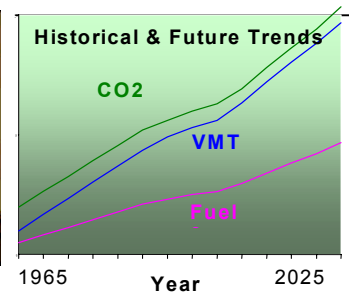




# Climate Action Program at Caltrans

California Department of Transportation  
Business, Transportation, and Housing Agency

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## **Introduction**

Greenhouse gas (GHG) emissions and the related subject of global climate change are emerging as critical issues for the transportation community. The California Department of Transportation (Department) recognizes the significance of cleaner, more energy efficient transportation. Improving performance of transportation systems and operations along with strong technology and market policy to encourage innovations are important steps toward lowering fossil fuel consumption and GHG emissions.

The Department's Climate Action Program promotes clean and energy efficient transportation and provides guidance for mainstreaming energy and climate change issues into its business operations. The framework is provided by the Director's Policy (DP) 23 - Energy Efficiency and Conservation – and is intended to implement a comprehensive, long-term departmental energy policy, interagency collaboration, and a coordinated effort in energy and climate policy, planning, and implementation.

The Department's overall approach to lowering fuel consumption and CO<sub>2</sub> from transportation is twofold: 1) reducing congestion and improving efficiency of transportation systems through smart land use, operational improvements, and Intelligent Transportation Systems. These are objectives of the State Strategic Growth Plan, a ten-year mobility investment program, and 2) institutionalizing energy efficiency and GHG emission reduction measures and technology into planning, project development, operations, and maintenance of transportation facilities, fleets, buildings, and equipment.

On June 1, 2005, Governor Schwarzenegger signed Executive Order (EO) S-3-05, establishing climate change emission reduction targets for the State. The Climate Action Team (CAT) was created to coordinate the statewide effort. Assembly Bill (AB) 32: California Global Warming Act of 2006 gave new weight to the State's renewable energy goal by requiring the reduction of GHG emissions to 1990 levels by 2020. The EO S-20-06 further directs State agencies to begin implementing AB 32 and recommendations in the CAT report. The Department is a member of the CAT and committed to implementing transportation strategies that will help reduce fossil fueled energy and GHG emissions.

The Governor has worked to forge agreements with other states, regions and nations, including the United Kingdom (UK); Manitoba, Canada; and the Northeast/Mid-Atlantic states on reducing GHG and promoting low carbon technology. California, UK, and Manitoba commit to share experiences, find new solutions and take more aggressive action to address climate change and promote energy diversity. The Department is prepared to actively support these efforts. Coordination and collaboration between State, local and regional agencies; other states, the federal government, and the international community is essential in reducing GHG emissions and will influence California's effort.

For further information on the Department's Climate Action Program, please contact Dr. Reza Navai, Program Manager at (916) 653-3424, [reza.navai@dot.ca.gov](mailto:reza.navai@dot.ca.gov).

## **What is Climate Change?**

Climate change is a shift in the “average weather” that a given region experiences. The temperature on Earth is regulated by a system commonly known as the “greenhouse effect.” Naturally occurring climate change pollutants, primarily water vapor, CO<sub>2</sub>, CH<sub>4</sub> and N<sub>2</sub>O, absorb heat radiated from the Earth’s surface. As the atmosphere warms, it in turn radiates heat back to the surface to create the greenhouse effect. The Earth’s surface temperature would be about 34°C(61° F) colder than it is now if it were not for the natural heat trapping effect of climate change pollutants like CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O, and water vapor.

In addition to natural sources, human activities are exerting a major and growing influence on climate by changing the composition of the atmosphere and by modifying the land surface. Particularly, the increased consumption of fossil fuels (wood, coal, gasoline, etc.) has substantially increased atmospheric levels of greenhouse gases. The primary concern is to meaningfully slow the rate and the adverse impacts of climate change. The concentration of CO<sub>2</sub> in the atmosphere reached 379.1 parts per million in 2005, more than 35 percent higher than in the late 1800’s. Given our current path, it will be difficult to rein in carbon emissions enough to stabilize the atmospheric carbon dioxide concentration at 450 parts per million, according to scientists. Fossil fuel combustion accounted for 98 percent of gross California CO<sub>2</sub> emissions, or 360 million metric tons CO<sub>2</sub> in 2002, or 7 percent of the U.S. emissions from this source.

## **Impact of Climate Change**

An enhanced greenhouse effect will generate new patterns of microclimate and will have significant impacts on the economy, environment, and transportation infrastructure and operations due to increased temperatures, intensity of storms, sea level rise, and changes in precipitation. Impacts may include flooding of tunnels, coastal highways, runways, and railways; buckling of highways and railroad tracks, submersion of dock facilities, and shift in agriculture to areas are now cooler. Such prospects will have strategic security as well as transportation implications and require new generations of transportation facilities and material that satisfy concerns of climate change and demonstrate that reducing GHG must be a priority.

