better land use planning, and other reduction strategies, and targeting projects to reduce emissions in low-income or disadvantaged communities. The type of dedicated use of allowances is typically referred to as an allowance 'set aside" (ARB, 2008, p. 35).

More specifically, a possible use of allowances and revenues generated are "incentives to local governments from well-designed land-use planning and infrastructure projects" (ARB, 2008, p. 70).

ETAAC recommended that ARB create a California Carbon Trust to administer the revenues (leveraged with private sector support) to advance AB 32 goals (ETAAC, 2008). LUSCAT also recommended a cap-and-trade program that would auction allowances but did not specifically recommend offsets.

Offsets

ARB defines offsets as "'verifiable reductions of emissions whose ownership can be transferred to others'….The cap-and-trade rulemaking will establish appropriate rules for use of offsets" (ARB, 2008, p. 36). Offsets include voluntary reductions (ARB, 2008). ETACC also emphasized the use of offsets in its recommendations. (See ETAAC report, pp. 9-5 to 9-6.)

Regional and Local Government Targets

The Scoping Plan recommends regional and local government GHG emission targets. "ARB increased the anticipated reduction of [GHG] emissions for Regional Transportation-Related GHG Targets from 2 to 5 MMTCO2e….In recognition of the critical role local governments will play in the successful implementation of AB 32, ARB add[ed] a section describing this role and recommends a [GHG] reduction target for local government municipal and community-wide emissions of a 15 percent reduction from current levels by 2020 to parallel the State's target" (ARB, 2008, p. 3). LUSCAT also recommended regional targets.

On September 30, 2008, SB 375 (Steinberg's anti-sprawl legislation) was signed into law, creating "a process whereby local governments and other stakeholders work together within their region to achieve reduction of GHG emissions through integrated development patterns, improved transportation planning, and other transportation measures and policies" (ARB, 2008, p. 27). It requires that ARB develop GHG targets for 2020 and 2050, in conjunction with regional MPOs, by September 30, 2010.

SB 375 requires a process that establishes targets, which includes a Regional Targets Advisory Committee (or RTAC appointed by ARB) to recommend methods for setting GHG emission targets and factors to consider. SB 375 requires MPOs to prepare a sustainable communities strategy (or SCS) to reach their regional targets. It also provides for CEQA streamlining (which acts as an incentive) to release projects that are consistent with the required SCS and RTP, and it facilitates RHNA coordination with the SCS and RTP processes. In its recommendations, ETAAC supported regulatory streamlining in conjunction with local land use planning and development (ETAAC, 2008). In the case that the SCS "strategy does not meet the target, the MPO must document the impediments and show how the target could be met with an alternative planning strategy. CEQA relief would be provided to those projects that are consistent with either the SCS or alternative planning strategy, whichever meets the goal" (ARB, 2008, pp. 47-48).

Supporting Measures

There are several land use and transportation-related supporting measures that should be considered in the SCS and in regional target setting including: 1) congestion pricing; 2) pay-as-you-drive insurance; 3) indirect source rules for new developments; 4) programs to reduce vehicle trips (e.g., employee transit incentives, telework programs, carsharing, parking policies, and other strategies that enhance and complement land use and transit strategies); and 5) public education programs to reduce vehicle travel. Each is described briefly below:

Congestion Pricing

Consistent with both LUSCAT and ETAAC recommendations, the Scoping Plan identifies congestion pricing as a transportation measure for further consideration in both the regional target setting and SCS processes. ARB notes that legal authority would be needed for regional agencies to implement congestion pricing (ARB, 2008).

Pay-As-You-Drive (PAYD) Insurance

Both ETAAC and LUSCAT recommended the PAYD insurance strategy. According to the Scoping Plan, PAYD insurance in which drivers realize a direct financial benefit from driving fewer miles could reduce GHG emissions and VMT. "California's Insurance Commissioner recently announced support for PAYD and has proposed regulations to permit PAYD on a voluntary basis" (ARB, 2008, p. 49).

Indirect Source Rules (ISRs) for New Development

According to the Scoping Plan, "Indirect source rules for new development have already been implemented by some local air districts and proposed by others for purposes of criteria pollution reduction. Regions should evaluate the need for measures that would ensure the mitigation of high carbon footprint development outside of the [SCS] or alternative planning strategies that meet the targets established under SB 375" (ARB, 2008, p. 49). LUSCAT acknowledged that ISRs are similar to other project design elements that many agencies, governments, and programs require or recommend. However, they caution that ISRs must be streamlined with other emission requirements, such as CEQA, to avoid needless redundancies. The State could create a model ISR rule or CEQA threshold, which local governments could use to adopt such a policy in their jurisdictions (LUSCAT, 2008).

Public Education and Programs to Reduce Vehicle Travel

In the Scoping Plan, ARB emphasized the importance of public education in bringing about voluntary individual action, as well as programs to reduce vehicle trips (e.g., employee transit incentives, telework programs, carsharing, parking policies, and other strategies that enhance and

complement land use and transit strategies). ETAAC and LUSCAT also recommended public education and programs to reduce VMT.

"The Climate Action Team will convene a steering team that includes State agencies and other public agencies such as the State's air districts, and public and private utilities, which have a strong track record of successful efforts at public education to reduce driving (Spare the Air) or promote energy efficiency….The steering committee will develop a coordinated array of messages and draw upon a wide range of messengers to deliver them. These will include the regional and local government whose individual outreach campaigns can reinforce the broader State outreach themes while also delivering more targeted messages directly tied to specific local and regional goals" (ARB, 2008, p. 101).

High Speed Rail

The Scoping Plan also supports high speed rail (HSR) as an emission reduction measure. "This measure supports implementation of plans to construct and operate a HSR system between northern and southern California. As planned the HSR is a 700-mile-long rail system capable of speeds in excess of 200 miles per hour on dedicated, fully-grade separated tracks….The system would serve major metropolitan centers of California in 2030 and is projected to displace between 86 and 117 million riders from other travel modes in 2030" (ARB, 2008, p. 34). The Proposition 1A ballot (the Safe, Reliable High-Speed Passenger Train Bond Act for the 21st Century) was approved in November 2008. Construction is anticipated to begin in 2010, with full deployment in 2030. Over the long term, HSR has the potential to reduce GHG emissions. ARB assigned the HSR measure (Measure T-9) a 1.0 million metric ton CO2 equivalent (MMTCO2e) in 2020. LUSCAT's long-term land use vision also included HSR to meet the 2020 and 2050 GHG reduction targets and beyond.

Voluntary Early Action

The Scoping Plan provides that entities that implement voluntary early action will be credited for their reductions via: 1) the cap-and-trade program and 2) other regulations that will be put in place to reward their early action.

CONCLUSION

Global warming mitigation is of increasing concern worldwide, and more and more policymakers have drafted and passed legislation that will commit states and countries to reduce GHG emissions. Despite its economic prowess, the U.S. has failed to adopt GHG reduction policies at the national level in as aggressive a fashion as other countries with a similar per capita gross domestic product. By passing AB 32, California has committed itself to becoming a leader in GHG emission reductions in the U.S., and the policies implemented in California will likely shape decisions made at the national level regarding global warming mitigation. This chapter has summarized the key transportation and land use-related policy approaches, possible policy mechanisms, and strategies that could be employed to meet AB 32's GHG reduction goals. A variety of policy approaches are available on a spectrum ranging from voluntary to regulatory;

while regulatory approaches have traditionally been used in environmental policy in the U.S., market-based approaches have become increasingly popular due to concerns about the cost of GHG reduction. Due to the wide range of policies needed to meet AB 32 goals, a mix of policy approaches is likely to be adopted.

To implement AB 32, several policy mechanisms are available; regional emission targets will be set by ARB in consultation with local governments, and this chapter has outlined the difference between absolute targets and intensity targets, which have been proposed by the Bush Administration. Cap and trade is a major policy mechanism that is already underway in the European Union. While the EU examples do not directly target transportation, Millard-Ball (2008) proposed a variety of potential cap-and-trade mechanisms that could be implemented in the transportation sector. The Scoping Plan does not directly specify a cap-and-trade mechanism to address the transportation and land use connection. However, this area may be eligible for California cap-and-trade revenues, which could be used as an incentive for local governments in promoting better land use planning.

Within a given policy approach and policy mechanism, there are numerous potential strategies that may be employed to reach AB 32 goals. These range from easy to implement strategies, such as park-and-ride facilities, to much more politically and administratively challenging strategies, such as congestion pricing. Such breadth of potential strategies is useful as the State will likely need to introduce multiple strategies in tandem to be as effective as possible.

The Land Use Subgroup of the Climate Action Team (LUSCAT) as well as the Economic and Technology Advancement Advisory Committee (ETAAC) have both provided recommendations per AB 32. While their recommendations differed in some details, general themes emerged from both recommendations including the implementation of a suite of policies in conjunction with new funding mechanisms, coordination between the public and private sector, and engagement of citizens and consumers through education and information. The Scoping Plan adopted many of the approaches mentioned by both advisory groups with several under further development.

CHAPTER 2: EXPERT INTERVIEW SUMMARY

Between February and July 2008, researchers from the University of California, Berkeley's Transportation Sustainability Research Center completed 15, two-hour (on average) expert interviews with 24 participants who represented various perspectives on the problems and solutions for meeting the emission reduction targets mandated by AB 32 and Executive Order S-3-05. Experts were interviewed from a range of stakeholder groups, including state and local transportation agencies, local government, elected officials, builders and developers, regional agencies, environmental advocates, and business groups. Researchers categorized experts into stakeholder groups depending upon their perspective and job responsibilities and jurisdiction. For example, land use attorneys, building industry consultants, and building industry legislative advocates comprised the builder/developer stakeholder group; elected officials included state level representatives as well as a mayor; environmental stakeholders included non-profit groups advocating for smart growth practices as well as air pollution policy advocates; regional governments included organizations, such as regional planning and transportation agencies; and local governments included local agencies involved with the blueprint planning process. The majority had over 20 years experience in their field, and many had more than 30 years of experience. See Table 4 below for a breakdown of participants by stakeholder group.

Table 4 Expert Interview Participants by Stakeholder Group

Expert Interview Stakeholder Groups	Number of Participants (N = 24)
Builders/Developers	4
Elected Officials	4
Environmental Stakeholders	5
Regional Governments	6
Local Governments	5

Researchers made several observations during the course of the interviews. First, study participants felt most comfortable discussing: greenhouse gas (GHG) reduction strategies (e.g., carpooling, telecommuting); policy approaches (i.e., voluntary, mandatory, and market based); and public education and community outreach. Second, the majority felt less confident discussing specific policy mechanisms (i.e., emission targets, budgets/caps, and cap and trade) and details of modeling, monitoring, and measurement. Third, few defined/discussed market approaches in detail. Three participants were from other states; the remainder (21) were from California. California experts represented the following cities/regions throughout the State: Sacramento, the Bay Area, the Central Valley, and the Inland Empire.

Limitations of this approach include its small sample size and self-selection bias (as all participants were volunteers). Furthermore, all participants were selected by the study organizers

including the California Air Resources Board (ARB), California Department of Transportation, California Energy Commission, and the University of California, Berkeley and Davis campuses. Nevertheless, the expert sample provides a representation of several key stakeholder groups in California on the AB 32 land use and transportation connection and can provide insights into their various perspectives, including similarities and differences, in response to AB 32 implementation in the State.

This summary is organized into nine key sections including respondent response to the following topics: 1) GHG emission reduction strategies; 2) barriers to reduction strategy implementation; 3) policy approach (i.e., voluntary, mandatory, and market based); 4) emission targets; 5) policy mechanisms (e.g., targets, budgets, emission trading); 6) modeling and baseline assessment, monitoring, and enforcement; and 7) public education and outreach. The authors also provide a synopsis of the main points provided by the experts and a summary organized by stakeholder group.

GHG EMISSION REDUCTION STRATEGIES

Experts were first asked to consider various GHG emission reduction strategies including land use, mobility management, pricing, intelligent transportation systems (ITS), and behavioral change. Experts discussed which strategies or combination of strategies they believed would be the most effective at reducing GHG emissions related to land use and transportation in the short- and long-term given the current political, technological, and fiscal landscape. In addition, experts were asked to discuss possible barriers to the implementation of these strategies and how to address them. They also were questioned about which GHG reduction strategies their organization is considering and have already implemented (e.g., telecommuting, ridesharing).

There was near consensus among experts that a reduction in vehicle miles traveled (VMT) should be the highest priority for meeting AB 32 requirements. The strategies most commonly cited by experts to reduce VMT included smart growth, transit-oriented development (TOD), pricing, and encouraging the development of "best practice" blueprint planning. Pricing and improving public transit were viewed as short-term strategies (although funding and political support may be challenging), while land use changes were cited by nearly every expert as the most important approach for meeting the 2050 target.

Short-term GHG reduction strategies included:

- Increasing energy conservation efforts;
- Prioritizing public transit in the budget to build a more effective system that offers users more travel options;
- Making communities and cities more pedestrian and bike friendly;
- The rising price of gasoline was thought to reduce VMT by economically encouraging behavioral changes, such as riding the bus;
- Changing travel behavior by providing consumer training programs on public

transportation and carsharing (short-term vehicle access) and increasing telecommuting; and

- Various pricing strategies, such as congestion charging, peak traffic charging, creation of High Occupancy Toll (HOT) lanes, parking fees, and taxation based on fuel efficiency.

Long-term GHG reduction strategies included:

- Smart growth and TOD, including mixed use and infill, and placing a priority on increasing the job-housing balance across the State to decrease commutes; and
- Development and implementation of "best practice" blueprint planning for land use and transportation.

Other GHG reduction strategies included:

- Developers thought the focus should be on new technologies and regulating big polluters rather than regulating land use;
- Environmental advocates stressed the need to recognize the interconnectivity of regions and assess the transportation and land use system from a statewide perspective; and
- Schools were cited as having large emission reduction potential, as carpooling and public transportation could greatly reduce VMT to these locations.

Current strategies that experts are working on include:

- Encouraging behavioral change and a reduction in VMT by connecting local agricultural producers and large supermarkets;
- Improving rest stop infrastructure with energy efficient technology, such as solar power and increasing Wi-Fi coverage;
- Implementing smart growth plans and high-density housing;
- Increasing the proportion of energy derived from renewable sources;
- Measuring the carbon footprints of existing residential structures and identifying the carbon footprints of new developments;
- Creating innovative mixed-use developments; and
- Mandating smart growth through SB 375 (anti-sprawl legislation).

BARRIERS TO GHG REDUCTION STRATEGY IMPLEMENTATION

Experts also discussed how to overcome barriers that may prevent the implementation of GHG reduction strategies. Experts identified behavioral change, pricing, reducing VMT,

and smart growth as the strategies that are the most difficult to implement. The experts then explored specific barriers to each strategy and ways in which these barriers could be overcome. Their responses are summarized in Table 5 below.

Table 5 Summary of Reduction Strategy Barriers and Methods to Overcome

Reduction Strategy	Barriers	Methods to Overcome Barriers
Behavioral Change	Reluctance of the public to reduce personal vehicle use; no options in some areas	Require organizational change by partnering with employers; market public transit with promotions, such as "kids ride free;" and increase driving costs
Pricing	No political will; public views as loss of "free" service	Public education campaigns; stronger political leadership; development of viable and affordable options for consumers; and short-term benefits, such as reduced travel time
Reducing VMT	Insufficient modeling to predict emission reductions	Better VMT measures; develop models to measure VMT reduction potential related to land use changes
Smart Growth	Some building companies do not have an interest in land use or policy; financing institutions do not view mixed use as profitable	Land use regulation preventing sprawl; work with companies to market green communities and mixed use; make green developments profitable; make infill development easier; and public education on smart growth
Increase GHG Reduction Pace	Political inflexibility and lack of funding	Stronger political leadership; public education on climate change; and encourage business leaders to take corporate action, which is faster moving and can be more effective
Coordination of Effective Responses	Disparate action and lack of enforcement	Multiple stakeholder coordination (e.g., media, government, business, agencies, individuals, etc.); make responses organizational rather than individual

POLICY APPROACHES

The respondents were then asked to consider which of the policy approaches (i.e., voluntary, regulatory, market based) or combination of approaches would be the most effective at achieving GHG emission reductions in the transportation sector. Experts were asked to suggest other policy approaches, if they thought others would be more successful. The majority endorsed a mix of voluntary, regulatory, and market-based approaches. A mixed voluntary and market-based approach was considered best for personal behavioral change and compliance with land use

policies and targets. Regulatory approaches were coupled with voluntary or market-based approaches. Below is a summary of key responses to each of three policy approaches examined.

Voluntary Approach

- Good to start with voluntary approach then phase in regulatory mandates (e.g., "best practice" blueprint planning compliance);
- Should be used to encourage individual behavioral change;
- Public-private partnerships need to be forged to bring about emission reductions at a larger scale—requires business leadership; and
- If used alone, a voluntary approach will not reduce emissions enough to meet goals.

Regulatory Approach

- Good for the "easy fixes" in which there is accurate modeling and substantial information in reduction technologies;
- Good for stationary and point sources as well as fuel efficiency standards;
- Regional GHG targets that decrease year by year need to be regulated; and
- Many experts thought a regulatory approach should be coupled with financial incentives and disincentives, and regions should receive state funding to reach targets and implement smart growth practices.

Market-Based Approach

- All experts from transportation agencies were unsure how a large market-based system could be established to measure reductions from the transportation sector given the current lack of sophistication in emission modeling; and
- The majority believed that offering financial incentives and disincentives, such as pricing individuals and businesses, would be an effective reduction measure, if policies were well publicized and coupled with educational programs.

EMISSION TARGETS

Next, experts were asked how the 2020/2050 GHG reduction targets should be achieved for transportation and VMT/vehicle use in particular and why. They were asked for ideas on which tools or information should be used to evaluate reduction strategies and how to set the basis for mandated reductions (e.g., AB 32 and E.O. goals or reasonable reduction potential). They were also asked for their opinions on whether targets should be an absolute emission goal or a per capita emission goal.

The majority of experts identified increased housing density as the method to achieve targets for transportation and VMT. Carbon dioxide emissions were the measure that most experts thought should be used to evaluate reductions. Strategies for increasing density included:

- Setting zone performance standards that are enforced through incentives and penalties;
- Using incentives/revenue to fund TODs;
- Creating growth boundaries to immediately limit further sprawl; and
- Amending SB 375 to include incentives.

There was consensus that to set meaningful VMT targets, better models need to be developed for quantifying the emission reduction benefit resulting from per mile changes in VMT. The majority of experts favored absolute targets that were tailored to each region's characteristics, although a minority of experts did favor a per capita approach. A majority cited the following recommendations for the evaluation of emission reductions:

- Develop more accurate modeling to predict GHG reductions and per mile reductions in VMT;
- Cities need more GHG reduction measurements associated with actions, such as toll lanes and mixed use development, to estimate their progress towards reduction goals;
- Statewide use of common indicators, such as gasoline sales, to monitor regional progress;
- Set targets for regions, cities, sectors, and CO_2 hotspots (e.g., Ports, highways, etc.) so that all levels of government are working to achieve reductions;
- Monitor progress through a combination of self reporting with ARB supervision;
- Enforce targets through incentives and penalties;
- Builders believe that focusing on fuel efficiency to reduce GHG would be a better measure for reductions; and
- A per capita basis for reductions would make targets more attainable.

POLICY MECHANISMS AND APPROACHES

The participants were then asked to think more in depth about the previously discussed policy approaches. Voluntary approaches, such as emission targets met through incentives and regulatory levers, were introduced first. Experts were asked if a voluntary policy approach would be an effective way to reduce GHG emissions; what the greatest challenges to this approach might be; and how to address these challenges using economic incentives, regulatory reforms, and zoning ordinance changes. Similar questions were asked about regulatory and market-based approaches. Experts were asked to consider aspects of possible programs, such as carbon budgets, timeframes, compliance, and enforcement.

Experts were asked to consider the following in their comments:

- All sectors that should be included in emission budgets;

- Local vs. regional emission budgets;
- Who should be able to trade;
- The role of measurement;
- Who should oversee compliance;
- Vehicle-use reductions;
- How trading systems tend to favor strategies in certain timeframes;
- The distribution of allowances and revenues;
- The allowance of trading and/or cap and trade; and
- Offsets, "banking," capping prices, and enforcement.

Voluntary Approach

Most experts believed a voluntary approach would be useful in reducing GHG emissions. One respondent noted the difficulty of using a voluntary approach with millions of people and argued that a voluntary approach alone would be ineffective. However, the experts that believed this approach could be effective offered a variety of strategies for its implementation. A common theme found throughout the answers was the need for incentives to encourage smart growth, including housing and infill development. The following are some of the examples that experts provided on how to implement a voluntary approach:

Incentives:

- Economic incentives should be used in an urban setting where housing and new development is occurring;
- Incentives should be used in an aggressive way by setting time goals;
- Incentives and disincentives need to be used strategically (e.g., make drivers pay for parking, and public transit is free);
- Cities that are doing well should be rewarded; and
- Cities requiring financial help should be able to access State funds.

Smart Growth:

- Regional Housing Needs Assessment (RHNA), which plans for growth, has not been successful, and therefore needs to be revamped so that development of affordable housing can occur near TODs;
- There needs to be more TODs, such as Tax-Incremental Financing (TIF) districts;
- Preservation and rehabilitation of assets, brownfields, and infrastructure needs to be encouraged;
- Smart growth needs well devised regulations; and

- Rewrite local zoning ordinances so new development is walkable.

Regulatory Approach

The majority of experts believed that a regulatory approach would have to be implemented regionally, although one respondent said that it should take place at the State level. Many experts believed that although mandatory reduction targets would be difficult to implement, they would be necessary to cause all regions and cities to begin making changes. Common challenges included:

- Difficulties in setting credible targets,
- Institutional barriers to implementing regulations, and
- Difficulties in monitoring and quantifying progress.

Experts cited the following as necessary to implement a regulatory approach:

- Transportation funding and public engagement;
- Time for a realistic regulatory system to evolve (perhaps by 2020);
- Enforcement and incentives for benchmarks and policies in cities;
- Carbon budgets to account for people in rural areas driving further than people in urban areas;
- Engine replacement should be regulated in the short term;
- New public transit lines should be regulated in the long term;
- Public support; and
- Elected officials who participated believed that this approach should be used at the regional level and that ARB has the authority to ensure compliance.

Market-Based Approach

Experts noted cap-and-trade as the dominant mechanism necessary to make a market-based approach effective. One environmental expert against the use of cap and trade believed that while a cap on VMT would be effective, there is not a great enough surplus for trading. Other responses to the market-based approach included:

- If businesses are put in peril to create synergy, then the market will respond;
- A market-based approach needs to follow the implementation of a regulatory approach;
- The key is to get the price of gas high enough so that people will change their behavior;
- Cap and trade needs to be mandated and regulated for gross polluters;

- Enforceable and quantifiable measures must be used with cap and trade;
- Market-based approaches would be best for the long term;
- All sectors should be included in this approach, and it should be set at the State level with the State establishing regional budgets;
- Need to figure out how to accurately measure VMT;
- Fuel consumption may be a better measure than VMT;
- ARB should oversee this approach; and
- This approach could be considered the most equitable and is likely to receive public support.

MODELING AND BASELINE ASSESSMENT, MONITORING, AND ENFORCEMENT

Next, experts were asked to think about what kinds of data will be needed to establish baseline targets or allowances, monitor progress towards goals, and enforce regulations. Experts also were asked to comment on how accurate the measurement must be for monitoring and enforcement purposes. They also were asked to consider the capabilities and limitations of current modeling tools and how they would address these limitations in both the short- and long-term.

Due to limited expertise in this area, many of the experts did not respond to questions related to modeling and baseline assessments. Nine out of the 24 experts answered the questions in this section. The following reflects their various responses:

- Current models are limited as they do not consider population migration;
- Historical performance is very important because it is the easiest to measure;
- The baseline is to set regional, not local, targets and incentives;
- There is a need for separate VMT measurements for personal travel and commercial travel (such as trucking);
- VMT should be measured, and the Department of Motor Vehicles (DMV) should be responsible for tracking it;
- Existing State regulations can help with monitoring and enforcement;
- A reformed California Environmental Quality Act (CEQA) could be used to regulate enforcement;
- Taxes should not be used to regulate, as there are already too many taxes;
- To understand GHG and where and how it is actually produced, there needs to be Sacramento Area Council of Governments (SACOG)-like models to monitor the progress;
- There needs to be models that quantify the reduction effects of infill development and

TODs to make these policies move forward;

- It is important to map GHG production across the State;
- Allocate resources for helping local governments inventory land use and develop systems for this;
- Allocate resources for ongoing data collection, traffic counts, public transit counts, and the development of a stock inventory; and
- Residential commercial energy use is important because one can evaluate infill development and the carbon benefit.

PUBLIC EDUCATION AND OUTREACH

The experts also were asked to comment on what type of educational outreach is necessary to inform the public about ways to reduce GHG emissions from transportation and if they were aware of any existing efforts/campaigns by other organizations that could serve as an effective model.

The majority of experts agreed that public education was integral to achieving AB 32 goals. However, one expert thought the growing a "green and organic" culture in California would be more effective at changing behavior than educational campaigns. The main methods of public outreach included media partnerships, marketing, and training programs. Recommendations included:

- Marketing and promotion of public transit, carsharing, and other travel alternatives;
- Public workshops on the blueprint planning process;
- Public transit and carsharing training/education programs in schools, community centers, and other public locations;
- Promotion of the economic and moral benefits of green living (i.e., energy savings in green buildings, transportation efficiency, high cost of gas, etc.);
- Press releases on new pricing programs and other increasing costs that explain benefits;
- Provide training to people for clean technology jobs to jumpstart green economic growth;
- Provide education on training to young, emerging leaders to equip them to meet 2050 goals and future challenges; and
- A multistate, or even international, approach to education is appropriate given the nature of climate change.

The following campaigns and outreach efforts were mentioned as effective models:

- Spare the Air Day (San Francisco Bay Area),
- Energy Star,
- Anti-smoking,

- Recycling, and
- Flex Your Power.

MAIN POINTS

Finally, experts were asked to restate the most important points of their interview and offer any final comments. Funding and targets were cited as the most important take-home points across all stakeholder groups. Interestingly, many stakeholder groups wanted to emphasize many of the same key points:

- A combination of strategies are needed (found across all stakeholder groups);
- Pricing is needed but is challenging to implement (found across all stakeholder groups);
- Regulatory reforms (e.g., California Environmental Quality Act (CEQA)) are needed to streamline "smart" land use practices and infill development (found across all stakeholder groups);
- Emphasize behavioral change (found across all stakeholder groups); and
- Targets must consider regional differences (i.e., urban cores vs. agricultural centers) (found across all stakeholder groups).

Other key points included:

- The State should go after gross polluters first. This was discussed by local governments and builders/developers;
- Public education is an integral component of AB 32 implementation (supported by all but one stakeholder);
- A bottom-up approach is needed to AB 32 implementation. This was noted by builders/developers, environmental stakeholders, and local and regional government;
- Regions need financial assistance in the form of subsidies or incentives to meet goals. This approach was supported by builders/developers, environmental stakeholders, and local government;
- The State must take a leadership role in developing a new framework for dispersing State transportation funds to encourage smart growth and TODs while discouraging sprawl. This was noted by environmental stakeholders and elected officials;
- Cities and regions need better measurements of GHG reductions associated with the implementation of reduction strategies. This was mentioned by elected officials, builders/developers, and local and regional governments;
- Land use practices and other regulations should be phased from voluntary to mandatory. This was noted by builders/developers and local governments; and

- Market momentum can be used to increase construction of green homes and energy efficient communities. This was discussed by builders/developers, environmental stakeholders and elected officials.

SUMMARY

Builders/Developers

Overall, all of the builders/developers (n = 4) who participated in the expert interviews agreed that pricing has the potential to be one of the most effective GHG reduction strategies, but it is challenging to implement due to a lack of political will and public support. All also thought more emphasis should be placed on behavioral change. In addition, all agreed that a reduction in carbon emissions produces an inherent conflict for cities and local governments, as they have other requirements to meet (providing affordable housing) while still meeting AB 32 and SB 375 requirements. All thought that regional differences should be considered but were unclear on how community growth can be attributed to a target. All thought targets should be set on a larger per capita scale. Three also thought the State should go after gross polluters first. One expert, in particular, noted that point source emissions are the easiest to measure, and the State should start there. In addition, schools were cited as a major trip generator and that regulatory reform (e.g., CEQA) is needed to streamline land use development and the blueprint planning process. Experts also noted building efficiency as a strategy with great potential. Three experts noted that builders and developers are trying to build "smarter" and have been developing some approaches to identify the carbon footprints of new housing developments. They also are conducting a study to identify/measure the carbon footprints of existing residential structures in California. All noted that better measurement tools are needed, and they wanted more clarity from the State on what they should measure and how to quantify and attribute a reduction target. There was consensus that a mix of voluntary, market-based and regulatory approaches should be used. Three experts, in particular, thought market-based approaches are not the best approach for local regions, as they are smaller in size and not robust enough for this approach. One added that only difficult things will be left to market-based approaches, and all easy fixes will be regulated. In addition, all indicated that regulations need to be based on technology and models; however, models are not currently accurate measures to base regulations upon. The key points derived from the builder/developer stakeholder group include: 1) there is a strong need for CEQA reform, which will help facilitate infill project approval; 2) the State should go after gross polluters first; 3) the public needs education on how to reduce their carbon footprint; 4) regions need to develop their own plans; and 5) land use and transportation are complex, and these issues will take time.

Elected Officials

All elected officials (n=4) interviewed thought pricing was one of the top reduction strategies, but they noted how difficult it is to implement. One official noted that in his region pricing may have some degree of acceptance, as people seem to be willing to pay to drive in the express lane on the 91 Freeway. There also was consensus that changing current land use and transportation infrastructure practices is critical to reducing GHGs resulting from VMT. Three mentioned TODs as a possible long-term solution, including providing economic incentives for pedestrian

infrastructure, public transportation, and creating a more transit-friendly urban footprint. However, one expert noted that the market for condos and some mixed-use housing had disappeared in his region, as the cost of single-family homes had decreased significantly. Other strategies mentioned (two experts) included regulatory reform (e.g., CEQA and zoning ordinances) to streamline building and redevelopment near job centers. Additionally, two experts added that CEQA reform is needed because a lot of money is spent "doing CEQA," and this should be coupled with incentives for regions that are already engaged in smart growth practices. One added that new homes are generally built "smarter," as they are more energy efficient and have less square footage when compared to older homes. In addition, three of the four elected officials thought emphasis should be placed on smart/green economic growth. Three of the four also thought that public outreach and education is essential to cause behavioral change and driving reduction. One noted the importance of figuring out the "tipping point" or price point that leads to behavioral change. He added that the economy (i.e., price of gas) is driving change and not climate change concerns. All experts agreed that targets should be mandatory and set at the regional level. One expert cautioned that the State should be wary in addressing land use from the perspective of cities. He also supported market-based incentives and preferred carbon fees over cap and trade and thought consideration should be given to cities and regions with a lot of industry. All thought good measurement and modeling tools are essential. Key take-home points from this stakeholder group included: the need for mandatory targets with market-based incentives, a need for better measurements tools, and the need for public outreach and education (n=3).