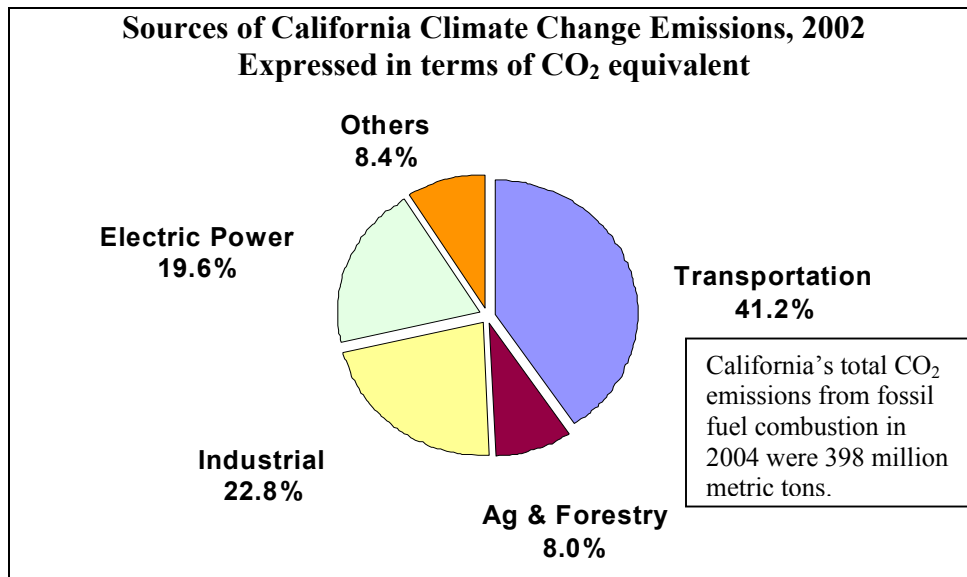
Climate change affects public health and the environment such as increased smog and emissions, respiratory disease, reduction in the State’s water supply, extensive coastal damage, and changes in vegetation and crop patterns. The impacts of climate change are broad ranging and interact with other market failures and economic dynamics, giving rise to many complex policy problems. One of the latest celebrated reports relates that climate change could “create risks of major disruption to economic and social activity, later in this century and the next on the scale of the Great Depression. If global GHG emissions continue rising on their current trajectory, the costs of climate change could eventually total 5 - 20 percent of the annual global gross domestic product (GDP), the report predicts. Five percent of the annual global GDP is equal to about \$7 trillion.” The findings are the latest in a string of reports warning that the rate of carbon dioxide accumulating in the atmosphere is increasing at an alarming pace.

Many experts assert that the emission reduction actions taken over the next decade will determine whether the world can meaningfully slow the adverse impact of climate change. Policies, programs, and budgets will change as California's Climate Change Program starts-up and is refined. Coordination and collaboration between State agencies, other states, the federal government, the private sector, and the international community regarding their efforts to reduce GHG emissions will also influence California's program.

### Climate Change and Transportation

Transportation accounts for over 40 percent of all anthropogenic GHG produced in California. Annual net GHG from transportation are roughly equal to the product of the:

- Number of vehicles.
- Average number of miles traveled by each vehicles (VMT).
- Average net emissions of GHG per vehicle mile traveled.



Source: Cal EPA CAT report, 2006

The number of vehicles in California is increasing faster than the population as rising standards of living increase vehicle ownership and as global trade increases freight movement through California. The annual VMT is increasing as people commute longer distances and make multiple trips. Finally, average on-road fuel economy, which correlates with emissions per VMT, is declining, primarily due to replacement of traditional family cars with light-duty trucks and sport utility vehicles (SUVs) and increasing levels of congestion.

In 2005, California drivers used an estimated 18.1 billion gallons of motor fuel at an estimated cost of \$44 billion and traveled 330 billion miles -- a 15 percent increase since 1990. If current growth trends continue, gasoline use and related CO<sub>2</sub> emissions in the State will increase approximately 30 percent over the next 20 years. This increase has alarming economic and environmental costs, for instance, an additional \$13 billion in the