Environmental Stakeholders

All respondents (n=5) from the environmental stakeholder group thought pricing could be an effective reduction strategy but noted challenges with implementation. One mentioned that pricing has the potential to help change behavior "but it does not matter if we increase the cost of gas if people do not have other transportation options." Three experts also noted that GHG reductions cannot be met if development occurs in a pattern that puts people in their cars. There was consensus that land use was the most critical strategy for meeting long-term goals (2050). All thought a bottom-up approach should be integrated into the blueprint planning process and laying the groundwork for land use and transportation infrastructure is critical to future success, including regulatory reforms. All noted the importance of TODs and thought this should be coupled with more bicycle and pedestrian infrastructure. Two environmental stakeholders thought that strategies will be adopted by the State, and citizens may lobby the legislature to say that ARB has gone too far. They added that the legislature must go back to their constituents to gain local support and educate individuals in a grass roots effort to make these changes. Additionally, there was consensus that the public needs to know how serious this is, and local governments who are doing a good job should be featured as model cities. Three experts thought regions and cities that are doing a good job should be rewarded with financial incentives. One expert disagreed and did not believe incentives are needed. There also was consensus that mandatory targets set at the regional level are needed. One expert suggested reduction targets be set incrementally (e.g., reduce by 25%, 35%, 50%, 80%) and be increased over time; regions that do not comply should be penalized. Two suggested that targets should be set regionally and then, over time, expanded to other states and even internationally, as they view climate change as a global problem. All noted the importance of models and making them as accurate as possible.

One expert thought that the Councils of Governments (COGs) should develop a way to measure VMT reduction potential. Key points from the environmental stakeholder interviews included a strong need for grass roots public education, more transportation options, and implementation of smart growth practices.

Regional Government

All representatives from regional governments (n=6) who took part in the interviews noted that a combination of strategies must be used to reach both short- and long-term goals. All thought pricing could result in significant reductions but thought it would be the most challenging to implement. One stated that "their is no silver bullet but strategies such as pricing parking, hot lanes, congestion pricing, and smart growth with compact development are the best strategies to meet the AB 32 targets." Three suggested prioritizing public transit and making it work more effectively as short-term strategies. Furthermore, fundamentally changing travel patterns and land use policies were viewed as longer-term strategies. Vehicle technology was also noted as longer-term solution. One respondent noted difficulty in reaching AB 32 targets through pricing and smart growth alone and thought fuel efficiency and clean-fuel mixes could provide longer-term reductions. Two noted that the better we make fuel economy, the cheaper it is to drive; policymakers need to carefully consider trade-offs and unanticipated consequences. All were in consensus that targets should be mandatory but supported the use of a combination of approaches set at the regional level. One expert suggested that each city in the region should have a target to work towards. Public transit operators, in particular, thought emission targets should be as comprehensive as possible. One expert added that targets should be mandatory, but the State should not regulate how targets are reached, and regions should have flexibility. All agreed that more accurate models and measurement tools are needed. One stated that cap and trade is predicted on solid base lines, but we are not measuring with enough accuracy to do this yet. This expert also suggested that the DMV track VMT. Representatives from regional governments emphasized the following key points: focus on public education, more public transportation information, a need for CEQA reform, and infill incentives.

Local Government

Finally, all local government stakeholders (n=5) thought pricing policies are needed but are extremely difficult to implement. One expert thought pricing high occupancy vehicle (or HOV) lanes and creating high occupancy toll (or HOT) could provide immediate results in GHG emission reductions. Many (four experts) thought behavioral change was critical in achieving short-term reductions, as well as public transportation investment and regulatory reform. Land use strategies were noted as being difficult to implement in the short-term but were mentioned as more effective longer-term strategies. All experts thought regulatory reforms should include streamlining the Blueprint Planning process, as well as examining ports and commercial vehicle travel for GHG reduction potential. Experts were not unanimous in their opinions on which policy approach would be most effective. Some felt a mandatory approach set at the regional level would be most effective. While others felt that to set mandatory targets, accurate measurement tools are needed, which currently do not exist. Thus, a voluntary approach would be best. One expert noted that many cities are already using green building standards, and he was

unsure how cities would receive credit under a mandatory system. He suggested that the only tool that can be used to achieve a mandatory level is congestion pricing. All experts agreed that to set any mandatory targets (at city/regional levels), there will need to be political will and reliable measurement tools. Key points from the local government stakeholder interviews include: a need to create credible targets, regions need to provide subsidies and financial assistance to meet these goals, and many experts are unsure if land use and transportation should be approached from a voluntary or regulatory perspective.

CHAPTER 3: STAKEHOLDER WORKSHOPS

Between March and April 2008, researchers at the University of California, Berkeley and Davis campuses conducted five regional one-day AB 32 workshops on the land use and transportation connection. The five regions included: Oakland/Bay Area, Sacramento, San Diego, Los Angeles, and Fresno/San Joaquin Valley. Between seven and 15 individuals participated in each of the workshops. Participants represented a range of stakeholder groups, including state and local transportation agencies, local government, elected officials, builders and developers, regional agencies, environmental advocates, and business groups. They were selected by the study organizers including the California Air Resources Board (ARB), California Department of Transportation, the California Energy Commission, and the University of California, Berkeley and Davis campuses.

A total of 55 individuals from a diversity of agencies participated in one of five regional one-day facilitated workshops designed to elicit recommendations regarding effective strategies, policies, and mechanisms to implement AB 32 goals. Approximately 10 percent of participants arrived late, missing one or more of the small group exercises and discussions that were held each morning. The invitation list was significantly larger than the attendance list. All participants understood the relationships between land use and transportation and climate change and appeared to fully support AB 32 goals.

Local city or county planning staff participated in every workshop as did staff from district offices of Caltrans. Local/regional elected officials, or their staff, participated in the Bay Area, Sacramento, and Los Angeles workshops. Staff of state assembly members participated in the Bay Area and the Los Angeles workshops. Regional transportation planning agencies and/or metropolitan planning organizations were represented in each workshop. A regional air district representative participated in all workshops except for in Sacramento, and an ARB observer did attend each workshop. Many observers attended the first two workshops as well; observers did not participate in workshop exercises or conversations.

The chambers of commerce and the construction/development communities were represented only in the Bay Area workshop; the San Joaquin Valley panel expressed concern regarding the lack of participation by stakeholders from agricultural interests as well as city elected officials. In addition, stakeholders from trucking, rail, air, and marine transportation were not present. Stakeholders from public health were present at four of the five workshops.

Researchers made several observations during the course of the workshops. First, study participants felt most comfortable discussing: greenhouse gas (GHG) reduction strategies (e.g., carpooling, telecommuting); policy approaches (i.e., voluntary, mandatory, and market based); and 3) public education and community outreach. Second, the majority felt less confident discussing specific policy mechanisms (i.e., emission targets, budgets/caps, and cap and trade) and details of modeling, monitoring, and measurement. Third, many had difficulty defining/discussing market approaches in detail. Similar observations were made among the AB 32 expert interviews that were also conducted as part of this study. Furthermore, there also appeared to be some generational differences among the participants, with younger individuals

appearing to be more generally committed to a land use paradigm change and the need for a general reduction in private automobile dependence.

Limitations of this approach include its small sample size and self-selection bias (as all participants were volunteers and selected by the study organizers). Nevertheless, the regional workshops provide a representation of key stakeholder groups in California on the AB 32 land use and transportation connection and can provide insights into their various perspectives, including regional similarities and differences, in response to AB 32 implementation in the State.

The workshop schedule is presented in Table 6 below.

Table 6 Regional Expert AB 32 Workshop Schedule and Participants

Workshop	Region	Date	Number of Participants
I	Oakland/Bay Area	March 25, 2008	15
II	Sacramento	March 27, 2008	11
III	San Diego	April 2, 2008	7
IV	Los Angeles	April 18, 2008	15
V	Fresno/San Joaquin Valley	April 21, 2008	7

The agenda for each of the workshops included: 1) workshop introduction (goals and procedures); 2) an ARB staff overview of AB 32, 3) effective reduction strategies (e.g., carpooling, public transportation) for California for two timeframes: 1) 2010 to 2020 and 2) 2021 to 2050 (exercises 1A and 1B; see below); 4) policy approaches (i.e., mandatory, voluntary, and market based) (exercises 2A and 2B; see below); 5) policy mechanisms discussion (i.e., establishing and using targets, incentives and disincentives, regulatory reform (e.g., California Environmental Quality Act (CEQA), emission budgets and trading; 6) projections, models, and monitoring; and 7) public education and community outreach.

Stakeholder agencies/organizations participating in the workshops included:

Oakland/Bay Area:

- Bay Area Rapid Transit (BART) District Board of Directors
- Bay Area Air Quality Management District
- California State Assembly (11th District)
- Caltrans (District 4)
- City of Berkeley
- City of Richmond
- City of Rohnert Park

- City of San Francisco
- Marin County Local Agency Formation Commission (LAFCo)
- Metropolitan Transportation Commission
- PolicyLink (a national non-profit focused on equity and development)
- Silicon Valley Leadership Group
- Transportation Land Use Coalition
- Triad Communities (private developer)

Sacramento:

- California Association of Local Agency Formation Commissions (CALAFCo)
- California Department of Housing and Community Development
- California Department of Public Health
- California Energy Commission
- Caltrans, District 3
- City of Lincoln
- City of Sacramento
- City of West Sacramento
- Institute for Local Governments
- Sacramento Area Council of Governments (SACOG)
- WALK Sacramento

San Diego:

- Caltrans, District 11
- City of Chula Vista
- City of San Diego
- Metropolitan Transit System
- San Diego Air Pollution Control District
- San Diego Association of Governments
- San Diego County Health and Human Services Agency

Los Angeles:

- California State Assembly
- Caltrans, District 7
- City of Santa Monica
- Fehr and Peers, Inc.
- Los Angeles County Board of Supervisors
- Los Angeles County Department of Health
- Los Angeles County Metropolitan Transportation Authority (LACMTA)
- Los Angeles Department of City Planning
- Rand Corporation
- San Bernardino Associated Governments (SANBAG)
- San Bernardino Local Agency Formation Commission (LAFCO)
- South Coast Air Quality Management District (SCAQMD)
- Southern California Association of Governments (SCAG)

San Joaquin:

- California Coalition for Rural Housing
- California Department of Conservation
- Caltrans, District 6
- Fresno County Department of Public Health
- Fresno Local Agency Formation Commission (LAFCO)
- Merced County Association of Governments (MCAG)
- San Bernardino Associated Governments (SANBAG)
- San Joaquin Valley Air Pollution Control District

This synopsis is organized into two sections: 1) highlights and recommendations from the workshops and 2) comparison and analysis across regions by topic.

HIGHLIGHTS AND RECOMMENDATIONS FROM REGIONAL WORKSHOPS

In this section, the authors provide highlights and recommendations from each of the five regional AB 32 land use and transportation workshops.

The Oakland/Bay Area Workshop

- There was unanimity that successful implementation of AB 32 would involve a process of pushing and pulling society and technologies towards a paradigm change for both land use patterns and travel habits, a change that could produce solid co-benefits for health, quality of life, and environmental sustainability. There was unanimity that the complexity and cost of doing this was worth it.
- The Oakland/Bay Area group expressed optimism about the Bay Area's receptivity to strategies that reduce both GHG emissions and vehicle miles traveled (VMT). Repeatedly they said that citizens of the region are poised to respond. The public needs to be given real options and some incentives. Local governments are similarly receptive, but they need funding to conduct the planning and make the code revisions that are necessary.
- Changes in land use and development patterns should be started immediately to have a long-term impact. Pricing, along with mobility management and more public transportation, which is coupled with a cooperative public taking voluntary individual actions will move the Bay Area towards the 2020 as well as the 2050 goal.
- All strategies are linked and broad behavioral changes will occur over time. ARB should therefore expect to monitor and modify the strategy mix and policy approach frequently, moving generally from voluntary actions and the "demonstration" of strategies towards establishing and managing mandatory regional targets that are supplemented by economic and regulatory signals that help people make choices that support AB 32 goals.
- GHG emissions are the preferred measure for implementing AB 32 goals; these are viewed as broad and equitable. GHG data can be captured from fuel consumption records. Most agreed it would also be useful to track regional VMT to monitor changes in land development and travel patterns producing co-benefits.
- Co-benefits are more tangible and immediate for most people than reductions in the speed of climate change or carbon dioxide (CO_2) emissions. Hence, ARB can use co-benefits as a way to attract voluntary actions from individuals and entities in achieving AB 32 goals.
- Incentives and disincentives for reducing GHG emissions or VMT should be large and meaningful. Meeting targets can be linked to regulatory release or the distribution of State funding to provide incentives (or disincentives) for action.
- Financial incentives can be paid for with revenues from carbon taxes, fees on sprawl development, and similar penalties to create some fiscal neutrality; however, more funding for infrastructure and public transportation will be needed to create viable

choices for individuals.

- Reforming rules that could work against AB 32 goals will be critical, particularly the California Environmental Quality Act (CEQA) and the effect of Prop 13 (the "People's Initiative to Limit Property Taxation") requirements on local government revenues. The Regional Housing Need Allocation (RHNA) timeframe needs to be adjusted to sync with the metropolitan transportation plan (MTP) process (as in SB 375, adopted in Fall 2008).
- Emission budgets and trading programs are not appropriate in this context. This mechanism is too bureaucratic, too litigious, and too opaque.
- Regional rather than local targets are preferred.
- Models and projections are useful tools for evaluating and tracking policies, but much better data accuracy would be needed before the Bay Area panelists felt comfortable using models for compliance and enforcement.
- Professional public relations and marketing campaigns as well as K-12 science curriculum should be developed and used to shift lifestyle choices and enlist the support of the next generation.

Sacramento Workshop

- The Sacramento panel comprised a mix of statewide and Sacramento regional perspectives. As a group, they focused on problems and issues in AB 32 implementation rather than on reaching consensus in discussions, although no clear counter positions emerged throughout.
- For achieving the 2020 AB 32 goal, this group recommended using a combination of pricing and mobility management strategies, with revenues generated by fees, taxes, and penalties used to support public transportation improvements and incentives and rewards for those who shifted their travel habits away from reliance upon single occupant vehicles. Most argued that pricing signals are the single most effective near-term strategy for influencing individuals' housing, job, and transportation choices.
- In the long term, land use pattern paradigm change would be needed, including denser more transit oriented development (TOD) and green building designs that lower energy consumption. Such changes should be started immediately through State support and technical assistance for regional blueprint planning and local ordinance revision. The group did not see these activities producing greater than marginal reductions in either VMT or GHG reductions in the near term but would be critical factors in the long term.
- Panelists generally recommended that policies be supported by market-based strategies to ensure that economic signals are consistent with AB 32 goals. Generally speaking, panelists agreed that near-term policies rely on voluntary measures (with strong economic incentives) and move towards a more regulatory approach crafted out of lessons learned from these near-term efforts.
- As a group, the Sacramento panel appeared to be dominated by planners and others

focused on lifestyle change and health and environmental co-benefits of GHG emission strategies. As a result, VMT appeared to be the preferred measure for establishing and using targets; however, at the same time, the group raised many practical problems associated with collecting and monitoring local as well as regional VMT.

- While seeing the accountability benefit of setting emission/VMT targets city by city, this group appeared most comfortable with regional targets. There was little discussion and no practical issues were raised with regards to cap-and-trade schemes.
- Panelists were clear regarding the need to avoid sending cross signals whether economic or regulatory (e.g., CEQA). As a group, this panel appeared to be wary about another top down set of rules. They talked many times about the success of the blueprint planning process as a forum for negotiating the variety of rules and regulations within which regions must comply. Participants repeatedly suggested that this process should be used to frame AB 32 implementation.
- Many issues were raised about the current state of the modeling practice. In the end, because of data flaws and other issues, this group felt that the primary role of models should be to plan and evaluate strategies rather than to monitor and enforce targets. A minority felt that the State needed to focus on model improvement.
- Most panelists agreed that the California general public was ready to adopt a low carbon lifestyle. However, the State needed to ensure that sufficient choices in terms of housing availability and affordability, as well as high quality public transit options were there. A public campaign should be sophisticated and targeted on what sectors can do now to lower their personal carbon footprint. There needs to be a robust statewide campaign, as well as creation of K-12 curriculum, to harness the enthusiasm and power of the next generation.
- There seemed general agreement that the AB 32 Scoping Plan would be just the beginning and implementation would be tough, require internally consistent and long-term commitment from all levels of government. Success would be contingent on removing economic and regulatory signals that counter AB 32 goals. Climate change is important and needs to be addressed.

San Diego Workshop

- Overall, the San Diego group appeared to be committed to climate change and AB 32 goals. They expressed a fairly strong consensus that significant carbon emission reductions could be achieved by implementing more transit oriented and new urbanist land use patterns, providing increased funding for public transportation operations and infrastructure, funding and supporting local government planning efforts, and implementing and enforcing land use paradigm changes for both infill and new development.
- All recognized that significant changes in land use patterns and transportation habits would take many years to accomplish if started now. Therefore, short-term strategies (i.e., those addressing the 2020 goal) should be selected from pricing and mobility

management categories. In San Diego, it was felt that behavioral change would follow the implementation of new strategies and alternatives, particularly if synchronous changes were made in economic signals.

- Land use change needs to begin with updating plans and local ordinances. Although these changes are made on the local level, there is a role for State government as the facilitator of change, including providing funding to local government, developing incentives for developers, and establishing centralized technical assistance including development model ordinances and a "tool box" of strategies and consistent statewide emissions models.

- Clear (but not "draconian") statewide targets and standards should be adopted. Failure to meet targets or to implement standards should carry significant consequences.

- This region preferred a mix of regulatory and market-based schemes; the panel felt it was too late to rely on voluntary approaches. Regulatory was defined by the group as "targets" and "standards;" market-based meant pricing schemes, signals, fees, subsidies, and any type of economic signal, as well as emission trading.

- The preferred metric for the transportation land use sector of carbon emissions was VMT, although throughout the workshop panelists indicated flaws with this measure with regards to data accuracy and ability to translate VMT into a broader GHG measure.

- Tying vehicle registration fees to VMT would be a good mechanism to raise additional funds. Generally, financial incentives and disincentives should be linked to achieve some fiscal neutrality. Nevertheless, additional State funds would be needed to successfully implement AB 32 goals over time.

- Cap and trade could be implemented for a variety of reduction strategies, such as parking densities, across regions and the State.

- There was no discussion among panelists regarding the effect of changing vehicle technologies or energy sources on these mechanisms; reducing VMT for climate change and co-benefits was their primary focus.

- Regional targets were preferred over local targets, although there was considerable concern that this region not be penalized for its geographic and climate differences (i.e., hot dry). Emission trading strategies might be used to equalize targets across the State. There was hesitation about the implementation of "caps," which the group generally viewed as too constraining and inflexible.

- Within the San Diego region, citizens are generally aware of climate change issues, although this awareness is not well translated into an understanding of consequences or behavioral change. Public campaigns should therefore make use of trendy entertainment glitz and celebrities to generate local concern and personalize impacts about climate change and to provide individuals with real actions that they can take now to make a difference.

Los Angeles Workshop

- Fifteen individuals participated in the Los Angeles panel from a diversity of stakeholder perspectives. Views differed somewhat, although in the end, this group displayed fairly strong agreement about effective strategies, policy approaches, and mechanisms for implementation and compliance. All panelists appeared supportive of AB 32 goals.

- A mild pessimism overlaid comments from this group regarding the ease with which the Los Angeles region could meet AB 32 goals by making land use and transportation changes. Most emphasized the drag placed on the region's capacity by its large, diverse, spread out, polycentric, car-focused nature. Strong, clear regulations and a meaningful pricing shift (i.e., economic signals that make single occupant vehicles less attractive), along with significantly more public transportation infrastructure, will be needed to achieve long-term goals. Behavioral change in this region will follow, rather than lead this paradigm shift, due to deeply embedded housing and travel patterns. Actual reduction of carbon emissions may in the end be more reliant on vehicle technology change.

- Most panelists focused their recommendations for effective reduction strategies on pricing and economics. Next, land use change and mobility management (e.g., carpooling, telecommuting) followed as effective reduction strategies; however, both would only be effective on the margin in the short term (i.e., within the 2010 to 2020 timeframe). Many expressed that implementing strategies would be relatively challenging for the Los Angeles region but would get easier over time. Public campaigns and K-12 curriculum to encourage behavioral change would become more effective in the long term, after laws and low carbon alternatives were in place. Mobility management dropped off the explicit strategy list, as panelists felt it would be "embedded" into new land use paradigms. Overall, this panel had difficulty prioritizing among strategies, feeling that all strategies should be used in this region.

- The policy mix should start out in the near term with clear regulations, employing various pricing signals to create a set of incentives and disincentives. During the 2012 to 2020 timeframe—once a regulatory framework had become more institutionalized—a greater reliance on pricing and market-based approaches would make sense in Los Angeles.

- Many expressed the need for additional public transportation funding for infrastructure development, service expansion, and operational improvement. Some local stakeholders recommended a moratorium on highway investment for the region, with a shift in transportation dollars going into mass transit.

- There was general agreement that both RHNA and CEQA needed some modification to ensure that GHG reduction be given priority over other variables. There was a sense, that if this were done these processes would work better and still accomplish their goals. Many expressed frustration with the current complexity of multiple review criteria and that CEQA requirements could undermine AB 32 goals.

- Regional targets for GHG emissions should be established, with some voluntary VMT

guidelines to assist implementation. Panelists felt that the Southern California Association of Governments (SCAG) should lead the process of allocating emissions down to local entities, possibly using a modified, or tiered, blueprint planning process. Stakeholders generally appeared to like how the blueprint process worked in other parts of the State, but they were united behind the concept that unless modified it could not work for Los Angeles, which is too large and diverse.

- Panelists expressed doubt about the use of models for compliance or enforcement, feeling that data were not accurate enough and the model algorithms not sophisticated enough for these purposes. However, models could be used for evaluating "what-if" scenarios and for public information. The preference in this group for compliance and enforcement was to collect GHG data directly similar to criteria pollutants. This would also lead to less litigation.

- Public education campaigns needed to be very Hollywood—glitzy, star-studded, targeted to market sector, and focused upon: 1) making the connections between current land use/travel patterns, climate change, and health impacts and 2) actions individuals could take now. Public campaigns should not get too far ahead of real options or law. Waste recycling campaigns were cited as a good model.

San Joaquin Valley Workshop

- The panel for the San Joaquin Valley workshop was small and somewhat diverse, but most agreed that input from several important players was missing—the farm community (e.g., Farm Bureau) and elected local officials. Another AB 32 meeting was held in the region on the same day as this workshop, making it challenging to attract as many participants.

- The majority felt that the most effective short-term (2010 to 2020) reduction strategies for the Valley would consist of a combination of mobility management, pricing, and Intelligent Transportation System (ITS) applications. Many felt that public campaigns to raise awareness and understanding of climate change should be started immediately to: 1) get people to buy into pricing and mobility management and 2) lay a foundation for changed development patterns.

- The most effective long-term (2021 to 2050) reduction strategies for this region would be changed land use development patterns—denser, walkable, mixed use and transit oriented with greater job diversity in conjunction with housing—coupled with green building standards and codes. Pricing schemes and ITS (e.g., adaptive signal control for urbanized areas) should be an ongoing continued focus, along with public campaigns and school curriculum to reinforce behavioral change.

- Panelists felt some pessimism regarding the "readiness" of Valley communities to undertake the AB 32 challenge. There was much discussion about the "failure" of local elected officials to engage with RHNA or the blueprint planning process.

- There was a presumed willingness to sell land in the Valley to developers to build large single-use bedroom communities to be inhabited by families working in

Sacramento and the Bay Area. The job-housing imbalance was perceived as a unique characteristic of the region that would make GHG emission reduction particularly challenging.

- Panelists believed that a balanced approach, weighted towards regulation (setting targets with consequences) and supported by market-based strategies to provide flexibility should be used in both the near term (present to 2012) and the 2013 to 2020 timeframe. Voluntary actions, with or without market incentives, would not be sufficient to achieve AB 32 goals. Most believed that regulation would need to become stronger—adding consequences—over time, but this could/should be mitigated (to some extent) by increasing market-based strategies to ensure economic signals lined up with climate change goals.
- Panelists appeared comfortable with targets set in terms of GHGs, but they were reluctant to set aside VMT, which was viewed as providing a way to track change patterns of land use-transportation relationships. VMT would be difficult to reduce in light of continued population growth in the Valley.
- Targets should be set regionally (i.e., by county) with counties allocating targets to cities. All cities should be accountable for making some emission reductions. Targets need to have serious consequences to engage local entities and employers in the process, which could be managed through use of the blueprint planning process.
- Many expressed the probable lack of cooperation from locals for code and ordinance revision to adopt land use changes. Grants to cities would not work, as many cities did not feel strapped (no cities were represented in this statement).
- Cap and trade can work with large stationary sources, but it would probably not be workable in the Valley.
- RHNA rules need to be reformed to remove their use to promote/support sprawl development. RHNA does not "work" because it carries no requirement to actually build affordable housing.
- Data flaws and inaccuracy mean models are best used to explore and evaluate policies—not for compliance and enforcement. The air quality conformity process and its models were perceived as flawed and malleable.
- Public campaigns and school education curricula need to be targeted to the region and start from the beginning with problem definition, then link the problem to solutions that individuals in the region can employ. Co-benefits of better health and farmland preservation should be emphasized.

COMPARISON AND ANALYSIS ACROSS REGIONS BY TOPIC

In this section, the authors contrast regional responses to a variety of topics including: 1) effective reduction strategies; 2) priority reduction strategies; 3) mix of policy approaches; 4) policy mechanisms; 5) regulatory reform; 6) emission budgets and trading; 7) projections, models, and monitoring; and 8) public education and community outreach.

Effective Reduction Strategies

Panelists participated in a group exercise designed to elicit a discussion of the most effective categories of reduction strategies to meet the 2020 and 2050 GHG reduction goals for AB32, respectively. The workshop facilitator described five broad categories.

- Land Use Strategies explicitly designed to reduce reliance on automobiles. Examples include encouraging mixed use, transit-oriented development (TOD), green building, expansion of public transportation facilities, and construction of pedestrian and bicycle facilities.
- Mobility Management Strategies involve public policies and programs that encourage individuals to reduce their use of single occupant vehicles (SOVs) through, for example, carsharing (short-term vehicle use), ridesharing, and telecommuting.
- Pricing Strategies involve use of fees, taxes, rebates, for example, to affect the relative cost of different transport mode use, sending economic signals that encourage individuals to reduce SOV use and thus reduce GHGs.
- Intelligent Transportation Systems (ITS) Strategies involve the application of sensing, computing, and communication technologies to improve public transit and traffic operations, smoothing congestion and encouraging transit ridership and thus reducing GHG emissions. Examples projects include bus rapid transit (BRT) and adaptive signal coordination.
- Behavioral Change Strategies involve public education and marketing campaigns, such as "buy local" or "Spare the Air," that encourage low carbon choices as well as the adoption of K-12 science curriculum for climate change.

Panelists recognized many linkages among the strategies. Panelists were asked to place dots on the chart between high or low within the categories to indicate the relative degree of difficulty they thought implementation might be within their region. All panelists then had an opportunity to discuss their choices. A number of changes in this exercise were made in later workshops to clarify it for participants. It is interesting to note that the main change—a clarification in the category definitions (listed above)—did not appear to significantly change the recommendations of panelists. Each exercise required participants to indicate their first, second, and third priority among the five strategies.

Exercise 1A asked panelists to focus on reduction strategies for the period leading up to 2020; Exercise 1B asked panelists to focus on strategies for the period from 2020 to 2050. The description of the timeframe became clearer over the course of the workshop deliveries, shifting slightly from "What strategies will be most effective for meeting the 2020 goal and 2050 goal," respectively, to "What strategies should be the focus of attention during the 2010 to 2020 timeframe and the 2021 to 2050 timeframe to achieve the respective goals." The difference between the two views of the exercise timeframes was most evident in the land use and behavioral change categories.

There was strong consensus that it will take 20 to 40 years (one to two generations) to evolve new land-use transportation relationships and to change lifestyle choice. Because of this, some panelists appeared to struggle when asked to choose between 1st, 2nd, and 3rd choices, trying to reflect in their vote the most appropriate level of ARB focus or attention. If a dot was not placed in a category, this did not mean it was insignificant or unimportant, but that public sector attention might not be needed because a particular strategy had become thoroughly institutionalized or embedded in dominant culture.

Many panelists also seemed to struggle with how best to respond to the behavioral change category. All felt that behavioral change absolutely needed to occur; the question was rather how much attention needed to be placed by government on pushing or pulling change forward. Some felt that change would be in the end generational and would occur without significant push from governmental agencies. The Bay Area panel, for example, felt that change was already far along for their region and that the emphasis of government was to follow, reinforce, and make sure that sufficient housing and non-auto infrastructure were available. Others spent considerable thought trying to determine whether behavioral change would be needed to push forward the creation of alternatives. This was the view in Sacramento, for example. In the end, there was no single answer, although there was little disagreement about the general principle that behavioral change was fundamental.

Panelists all made serious efforts to match their selection of strategic categories with their perception of the current attitudes towards climate change exhibited by citizens and local governments in their region and their understanding of relevant regional characteristics (i.e., characteristics making the region somehow unique within California).

Timeframe 2010 to 2020: Most Effective Strategies by Region (Exercise 1A)

Below are listed the rankings of the five categories of strategies for each region, using a weighted scoring system in which a blue vote is given three points, a green vote two points, and a yellow vote one point. The real number of panelists who selected a category at any level is noted in brackets. In the few cases where there was a tie between weighted scores, the number of panelists who placed any vote for the category was used to rank the category within that region.