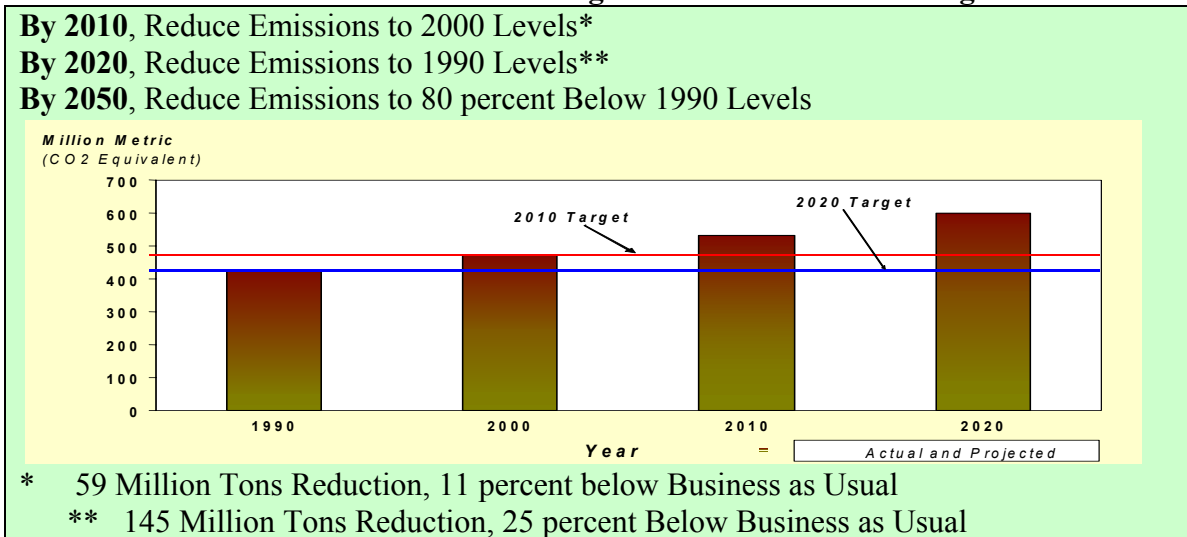
cost of fueling the transportation system alone. Considering that over 50 percent of the petroleum consumed in California is imported, the near total reliance of transportation on petroleum exposes the State’s economy to price spikes in the national or international markets and outflow of capital from the State and reducing Californian’s purchasing power and living standard.

It is notable that a conservative target of one-percent reduction in transportation energy consumption (or rate of consumption growth) could amount to \$440 million savings annually, removal of 1.81 million metric tons (MMT) of GHG from the air, and 0.5 percent reduction in overall GHG emissions. Considering other socioeconomic, environmental, health and strategic security benefits associated with proposed activities, the benefit to the State and local communities would be extremely high.

**Climate Action Team**

Climate Action Team (CAT) was created in response to the EO (S-3-05) by the California Environmental Protection Agency (CalEPA) Secretary and promulgated by AB 32 – California Global Warming Solutions Act of 2006 - to continue coordinating overall climate policy to achieve the state climate change reduction targets. The EO (S-20-06), signed by the Governor on October 17, 2006, further directs State agencies to begin implementation of the Act and recommendations put forth by the CAT. The Business, Transportation, and Housing Agency (BTH), represented by the Department, is a member of this multi-agency committee. The CAT has prepared a recommended list of strategies for the State to pursue in order to achieve climate change reduction targets. The work plans include implementation steps, a time frame, and estimated potential emission reductions and costs.

**Figure 1  
California’s Climate Change Emission Reduction Targets**



Source: Cal EPA CAT Report 2006

## **Caltrans/Business, Transportation, and Housing Agency (BTH) Climate Strategies**

Decisions we make today on land use and other determinants of VMT, on technology and other determinants of emissions per VMT, and on transportation policies and other determinants of the nature, number and use of vehicles will determine how we achieve sustainable transportation. In addition to reducing GHG emissions, sustainable transportation will yield other benefits: more efficient use of transportation resources; reduced dependency on fossil fuels; greater energy security; improved mobility and travel options, and more livable communities. The Department's Director Policy 23: Energy Efficiency and Conservation provides a framework for implementing a comprehensive, long-term energy policy and promotes interagency collaboration and coordinated effort in energy policy, planning, and implementation.

Working with CalEPA and the CAT member agencies, the Department formulated two sets of strategies to make transportation cleaner, more energy efficient, and lower GHG emissions. These strategies are primarily based on established departmental policy, the State Strategic Growth Plan, and planning activities and scenarios proposed at regional level. Implementation of these strategies requires an adequate level of funding and a concerted effort and collaboration on the part of State, regional and local agencies.

The Department believes the most effective approach to addressing GHG reduction, in the short-to-medium term, is strong technology policy and market mechanisms to encourage innovations. Rapid development and availability of alternative fuels and vehicles, increased efficiency in new cars and trucks (light and heavy duty), and super clean fuels are the most direct approach to reducing GHG emissions from motor vehicles (emission performance standards and fuel or carbon performance standards). The California Air Resources Board (ARB) is required to adopt regulations and standards that achieve the maximum feasible and cost-effective reduction of GHG emissions from motor vehicles. The Department participates in technical evaluation and emission reduction testing in this process. The State needs to mainstream its GHG reduction effort into its energy policies and maintain a coherent, consistent cross-agency energy and climate policy framework to create synergy and a coordinated State climate change program toward measurable outcomes.