Bay Area

There was strong consensus regarding the most effective strategies; however, panelists continuously remarked on linkages across categories and that no category should be completely ignored.

1. *Weighted score: 29 [11 out of 14]* It is important to implement change in local **LAND USE** patterns for both infill and new development to create denser, walkable, transit oriented, mixed use neighborhoods. Some panelists thought that land use changes would be difficult but easier than expected to implement; others viewed this as politically difficult.

2. *Weighted score: 19 [12 out of 14]* **PRICING** was recommended to support land-use travel behavior shifts by sending strong economic signals designed to discourage

auto use and to encourage green building design, residential choice in denser/mixed use communities, and non-auto travel mode use. Pricing was considered easy to difficult to implement, depending on specifics; equity was a key concern for this region.

3. *Weighted score: 15 [9 out of 14]* **MOBILITY MANAGEMENT** was emphasized, including bringing back transportation demand management (TDM) programs, carsharing (short-term vehicle use), and public transportation services. Mobility management was considered moderately difficult to easy to implement.

4. *Weighted score 13 [7 out of 14]* **BEHAVIORAL CHANGE** through targeted public campaigns and K-12 science curriculum was considered critical. Behavioral change ranged from moderately easy to difficult to implement; and

5. *Weighted score 8 [4 out of 14]* **ITS** applications were noted to smooth congested traffic and improve public transit services (e.g., BRT). ITS was considered easy to implement.

Sacramento

1. *Weighted score 14 [7 out of 9]* It is important to implement change in local **LAND USE** patterns for infill and new developments to create denser, walkable, transit oriented, mixed use neighborhoods. This will yield marginal reductions in this timeframe; it is difficult to implement but important to start now.

2. *Weighted score 12 [6 out of 9]* **BEHAVIORAL CHANGE** through public campaigns and school curriculum can reap immediate reductions by encouraging early adopters as well as driving forward more difficult land use, mobility management, and pricing agendas. This was considered moderately easy to implement.

3. *Weighted score 12 [5 out of 9]* **PRICING** is essential to support land-use travel behavior shifts by sending strong economic signals designed to discourage auto use and to encourage green building design, residential choice in denser/mixed use communities, and non-auto travel mode use. This was considered moderately easy to implement. Equity and political feasibility were seen as key issues. Prices drive behavioral change.

4. *Weighted score 10 [6 out of 9]* **MOBILITY MANAGEMENT** was considered an important approach, including bringing back TDM programs, carsharing, and public transit services. It was considered moderately easy to implement. Mobility management strategies can be linked to pricing schemes that generate revenue. Such strategies can be attractive to early adopters of a new low carbon lifestyle.

5. *Weighted score 6 [3 out of 9]* **ITS** applications are important to smooth congested traffic and improve public transit services (e.g., BRT). They were considered very easy to implement, making alternative modes more attractive.

San Diego

1. *Weighted score 16 [7 out of 7]* It is important to implement change in local **LAND USE** patterns for infill and new developments to create denser, walkable, transit oriented, mixed use neighborhoods. Co-benefits are important. There was some difference of opinion regarding the relative magnitude of reduction for the 2010 to 2020 time period. This was considered neither particularly difficult nor easy to implement.

2. *Weighted score 10 [5 out of 7]* **PRICING** strategies should be designed to send clear economic signals consistent with climate change goals and to reduce VMT. Pricing was considered moderately easy to moderately difficult to implement, depending on the strategy selected.

3. *Weighted score 7 [4 out of 7]* **BEHAVIORAL CHANGES** should be achieved through a combination of public marketing campaigns and the adoption of K-12 climate change curriculum. They should be linked to both land use and mobility management strategies; campaigns should not get too far ahead of the availability of choices. Behavioral changes should be moderately easy to implement.

4. *Weighted score 6 [3 out of 7]* **MOBILITY MANAGEMENT** was viewed as somewhat easy to implement but not particularly popular without significant changes in attitude. Effectiveness could increase with changing land use patterns. This was considered easy to hard to implement, depending on perspective.

5. *Weighted score 3 [2 out of 7]* **ITS** lacks funding, is moderately effective at reducing carbon emissions, and is easy to implement.

Los Angeles

1. *Weighted score 32 [14 out of 15]* **PRICING** strategies that send economic signals consistent with the goals of AB 32 are key for this polycentric region. Such strategies would be moderate to difficult to implement.

2. *Weighted score 27 [12 out of 15]* **LAND USE** strategies were considered important, including the construction of new public transportation infrastructure and changes in land development patterns (including infill) towards denser, more compact, transit-oriented and mixed use designs. Such strategies are moderate to quite difficult to implement and closely linked with pricing strategies.

3. *Weighted score 16 [10 out of 15]* **ITS** applications also were considered essential, which improve highway efficiency and public transit operation and services. They are easy to moderately easy to implement.

4. *Weighted score 10 [6 out of 15]* **MOBILITY MANAGEMENT** was selected as a marginally effective strategy by a minority; more believed that TDM was particularly difficult and ineffective in spread out polycentric Los Angeles. Where appropriate, these strategies are moderate to easy to implement.

5. *Weighted score 5 [4 out of 15]* **BEHAVIORAL CHANGE** ranked low for this region due to the general lack of available, climate friendly land use and transportation options. Panelists cited spread out land uses, lack of centers, and public transit poverty as reasons not to focus on what actions individuals can take in the near term as a means of achieving the 2020 reduction goals. The minority who selected this strategy viewed it as moderately easy to moderately difficult to implement.

San Joaquin Valley

1. *Weighted score 12 [4 out of 6]* **MOBILITY MANAGEMENT** strategies, focused on large employers, were viewed as the most effective short-term solution for the San Joaquin Valley region. Such strategies were considered moderate to easy to implement.

2. *Weighted score 11 [4 out of 6]* **PRICING** strategies encouraging use of mobility management strategies were viewed as a close second for this region. They should be moderate to difficult to implement.

3. *Weighted score 7 [4 out of 6]* **ITS** applications for smoothing congested traffic, including adaptive signal synchronization, would be effective in urbanized areas. They would be moderately easy to moderately difficult to implement.

4. *Weighted score 6 [5 out of 6]* **BEHAVIORAL CHANGE** strategies to support TDM and build understanding of climate change and the need for new land use patterns ranked fourth. They would be moderately easy to moderately difficult to implement.

5. *Weighted score 3 [1 out of 6]* Changes in **LAND USE** patterns to increase density in areas of current development and protect open farmland ranked fifth. They would be very difficult to implement.

Table 7 Timeframe 2010 to 2020—Comparison of Rankings Across Regions

	Bay Area	Sacramento	San Diego	Los Angeles	San Joaquin
Land Use	1	1	1	2	5
Mobility Mgmt	3	4	4	4	1
Pricing	2	3	2	1	2
ITS	5	5	5	3	3
Behavioral Change	4	2	3	5	4

Panelists in all five sessions agreed that over the long haul (20 to 30 years) GHG reductions will be achieved in part due to denser, more walkable, less automobile-oriented land use patterns that

are supported by more public transit (bus, rail) and embrace reasonable mixes of residential, commercial, and retail and "clean" work environments. These changes in land use patterns also will have many health and environmental co-benefits that are of value to California residents. All panels also displayed a strong consensus that the effectiveness of land use changes, carried out by changes in local planning and zoning and building codes, would take time to implement. However, change would become easier over time as political pressure for change developed. Many saw generational change as key. All believed that change should begin now. There was no significant difference in opinion across stakeholder groups.

Panels for the Bay Area, Sacramento, and San Diego all ranked land use change and public transit infrastructure development as their number one strategy for the 2010 to 2020 timeframe, largely because these changes have already begun through the regional planning process and have at least some support among some local governments, referred to by the panelists as "early adopters." The lower ranking given to land use change by both the Los Angeles and San Joaquin regions directly resulted from panelists' view that these changes would be very difficult due to current developmental patterns. The Los Angeles panel appeared to sense some movement towards a land use paradigm change within the region; however the spread out, polycentric historic development pattern of the region makes such a change more challenging than in more dense urbanized areas. This panel gelled around a strategy that used pricing signals to gain immediate reductions and that moves land use change forward. The San Joaquin panel viewed their region as "becoming Los Angeles." Their agenda revolved around preserving agricultural areas while being realistic about the difficulties of acting as bedroom communities for jobs in the west and north of the region. This panel was very concerned about the job-housing balance and the politics of farmland preservation (versus farmland development).

Strategy ranking in all panels appeared to be based upon a collective understanding of how best to move away from the standard post-WWII development practice of greenfield sprawl, single use, automobile dependent land use patterns through a combination of pushing and pulling change. All panels noted the importance of State leadership in resetting economic signals and in developing statewide green building codes, model zoning ordinances, and funding for the blueprint planning processes. Los Angeles expressed a need for a tiered blueprint process, while San Joaquin expressed a need for consequences to force participation from reluctant local officials.

All panels appeared to understand the uses and functions of mobility management strategies and ITS applications, although most panelists appeared to be less enthusiastic and less focused on these strategies except as interim and somewhat marginally effective. Public transit was viewed as critical; all panels at some point noted that more funds for public transit services and infrastructure would be key to achieving AB 32 goals. Both mobility management (public transit, TDM, carsharing, telecommuting) and ITS applications for transit and highways were viewed as "low-hanging fruit" and a relatively easy way to get started.

Pricing, which most panelists viewed as a combination of economic incentives and disincentives for use of single occupant vehicles, was viewed as tightly linked to land use patterns, either because it would push adoption forward or because it could be used to fund public transit and mobility management services. Pricing was ranked first by Los Angeles because of its strength and because it would be easier and quicker to implement than land use patterns. Pricing was ranked second by the Bay Area, San Diego, and San Joaquin Valley, again because of its power

and the relative speed with which it can have an impact on emission reductions. The Sacramento region could not decide whether to rank pricing or behavioral change second—their weighted scores were identical, with behavioral change being shown as second only because it was selected by one more person from the list of three. All panels appeared to assume that pricing strategies and economic signals would to some extent be led by State guidelines or regulations.

Regions tended to rank behavioral change differently largely due to how they worked through the linkages with other strategies. Behavioral change strategies were generally accepted to be: 1) public media campaigns and 2) the adoption of climate change information into the K-12 science curriculum. All regions felt that public media campaigns needed to be targeted to their region and focused on what individuals can do now to have an impact. All panels recommended professionally designed campaigns that were careful not to get too far ahead of the existence of low carbon housing and travel options. Overall, panelists appeared to view campaigns as having three components. First, they should promote general awareness of climate change as a problem for individuals and specific regions. Campaigns needed to personalize and specify the impacts of climate change so that individuals in the region understand what it means to them. Second, it is critical to link the climate change problem and the choices that people can make (e.g., making six separate trips from home to a destination produces more emissions than making a single trip that bundles together activities and destinations). Third, there are specific actions that one can take now, with actions being targeted very clearly to market segments including teenagers, young families, workers, and seniors. Co-benefits of specific actions also should be promoted to add value.

The Bay Area panel believed their region was ready for a campaign focused on personalized local impacts of climate change to drive the message home. The Sacramento region also thought their region was fairly aware of climate change as a problem, although many if not most people in the region failed to link their own daily behaviors and choices with that problem. The panel felt it important to make this linkage to achieve policy goals and adopt new practices and thus gave behavioral change strategies a relatively higher weighted score than other regions.

Timeframe 2021 to 2050: Vision for The Future (Exercise 1B)

Below are listed ranked categories by region, followed by a table summarizing the results of Exercise 1B. In each of the workshops, the moderator facilitated a discussion regarding the panelists' rationale for placing their dots as they did. During this process, it became clear that many approached the second timeframe differently than they did in Exercise 1A. A number of panelists made no change in their selection of effective strategy; others explained their dot placement as "it will be done by now." Many expressed mild frustration with the exercise as "things will be very different for this timeframe." All agreed that generational change, vehicle technology change, and changes in energy source would all have impacts on the transportation and land use sector. There was significant consensus across all the regions that in the "long run" land use changes were needed towards more dense, walkable, mixed use, and transit-oriented development, even if all vehicles were carbon neutral. Overall, panelists supported new development patterns and pricing strategies to reduce auto use due to the co-benefits associated with human health and environmental sustainability.

Bay Area

1. *Weighted score: 44 [14 out of 14]* It is important to implement change in local **LAND USE** patterns to encourage infill and new developments that create denser, walkable, transit oriented, mixed use neighborhoods. Most thought this strategy would continue to be moderately difficult, at the same time get easier over time as new patterns and rules became more mainstream.

2. *Weighted score: 15 [8 out of 14]* **PRICING** should be implemented to support land-use travel behavioral shifts by sending strong economic signals that discourage auto use and encourage green building design, residential choice in denser/mixed use communities, and non-auto travel mode use. Pricing will be moderately easy to moderately difficult to implement, depending on the specifics, during this timeframe; equity will continue to be an important concern for this region.

3. *Weighted score 11 [8 out of 14]* **BEHAVIORAL CHANGE** should be targeted through public campaigns and coupled with the implementation of a K-12 science curriculum. For panelists, behavioral change ranged from moderately easy to difficult to implement during this timeframe;

4. *Weighted score: 10 [6 out of 14]* **MOBILITY MANAGEMENT** should include TDM programs, carsharing, and public transit services. It will be moderately easy to implement in the second timeframe.

5. *Weighted score 6 [5 out of 14]* **ITS** applications should be deployed to smooth congested traffic and improve public transit services (e.g., BRT). This will be easy to implement in this timeframe.

Sacramento

1. *Weighted score 27 [9 out of 9]* The Sacramento region should implement change in local **LAND USE** patterns for infill and new developments to create denser, walkable, transit oriented, mixed use neighborhoods. This will yield greater reductions in the second timeframe and will be easier to implement.

2. *Weighted score 9 [6 out of 9]* **PRICING** should be employed to reinforce land-use travel behavior shifts by sending strong economic signals that discourage auto use and encourage green building design, residential choice in denser/mixed use communities, and non-auto travel mode use. This was considered quite easy to moderately difficult to implement, depending on the strategy, during the second timeframe.

3. *Weighted score 8 [5 out of 9]* **BEHAVIORAL CHANGE** through public campaigns and school curriculum can reap immediate reductions by encouraging early adopters as well as driving forward more difficult land use, mobility management, and pricing agendas. This was considered moderately easy to implement in this timeframe.

4. *Weighted score 5 [3 out of 9]* **ITS** applications are needed to smooth congested traffic and improve public transit services (e.g., BRT). This was considered very easy to implement in the second timeframe.

5. *Weighted score 4 [3 out of 9]* **MOBILITY MANAGEMENT** strategies, such as TDM programs, carsharing, and public transit services, should be linked with pricing schemes. This was considered moderately difficult to implement, particularly as vehicle technologies change towards low/no emission vehicles.

San Diego

1. *Weighted score 20 [7 out of 7]* It is important to implement changes in local **LAND USE** patterns towards infill and new developments that create denser, walkable, transit oriented, mixed use neighborhoods. There was strong consensus that implementation will be moderately difficult and get easier over time.

2. *Weighted score 11 [6 out of 7]* **PRICING** strategies should continue to send clear economic signals that are consistent with climate change goals and reduce VMT. Pricing will be easy to moderately difficult to implement during the second timeframe, depending on the strategy selected. There was a perception among the panelists that there will be holdouts, such as anti-tax proponents, who will always make pricing somewhat difficult.

3. *Weighted score 5 [4 out of 7]* **ITS** should continue to be used to gain all possible reductions from public transit and traffic applications. This should be easy to moderate to implement.

4. *Weighted score 4 [2 out of 7]* **BEHAVIORAL CHANGE** will occur with generational change and will become less of a focus of attention for ARB during the second timeframe. Behavioral change will be moderately difficult initially but accomplished by the end of the 30-year timeframe.

5. *Weighted score 2 [3 out of 7]* **MOBILITY MANAGEMENT** was viewed as somewhat easy to implement but not particularly popular without significant attitudinal shifts. Effectiveness could increase with changing land use patterns. This was perceived as easy to hard to implement, depending on perspective, in the second timeframe.

Los Angeles

1. *Weighted score 38 [15 out of15]* **LAND USE** strategies should be implemented, including the construction of new public transit infrastructure and changes in land development patterns (including infill) towards denser, more compact, transit-oriented and mixed use designs. This will be moderate to easy to implement in the second timeframe, with effectiveness closely linked with pricing and behavioral change strategies.

2. *Weighted score 22 [11 out of 15]* **PRICING** strategies that send economic signals consistent with AB 32 goals are key for this polycentric region. This was considered moderate to moderately difficult to implement in the second timeframe.

3. *Weighted score20 [11 out of 15]* **BEHAVIORAL CHANGE** strategies will gain effectiveness with generational change and the availability of new development patterns and transportation options. Behavioral change was considered very easy to moderate to implement in this timeframe.

4. *Weighted score 8 [6 out of 15]* **MOBILITY MANAGEMENT** strategies, such as public transit, TDM, and non-motorized patterns, will become embedded into new land use forms even in spread out polycentric Los Angeles. Mobility management will be moderate to easy to implement in the second timeframe.

5. *Weighted score 2[2 out of 15]* **ITS** applications that improve highway efficiency and public transit operation and services are well accepted and easy to implement in this timeframe.

San Joaquin Valley

1. *Weighted score 17 [6 out of 6]* Changes should be implemented in **LAND USE** patterns to increase density in current development areas and to protect open farmland. This was considered very difficult to implement, even in the second timeframe.

2. *Weighted score 8 [4 out of 6]* **PRICING** strategies are needed that encourage less driving, new vehicle technologies, and denser infill and development patterns. Prices change the equation people use to decide where and how to live and what vehicle to drive. Pricing was considered moderate to difficult to implement.

3. *Weighted score 5 [4 out of 6]* **ITS** applications for smoothing congested traffic, including adaptive signal synchronization, would be effective in urbanized areas. This was considered moderately easy to implement in this timeframe. ITS and behavioral change are tied in this region.

4. *Weighted score 5 [4 out of 6]* **BEHAVIORAL CHANGE** strategies are needed to support TDM and build understanding of climate change and the need for new land use patterns. Behavioral change was considered moderately easy to moderately difficult to implement in the second timeframe.

5. *Weighted score 0 [0 out of 6]* **MOBILITY MANAGEMENT**.

Table 8 Timeframe 2021 to 2050 Comparison of Rankings Across Regions

	Bay Area	Sacramento	San Diego	Los Angeles	San Joaquin
Land Use	1	1	1	1	1
Mobility Mgmt	3	5	5	4	N/A
Pricing	2	2	2	2	2
ITS	4	4	3	5	3
Behavioral Change	3	3	4	3	3

The most significant outcome from the five regional workshops is the general consensus across the regions and stakeholder groups regarding the long-term effectiveness of changing land use patterns from the dominant 20th century pattern of single use, automobile dependent development (more sprawling) towards a new paradigm for the 21st century. This new paradigm reflects denser, smaller-sized homes; supports more walkable development forms; mixed residential, commercial, and retail land uses; "clean" jobs; and public transit and other modes that are convenient and accessible. The co-benefits of this approach are perceived across regions and stakeholder groups as being notable in promoting individual health and general environmental sustainability.

Pricing strategies also are viewed across the region as critical success factors. Pricing should be used to send economic signals that discourage use of single occupant gasoline powered vehicles and encourage public transit and low/non-emitting alternatives, including bicycling and walking.

Behavioral change, which included public education campaigns to promote and encourage individuals towards making low carbon choices, was viewed by most panelists as "good" or "right," with one exception (i.e., in San Diego many panelists considered the public ready to make the right choice immediately). This was the third most effective strategy across the State. All regions believed these messages needed to personalize the problem of climate change for each region and to focus on encouraging individuals to make specific choices that were available. All panels recommended close coordination between public campaign messages and the availability of low carbon options. Many recommended use of highly professional marketing strategies, making use of California's home grown entertainment industry to make low carbon lifestyles trendy.

ITS and mobility management were considered by most as lower profile but still effective strategies that should be implemented and supported for their real, although marginal, impacts.

A constant theme of all discussions on reduction strategies involved the need for strong clear messages and assistance, including technical and financial assistance to local governments and implementing agencies. Many specific strategies were suggested, including more effective land use planning and zoning assistance from the State and statewide pricing guidelines or regulations to ensure consistency of approach across the regions. At the same time, all regions wanted to

customize and target their approaches, particularly with regards to public marketing and education campaigns.

Priority Reduction Strategies

Starting with the Sacramento workshop, panelists were asked to specify the top two priority reduction strategies for their region. In Sacramento, a prioritization exercise was used; for San Diego, Los Angeles, and Fresno, panelists were asked to submit two strategies in writing.

Across the regions of San Diego, Los Angeles, and Fresno, the authors found a number of themes that emerged regarding the most effective actions that could be taken by the State to assist regional and local agencies in implementing strategies to reduce carbon emissions from the transportation sector. They include:

- Facilitate and fund local zoning ordinance revision, including density increases, mixed use, jobs-housing balance considerations, and orientation toward non-automobile use and public transit modes;
- Facilitate revision of local/state building codes to promote green building and smaller units;
- Provide incentives (financial and procedural) for developers and local governments to push paradigm change;
- Fund public transit improvements, both infrastructure and services;
- Implement equitable transportation pricing mechanisms that reduce the use of private vehicles (e.g., parking, congestion pricing, VMT charges) and use revenues to support bicycling and walking and TDM;
- Squeeze marginal reductions from ITS and TDM in the short- and long-term;
- Develop clear public education and marketing campaigns that are targeted by market segment and region that are professional, trendy, and attractive. Individualize the climate change problem and specific actions that individuals can take in the region. Keep the message in sync with the housing and transportation options that are available in the region.
- Value co-benefits; and
- Develop and adopt K-12 climate change curriculum.

Mix of Policy Approaches

Exercises 2A and 2B elicited a discussion of the appropriate mix of voluntary, market-based, and regulatory emission reduction strategies for each region. The exercise employed in Oakland/Bay Area was modified somewhat for later workshops. Panelists were asked to view all strategies as being somewhere on a continuum from voluntary strategies, relying on various incentives to gain cooperation, to those specifically required by law or regulation. This continuum also involved a third dimension called "market based," which might involve some form of emissions trading. Participants were asked to place a dot representing their best view of how to "mix" or "balance"

policy approaches for their region. Several panelists seemed confused by the meaning of "market based" and what this type of policy would include, although the facilitator repeated the definition of "market based" as referring to some type of negotiated emission allowance and trading, as an example. Panelists also were encouraged to develop their own definition of market based, as appropriate, and note this when explaining their dot placement. Many noted market based as involving some type of price/cost manipulation for consumers of various land use transportation options, including but not limited to fees, subsidies, rebates, and price controls.

Several explained that they "liked" the concept of using "the market" to get things done and felt market strategies would add flexibility to regulation, effectiveness to voluntary options, and should be used to send the "right" economic signals (i.e., make low carbon emission practices and technologies cheaper for end consumers). There were fewer comments on the distinction between "voluntary" and "regulatory," although several noted that AB 32 was itself a regulation. Others indicated that they conceived of "regulatory" as referring to the establishment of clear consistent standards and requirements for emission reduction.

In the Bay Area, panelists were asked to represent the best policy mix for achieving the 2020 reduction goal through a single dot placement. The group then discussed placements. This process was repeated for the 2050 goal in the Bay Area. This exercise was modified for the remaining four workshops to the following timeframes: 1) present to 2012 and 2) 2013 to 2020. Unlike the Oakland/Bay Area workshop, no discussion was elicited regarding a post-2020 policy mix. In the remaining workshops, researchers also tested the influence of group discussion on how panelists placed their dots. As in the classic Delphi methodology, panelists were asked to place dots, discuss their rationale for placement, and then replace their dots.

Despite the impossibility of making precise comparison and analysis across regions, some themes did emerge that crossed regions. Most panels attempted to craft a balance representing their sense of what it would take to move local entities, private markets, and citizens towards a low carbon future. There was strong consensus across the State that this would take clear, strong State standards and emission targets supported by flexibility (voluntary selection of strategies) and economic signals (market-based strategies), which provided incentives for meeting targets. Several regions expressed awareness that writing and adopting regulations was a time-consuming process; thus, in the nearest term, several regions recommended establishing a strong voluntary program with incentives and to use the results of that program to improve regulation.

Panels emphasized selecting a balanced policy approach, involving clear targets set in law and with meaningful consequences while at the same time "softened" by rewards and financial incentives for both regional entities empowered to enforce targets and entities/individuals making choices about their transportation and land use arrangements. All were aware of the relatively short timeframe involved, which appeared to carry a need for speedy adoption of a regulatory framework for many.

Policy Mechanisms

Establishing and Using Targets

There was strong consensus across all five regions that the primary measure for AB 32 implementation should be GHGs. GHGs are the direct target of this legislation and by using GHGs regions have opportunities to make trade-offs across sectors to reflect regional differences. A strong majority across all regions also believed that VMT needed to be measured and tracked. VMT was viewed as a key performance measure for monitoring the effectiveness of changing land use and travel patterns and would provide helpful guidance for implementing agencies. Most panelists expressed awareness that VMT did not translate directly into GHGs but felt that VMT was still useful to collect and track. VMT was most directly related to co-benefits of climate change reductions.

Across California, workshop panelists believed that targets should be set regionally. By "regionally," most appeared to think in terms of either the metropolitan planning organization or the RTPA district, although air districts were considered by some to be an alternative. Panelists opposed creation of some new type of district; implementation would be easier to adapt, most thought, if administration and planning could be embedded in an already existing mechanism. That said, many panelists, including local stakeholders, felt that all entities, from the State itself to regional, county, and city entities should be "held accountable" for making GHG reductions. No entity should be allowed to "opt out." Most panelists expressed interest in using a blueprint planning process to negotiate and distribute reduction targets from the region to the local level.

Many viewed the establishment of targets as challenging but very necessary. Throughout the workshops, panelists voiced a need for clear, strong targets to be set as soon as feasible to provide direction to all implementing agencies and to send a message regarding the commitment of the State to meeting the AB 32 goals.

Regulatory Reform

At various points in the workshops, panelists raised a number of issues regarding the need to review and modify potentially conflicting legislation to gain consistency among goals. CEQA, RHNA, and the conformity process were particularly highlighted. CEQA's checklist criteria for project review specifically needs to revised to eliminate the apparent inconsistency between congestion mitigation requirements and VMT reduction. Panelists did not view congestion as inherently bad across the region. Congestion was viewed as an incentive that could shift travelers to non-automobile forms and could support a lifestyle change. Local ordinance revision and building code revisions were also seen as important to ensure that various governmental requirements did not cancel each other out. The most extensive discussion of the need for regulatory reform occurred in Sacramento and Los Angeles. Where the topic came up, most panelists expressed support for SB 375 (anti-sprawl legislation). The blueprint planning process was mentioned repeatedly, with the Bay Area, San Diego, and Sacramento viewing this process as a model that could embed AB 32 goals. Los Angeles and Fresno panelists were very familiar with the process as well, but they viewed it as difficult or inappropriate for their regions, unless

modified to allow for some bi-level tiering of the process (in Los Angeles) and to enforce consequences for non-participation (San Joaquin).

Emission Budgets and Trading

Across the regions, emission budgets and trading as a strategy did not raise significant interest. Discussions tended to be brief, with panelists expressing only mild interest. There was no expression, however, that such a program should not be instituted, although several thought it more appropriate to large stationary source producers rather than mobile vehicle sources. Several stakeholders wondered how cities would trade VMT impacts, worrying about local differences and through traffic.

Projections, Models, and Monitoring

Across regional workshops, panelists viewed models as primarily a tool for policy evaluation rather than targeted enforcement. There was considerable irritability regarding bad experiences with litigation around air pollution models (i.e., air quality conformity). To the extent possible, panelists wanted to avoid such instances. Monitoring for purposes of setting and tracking targets should be direct, either using some air quality monitor or by tracking fuel consumption figures.

The Los Angeles region appeared to be the most pessimistic about its ability to make changes in land use and travel patterns sufficient to reduce VMT. Therefore, spending money and time to improve flawed current models would not be of value. Real changes would come from vehicle technology. To some extent, the San Joaquin Valley panel felt similarly, although they expressed this less explicitly.

Panels agreed for the most part that current transportation models needed better reliability, more validation, more calibration, and better data inputs. Several panelists across the regions suggested the need for statewide models, so that regions worked with the same assumptions.

Public Education and Community Outreach

All panels felt that public education campaigns would be needed to shape and drive forward behavioral change. All panels wanted public campaigns to be targeted by region, developed by high quality professional marketers, and make use of California-trendy imagery. The Bay Area, Sacramento, and San Diego panels identified their regions as aware and ready to take action. The Los Angeles panel identified the region as aware but not yet ready for action because citizens did not universally connect personal lifestyle choices with climate change. The San Joaquin Valley panel suggested that awareness of climate change as a problem was weak in their region.

A number of successful public campaigns were cited as models for the effectiveness of these strategies to shift behavior, including the 2020 campaign to reduce energy consumption (Los Angeles); recycling campaigns (Los Angeles); anti-tobacco (Sacramento); “Spare the Air” (Bay Area); “Think Blue” (San Diego); and “Happy Cows” (San Joaquin) were all cited as regionally effective campaigns designed to shape individual behaviors.

Public campaigns need to personalize the problem and GHG/VMT reductions. Stakeholders in several regions pointed to the low-tech but effective Parent Teacher Association thermometer to track school donations, as well as the hybrid cars' immediate feedback technology for gas mileage calculations (also known as ecodriving).

REFERENCES

AB 939 in the New Millennium: Future Search Conference Issue. California Integrated Waste Management Board. (2007). http://www.ciwmb.ca.gov/2000plus/Events/FutureMar99/issues1.htm. Accessed May 5, 2008.

Air Resources Board. Proposed Scoping Plan. www.arb.ca.gov/cc/scopingplan/scopingplan.htm. Accessed February 1, 2009.

Assembly Bill 939. California Public Resources Code Section 40000 et seq. 1989. http://www.recyclelaw.com/ab939.htm. Accessed February 13, 2008.

Bender, S.L., Moezzi, M., Gossard, M.H., and Lutzenhiser L (2002). Using Mass Media to Influence Energy Consumption Behavior: California's 2001 Flex Your Power Campaign as a Case Study. *2002 ACEEE Summer Study on Energy Efficiency in Buildings — Proceedings,* Vol. 8, 2002, pp. 15-28.