### **Description of Strategies**

Table I outlines the BTH/Department strategy to reduce GHG emission from transportation. The strategy is twofold: a) making transportation system(s) more efficient through operational improvements, application of Intelligent Transportation Systems (ITS), and smart land use thus reducing congestion and lowering the rate of growth in fuel consumption and CO<sub>2</sub> from motor vehicles. In this case, GHG emission reductions are being realized through the Department's strategic growth plan and congestion relief program with collateral benefit for climate change, and b) cleaner, more energy efficient transportation systems and operations which focuses on integrating consideration of energy and GHG emission reduction measures into planning, project development, operations, and maintenance of transportation facilities, fleets, buildings,

and equipments. In this case, reducing energy consumption and GHG emissions is the primary reason for implementing this strategy. If fully funded and implemented, these strategies could result in lowering CO<sub>2</sub> growth by 2.72 MMT in 2010 and 18.67 MMT by 2020.

**Table I  
Transportation Strategies**

<p><b>1. More efficient transportation systems:</b> Reduce, manage, and eliminate trips, that are the primary cause of congestion, GHGs, and air pollution through smart land use, ITS, demand management, value pricing, and market based strategies.</p> <p>1.1. Implement Smart Growth/Land Use:              1.1.1. Regional Blueprint Planning              1.1.2. Local Development/ Inter-governmental Review              1.1.3. Transportation Planning Grants</p> <p>1.2. Improve operational efficiency of the existing and new transportation systems and movement of people, goods and services. Relieve congestion by enhancing operations and improving travel times in high congestion travel corridors</p> <p>Based on Strategic Growth Plan, Transportation Infrastructure Investment Plan, and DP 26: Intelligent Transportation Systems</p> <p><b>Estimated Savings:</b>          2010 – 1.04 MMT GHG          2020 – 9.97 MMT GHG</p>	<p><b>2. Cleaner, more energy efficient transportation operations:</b> Incorporate energy efficiency and GHG reduction measures into the planning, design, construction, operations and maintenance of transportation facilities, fleets, and buildings.</p> <p>2.1. Mainstream energy efficiency and GHG emissions reduction measures into land use and transportation decisions          2.2. Implement fleet greening and fuel diversification          2.3. Implement Non-Vehicular Conservation Measures          2.4. Reduce cement use in concrete without loss in performance          2.5. Provide education &amp; information on transportation energy and climate change          2.6. Improve freight transportation efficiency</p> <p>Based on DP 23: Energy Efficiency and Conservation.</p> <p><b>Estimated Savings:</b>          2010 -1.68 MMT GHG          2020 – 8.7 MMT GHG</p>
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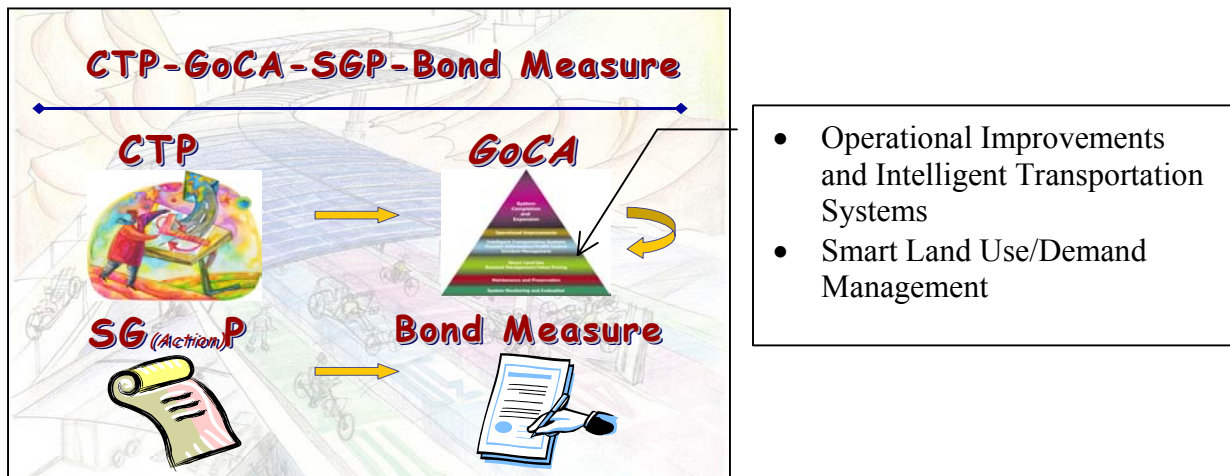
<b>Total Estimated Savings</b>	
<b><u>2010</u></b>	<b><u>2020</u></b>
<b>2.72 MMT CO<sub>2</sub></b>	<b>18.67 MMT CO<sub>2</sub></b>
0.116 billion gallons of gasoline	1.00 billion gallons of gasoline
6.1 million barrels of oil	54.6 million barrels of oil
\$0.28 billion retained in the economy	\$2.45 billion retained in the economy



California is currently experiencing over 500,000 daily vehicle hours of delay (DVHD) due to recurrent congestion. In the year 2025, this delay is projected to increase to 984,000 hours per day, approximately a 100 percent increase over existing conditions. An additional 150,000 DVHD will occur in areas or on freeways that are currently uncongested. This would mean significant increase in fuel consumption and CO<sub>2</sub> from mobile sources, if we do not bring about meaningful controls on factors causing GHG.