Bento, A.M., M.L. Cropper, A.M. Mobarak, and K. Vinha (2005). The Effects of Urban Spatial Structure on Travel Demand in the United States. *Review of Economics and Statistics*, Vol. 87, No. 3, 2005, pp. 466-478.

Betz, R., K. Rogge, and J. Schleich (2006). EU Emissions Trading: an Early Analysis of National Allocation Plans for 2008-2012. *Climate Policy*, Vol. 6, 2006, pp. 361-394.

Bloomfield, J. and H. L. Pearson. (2000). Land Use, Land-use Change, Forestry, and Agricultural Activities in the Clean Development Mechanism: Estimates of Greenhouse Gas Offset Potential. *Mitigation and Adaptation Strategies for Global Change*, Vol. 5, 2000, pp. 9-24.

Bowman, C. (July 27, 2007). Laying down law on global warming - Brown uses 1970 statute to insist projects assess climate-change impacts. *The Sacramento Bee*.

Brown, K. and W. N. Adger. (1994). Economic and Political Feasibility of International Carbon Offsets. *Forest Ecology and Management*, Vol. 68, 1994, pp. 217-229.

Cabanatuan, M. and R. Gordon. (February 19, 2008). Toll Dispute Threatens Doyle Drive Makeover. *San Francisco Chronicle*.

Cabanatuan, M. (August 12, 2008). Congestion Toll Plan Fizzles Out. *San Francisco Chronicle*.

California Air Resource Board. *Climate Change Draft Scoping Plan: A Framework for Change.*

California Moves Towards PAYD Insurance. (2007). Environmental Defense Fund. http://www.edf.org/article.cfm?contentID=5535. Accessed May 11, 2008.

Callaway, E. (April 30, 2008). London Congestion Charge Did Not Improve Air Quality. *New Scientist*. http://www.newscientist.com/article/dn13809-london-congestion-charge-did-not-improve-air-quality.html?DCMP=ILC-hmts&nsref=news1_head_dn13809. Accessed May 15, 2008.

Cayan, D., A. L. Luers, M. Hanemann, G. Franco, and B. Croes. (2006). *Scenarios of Climate Change in California: An Overview*. Publication CEC-500-2005-186-SF. California Energy Commission, California.

Chidiak, M. (2002). Lessons from the French experience with voluntary agreements for greenhouse-gas reduction. *Journal of Cleaner Production*, Vol. 10, 2002. pp. 121-128.

Chomitz, K. M. (1999). Evaluating Carbon Offsets from Forestry and Energy Projects: How Do They Compare? World Bank Policy Research Working Paper No. 2357. http://ssrn.com/abstract=630729

Clark, D.J. (2008). *Proposed Intervenors' Memorandum of Points and Authorities in Support of Motion to File Complaint in Intervention.* Wilson, Sonsini, Goodrich, and Rosati Professional Corp. www.edf.org/content.cfm?contentID=5573. Accessed May 9, 2008.

Confessore, N. (April 7, 2008). Congestion Plan Dies in Albany. *The New York Times*. http://cityroom.blogs.nytimes.com/2008/04/07/congestion-pricing-plan-is-dead-assembly-speaker-says/?scp=3-b&sq=congestion+pricing&st=nyt. Accessed April 8, 2008.

Cutright, N. J. (1996). Joint Implementation: Biodiversity and Greenhouse Gas Offsets. *Environmental Management*, Vol. 20, 1996, pp. 913-918.

de Steiguer, J. E. (2008). Semi Arid Rangelands and Carbon Offset Markets: A Look at the Economic Prospects. *Rangelands*, Vol. 30, 2008, pp. 27-32.

duVair, P., D. Wickizer, and M.J. Burer. Climate Change and the Potential Implications for California's Transportation System. Presented at The Potential Impacts of Climate Change on Transportation, Washington, D.C., 2002.

Ellerman, A.D., and I.S. Wing. Absolute vs. Intensity-Based Emission Caps. *MIT Joint Program on the Science and Policy of Global Change*, Report No. 100, 2003.

EU Action against Climate Change: Leading global action to 2020 and beyond. (2007). European Commission, Luxembourg. http://ec.europa.eu/environment/climat/pdf/eu_action_against_climate_change.pdf. Accessed March 31, 2008.

Evans, R. (2007). *Central London Congestion Charging Scheme: Ex-post Evaluation of the Quantified Impacts of the Original Scheme*. Transport for London, London, England. http://www.tfl.gov.uk/roadusers/congestioncharging/6722.aspx#2. Accessed May 15, 2008.

Ewing, R., K. Bartholomew, S. Winkelman, J. Walters, and D. Chen. (2007). *Growing Cooler: the Evidence on Urban Development and Climate Change*. Smart Growth America, Washington, D.C. http://www.smartgrowthamerica.org/gcindex.html. Accessed May 11, 2008.

Ewing, R., R. Pendall, and D. Chen. (2002). *Measuring Sprawl and Its Impact*. Smart Growth America, Washington, D.C. http://www.smartgrowthamerica.org/sprawlindex/MeasuringSprawlTechnical.pdf. Accessed November 19, 2007.

Figueiredo, L., I. Jesus, J.A.T. Machado, J.R. Ferreira, J.L. Martins de Carvalho. (2001). Towards the Development of Intelligent Transportation Systems. *2001 IEEE Intelligent Transportation Systems Conference Proceedings* IEEE, 2001, pp. 1206 – 1211.

Gielen, A.M., P.R. Koutstaal, and H.R.J. Vollebergh. (2002). Comparing Emission Trading with Absolute and Relative Targets. Presented at the CATEP Workshop on the Design and Integration of National Tradable Permit Schemes for Environmental Protection, London, England.

Greene, D.L., P.D. Patterson, M. Singh, and J. Li. (2005). Feebates, Rebates and Gas-Guzzler Taxes: a Study of Incentives for Increased Fuel Economy. *Energy Policy*, Vol. 33, 2005, pp. 757-775.

Grubb, M., C. Azar and U.M. Persson. (2005). Allowance Allocation in the European Emissions Trading System: a Commentary. *Climate Policy*, Vol.5, 2005, pp. 129-138.

Handy, S. (2005). Smart Growth and the Transportation-Land Use Connection: What Does the Research Tell Us? *International Regional Science Review*, Vol. 28, No. 2, 2005, pp. 146-167.

Handy, S., Cao, X., Mokhtarian, P. (2005). Correlation or causality between the built environment and travel behavior? Evidence from Northern California. In *Transportation Research Part D*., Vol. 10, TRB, National Research Council, Washington, D.C., 2005, pp. 427-444.

HDR (2003) *Community Connections A Transportation Vision for the Next 25 Years: Land Use Experiment Technical Memorandum No.8.* July.

Herzog, T., K.A. Baumert, and J. Pershing. (2006). *Target: Intensity: An Analysis of Greenhouse Gas Intensity Targets*. World Resources Institute.

http://www.arb.ca.gov/cc/scopingplan/document/draftscopingplan.htm. Accessed June 26, 2008.

Hugosson, M.B. and A. Sjöberg. (2006). Facts and Results from the Stockholm Trials. Congestion Charge Secretariat, Stockholm, Sweden. www.stockholmsforsoket.se/upload/Hushall_eng.pdf. Accessed May 15, 2008.

Indirect Source Rules: Cleaning Air in California and Beyond. (2008). Environmental Defense Fund, undated. http://www.edf.org/page.cfm?tagID=6709. Accessed May 9, 2008. Interview with LAFCo and RHNA Expert, March 5, 2008.

ISR Expert. (2008). At Global Warming Solutions: Land Use and Transportation Workshop in San Joaquin Valley. Fresno, California, April 20, 2008.

Jacobson, P.D., and J. Wasserman. (1997). *Tobacco Control Laws: Implementation and Enforcement*. RAND Corporation, Washington, D.C.

Kanninen, B.J. (1996). Intelligent Transportation Systems: an economic and environmental policy assessment. *In Transportation Research Part A: Policy and Practice,* Vol. 30, No. 1, TRB, National Research Council, Washington, D.C., 1996, pp. 1-10.

Kautz, B.E. (2005). A Public Agency Guide to California Density Bonus Law. Presented at the Land Use Fall 2005 Study Section Conference, Oakland, California.

Khanna, M. and W.R.Q. Anton. (2002). Corporate Environmental Management: Regulatory and Market-Based Incentives. *Land Economics*, Vol. 78, No. 4, 2002, pp. 539-558.

Kolstad, C.D. (2005). The Simple Analytics of Greenhouse Gas Emission Intensity Reduction Targets. *Energy Policy*, Vol. 33, 2005, pp. 2231-2236.

Kopp, R., and B. Pizer. (2007). *Five Recent Senate Bills Propose Mandatory Greenhouse Gas Caps: Side-by-Side Comparison and Analysis*. Resources for the Future, Washington, D.C.

Land Use Subgroup of the Climate Action Team (LUSCAT). (2008). LUSCAT Submission to ARB Scoping Plan on Local Government, Land Use and Transportation.

Lautso, Kari, Klaus Spiekermann, Michael Wegener, Ian Sheppard, Philip Steadman, Angelo Marino, Roberto Domingo, Sylvie Gayda. (2004). *PROPOLIS: Planning and Research of Policies for Land Use and Transport for Increasing Urban Sustainability: Final Report*, European Commission, Energy, Environment, and Sustainable Development Thematic Programme. February.

Litman, T. (2007). *Socially Optimal Transport Prices and Markets: Principles, Strategies and Impacts*. Victoria Transport Policy Institute, Victoria, British Columbia.

Luers, A.L., D.R. Cayan, G. Franco, M. Hanemann, and B. Croes. (2006). *Our Changing Climate: Assessing the Risks to California.* Publication CEC-500-2006-077. California Energy Commission, California.

MacCracken, M.C. (2002). Global Warming: A Science Overview. Presented at The Potential Impacts of Climate Change on Transportation, Washington, D.C.

McCarl, B. A. and R. D. Sands. (2007). Competitiveness of Terrestrial Greenhouse Gas Offsets: Are They a Bridge to the Future? *Climatic Change*, Vol. 80, 2007, pp. 109-126.

McKeever, M. (2008). SB 375 Update Memo, August 4, 2008. Sacramento Area Council of Governments, Sacramento, California, 2008.

McManus, W.S. (2007). *Economic Analysis of Feebates to Reduce Greenhouse Gas Emissions from Light Vehicles for California*. Publication UMTRI-2007-9-12. University of Michigan Transportation Research Institute, Ann Arbor, Michigan.

Millard-Ball, A. (2007). *The Municipal Mobility Manager: A New Transportation Funding Stream from Carbon Trading?*. Interdisciplinary Program in Environment and Resources, Stanford University, Palo Alto, California.

Moura-Costa, P. The Climate Convention and Evolution of the Market for Forest-Based Carbon Offsets. (2001). *Unasylva*, Vol. 52, 2001, http://www.fao.org/docrep/003/y1237e/y1237e08.htm#P0_0. Accessed August 13, 2008.

Osborne, T. and C. Kiker. (2005). Carbon Offsets as an Economic Alternative to Large-Scale Logging: A Case Study in Guyana. *Ecological Economics*, Vol. 52, 2005, pp. 481-496.

Owen, D. Climate Change and Environmental Assessment Law, *Columbia Journal of Environmental Law*, New York, New York. Forthcoming.

Pay-As-You-Drive (PAYD) Auto Insurance. Environmental Defense Fund. (2006). http://www.edf.org/article.cfm?ContentID=2205. Accessed May 11, 2008.

Pizer, W. (2005). *The Case for Intensity Targets*. Publication RFF DP 05-02. Resources for the Future, Washington, D.C.

PlaNYC: A Greener, Greater New York. (2007). The City of New York. http://www.nyc.gov/html/planyc2030/html/downloads/the-plan.shtml. Accessed February 24, 2008.

Portney, P.R. R.N. Stavins, eds. (2000). *Public Policies for Environmental Protection.* 2nd Ed. Resources for the Future, Washington, D.C.

Putting the Pieces Together: State Actions to Encourage Smart Growth Practices in California. Urban Land Institute. (2002). http://www.uli.org/AM/Template.cfm?Section=Home&CONTENTID=43684&TEMPLATE=/CM/ContentDisplay.cfm. Accessed November 29, 2007

Recommendations of the Economic and Technology Advancement Advisory Committee (ETAAC) Final Report. (2008). ETAAC, California. http://www.arb.ca.gov/cc/etaac/ETAACFinalReport2-11-08.pdf. Accesssed February 21, 2008.

Rennings, K., K.L. Brockmann, H. Bergmann. (1997). Voluntary Agreements in Environmental Protection: Experiences in Germany and Future Perspectives. *Business Strategy and the Environment*, Vol. 6, 1997, pp. 245-263.

Ryan, L., and H. Turton. (2007). *Sustainable Automobile Transport: Shaping Climate Change Policy*. Edward Elgar, Cheltenham, UK.

Sacramento Area Council of Governments (SACOG). (2004). *Tall order forum 2004: Regional choices for our future*. Sacramento, CA.

San Bernardino settlement sets standard for local CO_2 programs. (August 21, 2007). The *Sacramento Bee*. http://www.sacbee.com/static/weblogs/hothouse/archives/cat_land_use.html. Accessed May 8, 2008.

Schwarze, R. and P. Zapfel. (2000). Sulfur Allowance Trading and the Regional Clean Air Incentives Market: A Comparative Design Analysis of Two Major Cap and Trade Permit Programs? *Environmental Resource Economics*, Vol. 17, 2000, pp. 279-298.

Shaheen, S.A. and T.E. Lipman. (2007). Reducing Greenhouse Emissions and Fuel Consumption: Sustainable Approaches for Surface Transportation. *IATSS Research,* Vol. 31, No. 1, 2007, pp. 6-20.

Shaheen, Susan, Adam Cohen, and J. Darius Roberts. (2006). Carsharing in North America: Market Growth, Current Developments, and Future Potential. *Transportation Research Record* No. 1986, 2006, pp. 106-115.

Shaheen, Susan, Adam Cohen, and Melissa Chung. (2009). North American Carsharing: A Ten-Year Retrospective. *Transportation Research Record*, 2009. Forthcoming.

Simmonds, David, Andy Skinner, Olga Feldman, James Nicoll, and Caroline Sinclair. (2006). *Wider Economic Impacts of Transport Interventions: Final Report*. London, England.

Solomon, B.D. (1999). New Directions in Emissions Trading: the Potential Contribution of New Institutional Economics. *Ecological Economics*, Vol. 30, 1999, pp. 371-387.

Sorrel, M.L. (2005). *Transportation Choices: Can Social Marketing Make a Difference?* Thesis, Department of Urban Studies and Planning, MIT.

South Access to the Golden Gate Bridge: Toll Feasibility Fact Sheet. San Francisco County Transportation Agency. (2008). http://www.sfcta.org/images/stories/Planning/DoyleDriveReplacementProject/dd_tollingfactsheet022808.pdf. Accessed May 24, 2008.

Stavins, R.N. (2001). *Lessons from the American Experiment with Market-Based Environmental Policies*. Resources for the Future, Discussion Paper 01-53.

Strachan, N. (2007). Setting Greenhouse Gas Emission Targets under Baseline Uncertainty: the Bush Climate Change Initiative. *Mitigation and Adaptation Strategies for Global Change*, Vol. 12, No. 4, 2007, pp. 455-470.

Taiyab, N. (2006). Exploring the Market for Voluntary Carbon Offsets. International Institute for Environment and Development, London.