Improving performance of transportation systems and operations will have multiple benefits, including lowering GHG emissions. The Department’s effort is focused on reducing, managing, and eliminating trips that are the primary means of congestion, GHGs, and air pollution through operational improvements, smart land use, ITS application, demand management, and market based strategies. Figure II defines the planning process and the structural strategies incorporated into the strategic growth plan to reduce per capita vehicle travel, relieve congestion and improve travel time on congested corridors.

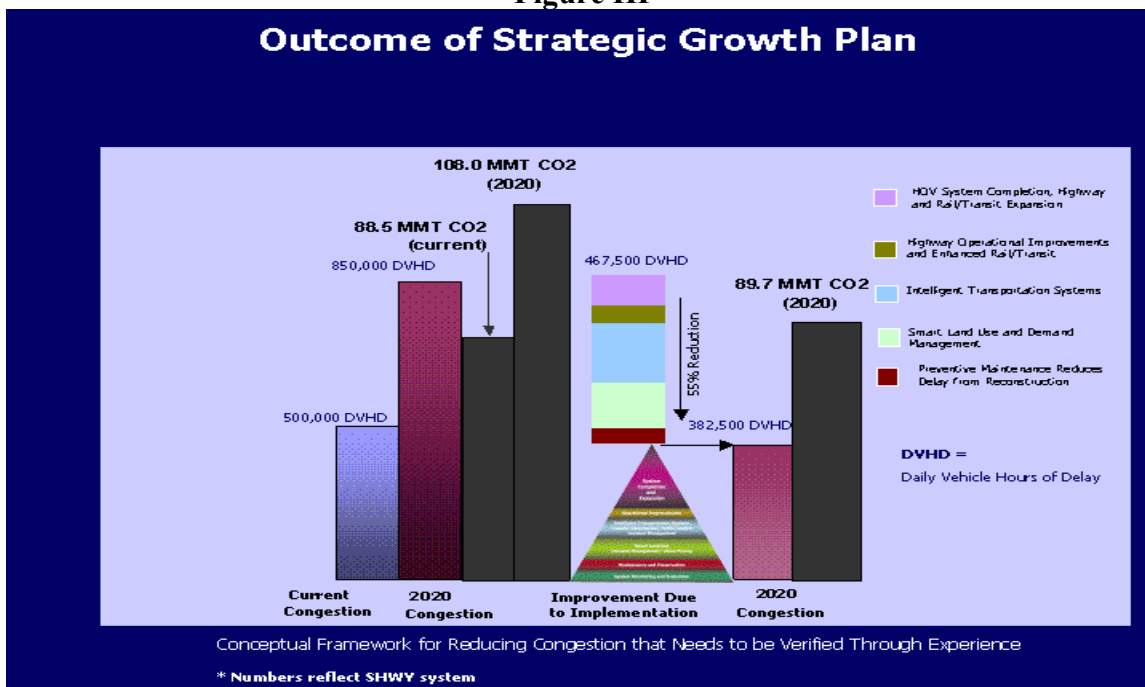
**Figure II**  
**Strategic Planning Process**



\* CTP: California Transportation Plan. \* GoCA: GoCalifornia 10-year Mobility Implementation Plan  
\* SG<sub>(Action)P</sub>: Strategic Growth Action Plan

Figure III shows the strategic growth investment strategies and projected outcome to reduce congestion in California and its secondary impact on the level of CO<sub>2</sub> produced.

Figure III



## 1. Transportation System Efficiency

The intent of this strategy is to reduce, manage, and eliminate trips, that are primary means of congestion, GHGs, and air pollution through smart land use, ITS, demand management, value pricing, and market based strategies.

**1.1. Smart Growth/Land Use Strategy** - Smart growth refers to development practices that result in more compact, accessible, multi-modal communities where travel distances are shorter, people have more travel options, and it is possible to walk and bicycle to more destinations. Smart growth policies could reduce per capita vehicle travel 10-30 percent. Although these land use changes provide diverse and durable benefits, they take many years to be achieved and require coordination of land use and transportation investment policies toward measurable outcomes.

The dilemma is that the transportation system management and land use planning are disjointed and there is disconnect between the timing and nature of these developments. While the State and metropolitan planning organizations have the responsibility for transportation planning, land use planning and zoning remains the prerogative of local governments and vice-versa. Land use and transportation agencies must build a stronger information and policy bridge. A more coherent and integrated land use-transportation approach is needed and a concerted effort among stakeholders to agree on regional growth scenarios that fully incorporate smart land use provisions and energy efficiency measures. The means to build this critical bridge exist.

**1.1.1. Regional Blueprint Planning** - The California Regional Blueprint Program is a strategic planning process and one of the tools the Department is using to link land use, transportation, housing, environment, economic development, and equity by developing

consensus on a preferred growth scenario for each region. This comprehensive, collaborative, and integrated process provides a framework for the state, local and regional agencies and the community to agree on long-term, land use patterns and transportation systems that improve mobility through smart land use measures. The program builds on regional efforts such as San Diego Association of Government's (SANDAG) Regional Comprehensive Plan, Sacramento Area Council of Government's (SACOG) Regional Blueprint, Southern California Association of Government's (SCAG) Blueprint, Merced Partnership for Integrated Planning, Riverside Integrated Planning Project, among others, to unite traditionally competing interests behind a single growth plan with benefit for all. The Blueprint Program provides incentives, analytic tools, workshops, and technical support to foster common ground and collaboration on the most effective land use-transportation plans and projects.

The State blueprint initiative will help resolve complicated growth issues in regions and advance implementation of desired regional growth plans, bringing about more coordinated, integrated land use and transportation decisions. If preferred growth scenarios are implemented a significant reduction in vehicle miles traveled and fuel consumption is expected with corresponding reduction in GHG. For example, the SCAG's land use strategies could produce savings up to 858,240 gallons of fuel per day by 2030. Similarly, SACOG's Blueprint plan would result in lowering 246,000 gallons of fuel each day. Because the Department's Regional Blueprint Planning program promotes sustainable development statewide, the State would realize additional benefit on other areas while providing support for development and implementation of the regional growth plans within such framework.

**1.1.2. Local Development/Intergovernmental Review (LD/IGR)** - The Department, through its LD/IGR program works with local jurisdictions early and through their land use planning and decision making processes consistent with the requirements of the California Environmental Quality Act (CEQA) and State planning law. The Department seeks to reduce vehicle trips associated with proposed new local development and recommends appropriate mitigation measures for dealing with the remaining transportation impact of such development. The LD/IGR program is intended to ensure that local land use planning and development decisions include the provision of transportation choices, including transit, intercity rail, passenger service, air service, walking, and biking, when appropriate. The Department advocates community design (e.g. urban infill, mixed use, transit oriented development) that promotes an efficient transportation system and healthy communities.

**1.1.3. Transportation Planning Grants** - Currently the Department provides \$9.3 million annually in grants to local and regional governments, community advocates, and universities for advancing livable communities, environmental justice, energy efficiency, and alternative modes of travel in transportation. The program and projects funded through these grants provide awareness and support development and implementation of best practices in community and regional planning.

**1.2. Operational Improvements and ITS** - Today, nearly half of the State's urban freeways are classified as "congested" – meaning they carry more traffic than they were

designed to handle. This also means wasted time and fuel. The highest levels of CO<sub>2</sub> from mobile sources are associated with congested, stop-and-go speeds (0-to-25 miles) and speeds over 55 mph. Operational improvements and ITS strategies are applied across the modes and intermodally (State highways, local streets and roads, bus and rail transit) and are intended to smooth out traffic flow, restore speed and improve travel time on the congested roadway system. These measures along with demand management strategies could significantly contribute to reducing fuel consumption and CO<sub>2</sub> from transportation. Market based strategies and demand pricing (i.e. State Route 91 toll lanes in Orange County and San Diego managed lane FasTrack on Interstate 15) are proven to be effective in managing demand and their application can be enhanced through joint venture and public-private partnerships.

Two major elements of the Department’s ITS program are the State Architecture and the Transportation Management System (TMS) Master Plan. The State Architecture is designed to provide a developmental framework and consistency between regional architectures and facilitate system integration and deployment of ITS technologies. The TMS elements, within the framework of the State Architecture, focuses on traveler information, traffic control, incident management, and system monitoring and evaluation to maximize the productivity of the transportation system and minimize a need for system expansion. Analysis shows these measures could reduce the VMT and delay by 20 percent in congested corridors. Table II shows metrics associated with improving transportation system efficiency.