Toward a Tobacco-Free California: The Myth of Victory. (2003) The Tobacco Education and Research Oversight Committee. http://www.dhs.ca.gov/tobacco/documents/pubs/TobaccoMasterPlan2003.pdf. Accessed March 14, 2008.

Tucker, M. (2001) Trading Carbon Tradable Offsets under Kyoto's Clean Development Mechanism: The Economic Advantages to Buyers and Sellers of Using Call Options. *Ecological Economics*, Vol. 37, 2001, pp. 173-182.

Wara, M. (2006). *Measuring the Clean Development Mechanism's Performance and Potential*. Working Paper #56. Program on Energy and Sustainable Development at Stanford University, Palo Alto, California.

Welch, E.W., A. Mazur, and S. Bretschneider. (2000) Voluntary Behavior by Electric Utilities: Levels of Adoption and Contribution of the Climate Challenge Program to the Reduction of Carbon Dioxide. *Journal of Policy Analysis and Management*, Vol. 19, No. 3, 2000, pp. 407-425.

What is LAFCo?. California Association of Local Agency Formation Commissions. http://www.calafco.org/about.htm. Accessed May 5, 2008.

Wilman, E. A. and M. S. Mahendrarajah (2002). Carbon Offsets. *Land Economics*, Vol. 78, 2002, pp. 405-416.

Winkelman, S., T. Hargrave, and C. Vanderlan (2000). *Transportation and Domestic Greenhouse Gas Emissions Trading*. Center for Clean Air Policy.

APPENDIX A

ASSEMBLY BILL (AB) 32: GLOBAL WARMING SOLUTIONS ACT: TRANSPORTATION SECTOR

Draft Stakeholder/Expert Discussion Guide:

Caltrans, California Air Resources Board (CARB), California Energy Commission (CEC), city and county representatives, Metropolitan Planning Organizations (MPOs), Air Quality Management Districts (AQMDs), transit operators, academics, and Non-Governmental Organizations (NGOs).

I. Introduction

Hello, my name is XXXX. I am a research associate at the Transportation Sustainability Research Center (TSRC) at the University of California, Berkeley. The California Air Resources Board (CARB) is seeking to develop a plan to achieve the emission targets set forth by California Assembly Bill 32; this includes a reduction of greenhouse gas (GHG) emissions to 1990 levels by 2020 and to 80 percent below 1990 levels by 2050. An initial step in this research involves interviews with stakeholders in California to explore barriers and opportunities for reducing GHG emissions from the transportation sector (e.g., policy, resources, research, education, and performance measures and tools) and investigate a range of possible strategies (e.g., cap and trade). Can we set up a time for me to interview you? The interview should take approximately 45 minutes. Please note that the information you provide will be kept confidential and reported only in the aggregate and not for individual attribution. Your participation is voluntary, and you may choose to withdraw at anytime.

II. Preliminary Information

1. Identify name, position, and organization. Years worked for the organization? Years worked in the field?
2. Time when the interview took place.

III. Expert Information

First, I would like to start by asking you some basic questions about your organization to help collect background information on how it is exploring GHG emission reductions from changes in travel behavior and the built environment.

1. Can you please provide an overview of the research, activities, or policies your organization is exploring to reduce GHG emissions through changes in travel behavior and the built environment? In your opinion, which of these are the most

cost-effective strategies being explored or implemented? Most politically feasible? Most likely to reach widespread adoption?

2. What kinds of resources are dedicated to these efforts?

3. What role does education/public outreach have in these GHG emissions reduction strategies?

4. What tools or performance measures are you currently using to evaluate the GHG emission reductions of these strategies (either real or proposed)?

IV. Next, I would like to ask you some questions about (you or your organization's) perspective on potential GHG emission reduction strategies for implementation in California. I will ask about such specific strategies like cap and trade, feebates, carbon budgets for cities, and land use/transportation funding in the next section to get more detailed responses.

In terms of land use (e.g., mixed-use and transit-oriented development), mobility management (e.g., carsharing, ridesharing, improving the bicycle/pedestrian infrastructure, and telecommuting), pricing (e.g., congestion pricing, peak period tolls/high occupancy toll (HOT) lanes, mileage-based fees, and carbon taxes), and intelligent transportation systems (ITS) (e.g., traffic signal coordination, bus rapid transit (BRT), and weigh-in-motion (WIM) technologies) strategies,

1. Which strategy or combination of strategies would be most effective? Why? What might be the barriers to implementing these policies and how might they be overcome?

2. What specific policies is your organization considering?

3. Considering ease of implementation (i.e., cost, political feasibility, and monitoring), which strategies and/or combinations might you recommend?

4. Do (you or your organization) suggest any other strategy not previously mentioned?

V. Now I'd like to ask you some questions about (you or your organization's) perspective on different policy strategies for reducing GHG emissions in the transportation sector in California.

1. CARBON BUDGETS FOR CITIES

a. a. Are you familiar with the concept of carbon budgets for cities? [If not, it is a policy that caps emissions at a maximum level and then allows entities to emit with a specified "allowance."]

b. If carbon budgets were mandated for cities, what timeframe should they be set for (e.g., one year, five years, fifteen years)? Why?

c. How should cities demonstrate compliance in such an instance (e.g., independent auditing, reports, etc.)? Why?

d. Should cities be allowed to a) trade, b) borrow, c) sell/auction, and/or d) bank carbon budget allowances in this scenario? Why or why not?

e. What do you think the greatest challenges of a carbon budget for cities are? Why? How do you think these challenges could be addressed?

Overall, do you believe setting carbon budgets for cities in California could be an effective means to reduce greenhouse gas emissions in transportation? [If yes, what design elements besides those previously discussed would be necessary/crucial?]

2. CAP AND TRADE

a. Are you familiar with the cap and trade concept? [If not, it is a policy that caps emissions at a maximum level and then allows entities to emit with a specified "allowance."]

b. In (you or your organization's) opinion, how would an effective cap and trade program in California distribute allowances (e.g., sell/auction, give away for free, or a combination)?

   i. If sell/auction, what should be done with any revenues? Why?

c. Should entities be allowed to a) trade and/or b) borrow allowances in a cap and trade scheme? Why or why not?

d. "Offsets" are emission reduction allowances from entities in sectors that are not capped, which could be used by entities in capped sectors for compliance. Should offsets be allowed? Why or why not?

e. Should entities be allowed to "bank" allowances (e.g., entities hold extra allowances to use in future years for compliance)? If so, should time limits be used on them?

f. Should a cap and trade program have a "price cap" (e.g., a maximum price above which unlimited additional allowances will be issued)? Why or why not?

g. Should a cap and trade program in California be linked with other cap and trade programs (e.g., in Europe). Why or why not?

h. What enforcement actions should be taken against non-compliant entities (e.g., fines or legal remedies)?

i. What do you think the greatest challenges of a cap and trade program are? Why? How do you think these challenges could be addressed?

j. Overall, do you believe a cap and trade program in California could be an effective means to reduce greenhouse gas emissions in transportation? [If yes, what design elements besides those previously discussed would be necessary/crucial?]

3. LAND USE STRATEGIES & TRANSPORTATION FUNDING

a. What land use and funding strategies could be used to ensure that the transportation needs of cities and regional areas are balanced with the need to meet AB 32 GHG emission laws?

   i. Should economic incentives (e.g., rewarding cities for smart growth practices in the planning/development process, using transportation funds to promote smart growth, and/or authorizing tax-increment financing (TIF) for smart growth) be used? Why or why not?

   ii. Should regulatory reforms (e.g., revising regulations for environmental review, such as the California Environmental Quality Act (CEQA) and local planning to encourage smart growth and/or eliminating barriers to the development of brownfields/infill) be used? Why or why not?

   iii. Should zoning ordinance changes be considered?

b. What do you think the greatest challenges of economic incentives, regulatory reforms, and revising zoning ordinances are? Why? How do you think these challenges could be addressed?

c. Overall, do you believe economic incentives, regulatory reforms, or zoning ordinances could be an effective means to reduce GHG emissions in transportation? [If yes, what design elements besides those previously discussed would be necessary/crucial?]

4. MODELING FOR BASELINE ASSESSMENT, MONITORING & ENFORCEMENT

a. What types of modeling tools, if any, should be used for baseline assessment, monitoring, and enforcement in the near- and long-term? What are the key requirements of these tools?

b. What are the key challenges to widespread implementation of modeling tools that are capable of evaluating the effects of key policies necessary for GHG reductions? How might these barriers be overcome? What level of resources do you think will be necessary to support the development and implementation of such tools?

c. How accurate will current and future models need to be for monitoring and enforcement of GHG regulations? How do you think the limitations of these models can be addressed in the implementation of GHG regulations?

d. Based on your professional experience, can you describe any lessons learned from past monitoring and evaluation experiences that might be useful in the AB 32 context?

5. PUBLIC OUTREACH

a. What kind of education outreach could be done to inform the public about ways to reduce GHG emissions from transportation?

Can you recommend any other individuals who may be able to provide us information on this subject? Finally, can you direct us to reports and data that address these issues?

Thank you.

APPENDIX B

Global Warming Solutions: Land Use and Transportation

Workshop Agenda

9:00-10:00 Registration

Review and Sign Consent Forms

Light Breakfast

10:00-10:15 Introductions

- Caltrans, ARB, CEC Introductions
- Moderator Introduction/Workshop Overview
- Participant Introductions

10:15-10:30 Background

Introductory Presentations

10:30-11:20 Discussion: Potential GHG Emission Reduction Strategies for California

1. Define strategies (slide showing them)
2. Exercise placing dots on 2010 to 2020 and 2021 to 2050 continuums, top three strategies by color and place along continuum of high and low feasibility in each timeframe
3. Discussion about placement of dots and why they are placed accordingly

Exercise 1A: 2010 to 2020

Land Use	Mobility Management	Pricing	ITS	Behavioral Change
High Feasibility				
Low Feasibility				

Exercise 1B: 2021 to 2050

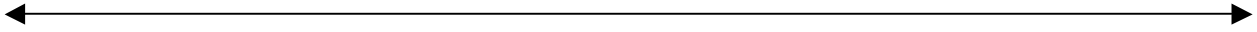
Land Use	Mobility Management	Pricing	ITS	Behavioral Change
High Feasibility				
Low Feasibility				

11:20-11:30 Break

11:30-12:30 Policy Approaches (Voluntary, Regulatory, Market-Based)

1. Define approaches (slide showing them)
2. Continuum of voluntary and regulatory, ask participants to place their dots along this; why did you place there? How do you define (voluntary, regulatory, market-based instrument) Advantages/disadvantages of each approach? Tradeoffs? What's the best mix?
3. Conduct exercise along Present to 2012 and 2013 to 2020 time horizons and discuss.

Exercise 2A: Present to 2012

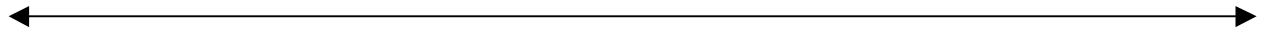


Voluntary **Regulatory**

Market-Based

Instrument

Exercise 2B: 2013 to 2020



Voluntary **Regulatory**

Market-Based

Instrument

12:30-1:30 Lunch

1:30-2:30 Policy Mechanisms (More of a focus group discussion)

• Targets

1. Should targets focus on vehicle use of GHG?
2. Could voluntary targets be effective through appropriate incentives and regulatory levers?
3. What are the greatest challenges of this approach (e.g., geography, stage of growth, no assurance of meeting reduction

• Incentives & Regulatory Reforms

1. What are the most important incentives (e.g., rewarding cities for smart growth practices in the planning/development process, using transportation funds to promote smart growth, etc.)? List and discuss.
2. What are the most important regulatory reforms (e.g., CEQA efficiency, local planning to encourage smart growth, zoning ordinances, etc.)? List and discuss.

• Budgets

1. Could budgets (regulatory approach) be effective?
2. What are the greatest challenges?

   --Regional vs. local

   --Timeframe (e.g., one year, five year, ten years)?

   --How should compliance be demonstrated?

--How should compliance be enforced (e.g., fines, increased consideration for funding opportunities)?

• Emission Trading

1. Could budgets (regulatory approach) be effective?
2. What are the greatest challenges?

--What sectors should be included in an emission budget?

--Should emissions be aggregated in a budget or allocated among sectors?

--Regional vs. local?

--What is the role of measurement in this approach?

--Who should oversee and enforce an emission budget program?

--How would vehicle-use reductions be attributed to specific local actions (e.g., smart growth)?

--Trading systems seem to favor implementation strategies with shorter timeframes between initial investment and realization of emission reductions. Is this problematic for encouraging smart growth strategies?

--How would a cap-and-trade program distribute allowances (e.g., sell/auction, give away for free, etc.)?

--What would be done with revenues from cap-and-trade?

--Offsets are emission reduction allowances from entities in sectors that are not capped, which could be used by "capped" sectors. Should this be allowed?

--Should entities be allowed to bank allowances, and if so, how long?

--Should cap-and-trade programs have a price cap (e.g., maximum price for allowances)?

--Should a cape-and-trade program in California be linked to a cap-and-trade program in Europe?

--What enforcement should be taken against non-compliant entities (e.g., fines or legal remedies)?

2:30-2:40 Break

2:40-3:10 Projections and Monitoring (More of a focus group discussion)

1. What kind of data will be required to make sure that we are meeting our GHG emission reduction targets (e.g., VMT and fuel consumption data over time)? Should this type of data be used for purposes of enforcement actions?
2. What role should modeling tools play in planning for GHG reductions and monitoring progress?

   -- What if regions or localities don't have tools that are sensitive to policies that may effectively reduce GHG emissions (e.g., pricing, land use, transit, and change in vehicle fleet)?

   -- If you think models should play a role, how should modeling limitations be addressed in the short- and long-term? What institutional barriers need to be overcome to make these improvements including securing necessary funding?
3. How accurate will measurement and forecasting need to be for monitoring and enforcement of GHG targets?
4. What lessons can we take from monitoring and forecasting in the conformity process to better use these tools to meet GHG targets?

3:10-3:50 Public Outreach (More of a focus group discussion)

1. What kind of education outreach could be done to inform the public about ways to reduce GHG emissions from transportation?

2. Are you aware of any existing outreach efforts/campaigns by other organizations that you think would be effective models for this type of effort, and why do you think these would be good models?

3:50-4:00 Final Questions and Thoughts

Before leaving, ask participants to write down the top three to five points that they raised during the workshop.

4:00 Adjourn.

Thank you!!

Reduction Strategies

- **Land use** (e.g., mixed-use and transit-oriented development)
- **Mobility management** (e.g., carsharing, ridesharing, improving the bicycle/pedestrian infrastructure, and telecommuting)
- **Pricing** (e.g., congestion pricing, peak period tolls/high occupancy toll (HOT) lanes, mileage-based fees, and carbon taxes)
- **Intelligent transportation systems (ITS)** (e.g., traffic signal coordination, bus rapid transit (BRT), and weigh-in-motion (WIM) technologies)
- **Behavioral change** (e.g., buying local, "Clean the Air" transit campaign)

Policy Approaches Defined:

Voluntary: Entities are encouraged to reach an emission target through appropriate incentive and regulatory levers.

Regulatory: Entities are given definitive emission allowances that they must meet.

Market-Based Instrument: Entities are allowed to negotiate their emission allowances.