**Table II – Improving Transportation System Efficiency**

STRATEGY	PROGRAM	PARTNERSHIP	METHOD/PROCESS	ESTIMATED GHG SAVINGS CUMM.		CURRENT RESOURCES – Operating Expenses Only*
				2010	2020	
Smart Land Use	IGR	Lead: Department Partner: Local Governments	Review and mitigate development proposals	Not Estimated	Not Estimated	\$167,000
	Planning Grants	Lead: Department Partner: Local and regional agencies, other stakeholders.	Competitive selection process	Not Estimated	Not Estimated	\$9.3 million
	Regional Plans and Blueprint Planning	Lead: Regional Governments Partner: Department	Regional Plans: SCAG, Metropolitan Transportation Commission, SANDAG, SACOG	0.975 MMT	7.8 MMT	\$15 million
Operational Improvements and ITS Deployment	Strategic Growth Plan	Lead: Department Partner: Regions	State ITS Architecture Congestion Management Plan	0.07 MMT	2.17 MMT	\$21.9 billion over 10-year
<b>TOTAL SAVINGS</b>				<b>1.04 MMT</b>	<b>9.97 MMT</b>	

\* Does not include person year (PY). Current resources are inadequate to achieve stated objectives.

## 2. Cleaner, More Energy Efficient Transportation Systems and Operations

The most direct approach to improving energy efficiency of the transportation sector is to increase vehicle fuel economy in new cars, light and heavy-duty trucks with rapid development and availability of alternative fuels and infrastructure. The State needs to pursue a diverse portfolio based on technology and fuel options that are achievable and cost-beneficial. ARB is charged with adopting a plan and setting forth how emission reductions will be achieved from significant GHG sources through a combination of regulatory, incentive, and market-based programs. The Department, building on existing effort, has taken steps to institutionalizing energy efficiency and GHG emission reduction measures into its planning, project development, operations, and maintenance of transportation facilities, fleets, buildings, and equipments. Table III shows metrics associated with this strategy.

**Table III – Cleaner, More Energy Efficient Transportation**

STRATEGY	PROGRAM	PARTNERSHIP	METHOD/PROCESS	ESTIMATED GHG SAVINGS CUMM.		CURRENT RESOURCES Operating Expenses Only*
				2010	2020	
<b>Mainstreaming Energy and GHG into plans and projects</b>	Office of Policy Analysis and Research	Interdepartmental effort	Policy establishment, guidelines, technical assistance	Not Estimated	Not Estimated	\$100,000
<b>Educational and Information program</b>	Office of Policy Analysis and Research	Partner: interdepartmental, CalEPA, CARB, CEC	Analytic report, data collection, publication, workshops, outreach	Not Estimated	Not Estimated	
<b>Fleet Greening and Fuel Diversification</b>	Division of Equipment	Dept of General Service	Fleet replacement		0.0065 MMT	
			B20 B100	0.0045MMT	0.045 MMT 0.0225 MMT	\$40 million*
<b>Non-Vehicular Conservation Measures</b>	Energy Conservation Program	Green Action Team	Energy Conservation Opportunities	0.117 MMT	0.340 MMT	\$200,000
<b>Portland Cement</b>	Office of Rigid Pavement	Cement and Construction Industries	2.5% limestone cement mix	1.2MMT/CA (0.144MMT/CT)	4.2MMT/CA (0.50MMT/CT)	
			25% fly ash cement mix	0.36 MMT/CT	3.6 MMT/CT	
			>50% fly ash/slag mix	Not Estimated	Not Estimated	
<b>Goods Movement</b>	Office of Goods Movement	CalEPA, CARB, BTH, MPOs	Goods Movement Action Plan	Not Estimated	Not Estimated	
<b>TOTAL SAVINGS</b>				<b>1.68 MMT</b>	<b>8.7 MMT</b>	

\* Does not include person year (PY). Current resources are inadequate to achieve stated objectives

**2.1. Mainstreaming GHG emissions reductions and energy efficiency into the policy framework governing land use and transportation** – Federal and State required statewide transportation planning, regional transportation planning, and local government land use planning do not require an analysis of the impacts of land use and transportation decisions on fossil fuel use and GHG emissions. This effort focuses on integrating energy and GHG emission concerns into transportation and land use plans, programs, projects, and investment decisions. Specific measures include:

- Strengthen the consideration of energy efficiency and climate change factors in the State Strategic Growth Plan, State and regional transportation plans, products and services; and the design, construction, operation, and maintenance of facilities. Provide incentives to transportation planning agencies that pro-actively address these issues, and if necessary through requirements, including provisions of the California Transportation Commission’s Regional Transportation Planning Guidelines.
- Incorporate analysis of economic, security, and environmental benefits associated with energy efficiency measures and emission reduction strategies in the State Transportation Plan and subsequent Action Plan. This includes, but is not limited to new vehicle and fuel technology, alternative vehicle concepts, new low-carbon fuels, more energy efficient combustion engines, sustainable means of freight movement, and value pricing and market-based approaches.
- Strengthen the consideration of energy efficiency and climate change in local government General Plans through provisions of the Governor’s Office of Planning and Research General Plan Guidelines and technical assistance to targeted local governments.
- Maintain better inventories and projections of GHG emissions from transportation, such as, develop more detailed information on the sources and nature of GHG emissions from transportation; improve modeling capabilities for projecting and evaluating impacts of energy efficient transportation and land use options; and maintain interagency research partnerships, including with federal agencies, universities, and nonprofit research organizations to ensure enhanced and active research and evaluation of energy and global warming issues.

**2.2. Fleet Replacement, Fleet Greening, and Fuel Diversification** - The on-going turnover of California’s fleet of vehicles offers the opportunity to move toward cleaner and more efficient vehicles for the private sector and especially the public sector. The State can accomplish this by committing to replace vehicles at their planned retirement date. Specific actions include:

- Modify vehicle purchase specifications to consider life cycle cost considerations rather than simply the initial purchase price.
- Include criteria for vehicle efficiency and emission levels in purchase criteria.
- Pursue emission reductions in heavy-duty vehicles, school buses, and vehicle classes other than light-duty cars and trucks.
- Promote alternative fuel infrastructure support and distribution.
- Enhance opportunities for State government to employ cleaner technologies for travel.
- Utilize alternative fuels such as biodiesel and ethanol blends.

The current level of funding in the Division of Equipment's budget is \$40 million and does not keep pace with the need to replace vehicles as planned. This level of funding allows only for the replacement of a portion of the existing fleet that needs to be replaced; approximately 600 to 800 vehicles a year. The Department currently uses over 13 million gallons of fuel annually. At the current rate, fuel savings of up to 5 percent could be achieved by 2020 or 650,000 gallons annually. This could result in reduction of 0.0065 MMT of CO<sub>2</sub> by 2020. A fleet replacement funding level of \$76 million over the next ten years is required to replace the vehicles needing replacement. By 2010, the Department could be using upwards of 3 million gallons per year of B20 biodiesel (B20 biodiesel has 15 percent reduction of GHG over conventional diesel fuel). By 2020, it is feasible that the Department could be using B100 biodiesel (75 percent reduction of GHG) for nearly all of its diesel fuel and E85 ethanol could replace gasoline.

**2.3. Non-Vehicular Conservation Measures** - The Department's energy conservation program focuses on non-vehicular energy consumption by the Department. Facilities and roadway related electrical and LPG/natural gas consumption loads include: lighting; heating; ventilation; air conditioning; and process loads including computers, office equipment, elevators, testing equipment, telecommunications, and minor appliances.

As a result of projects implemented since the late 1990s, the Department currently saves about 125,000,000 KWH per year. If saving 4,383 KWH avoids the generation of one metric ton of CO<sub>2</sub>, then the annual energy savings by the Department has avoided the annual generation of 28,519 metric tons of CO<sub>2</sub>.

Based upon the forecasted potential savings from projects currently not implemented (facilities upgrade program, on/off ramp illumination systems modifications, photovoltaic system applications at Department facilities, and other pending projects) and added to the existing energy infrastructure upgrades, the estimated annual electrical savings will approach 258,000,000 KWH. The avoided GHG impact of that total effort should approach 58,864 metric tons of CO<sub>2</sub> per year. These projects should be in place by the 2010 to 2020 time frame, if not sooner. The Governor's Green Action Team leads the State's effort on conservation measures.

**2.4. Portland Cement** - Cement is the ingredient in concrete that binds the rock and sand (aggregates) together to make a hard and durable product. Cement is made from melting pure limestone, adding some metals, and then letting the new mixture re-harden as "clinker" in a kiln. Limestone is CaCO<sub>3</sub>. Heating limestone releases a great deal of CO<sub>2</sub>. Cement production in California was about 12 MMT in 2004, 12 percent of which was used in Department projects (1.44 MMT). Assuming the production of one ton of cement generates about one ton of CO<sub>2</sub>, this level of production corresponds to 12 MMT of CO<sub>2</sub>.

The Department goal is to reduce the amount of cement used in pavements and bridges by up to 50 percent, and yet have stronger, longer-lasting concrete. Supplementary cementitious materials, such as fly ash, slag, silica fume, etc., are potential substitutes.

Consequently, CO<sub>2</sub> levels will be lowered and waste products used instead of newly produced materials.

The typical Department concrete mix is about 25 percent fly ash, generally with no other cement substitutions. This has produced 25 percent less GHG from cement production statewide. The Department objective is to increase concrete mixes with up to 60 percent fly ash and 50 percent slag, thereby improving GHG emissions saving from the 25 percent currently specified to 50 percent or better. The Department received the U.S. EPA Award for the use of recycled ash from burned coal in concrete for the construction of the new Bay Bridge. This project will use 450,000 cubic yards of concrete, and based on the new concrete mixed will save 0.75 MMT of CO<sub>2</sub> in the construction process.

Further reduction can be achieved by including interground limestone up to 2.5 percent without loss in concrete performance. The Department has changed its specification to allow 2.5 percent limestone concrete mix in future cement use. Consequently, an additional 0.3 MMT of CO<sub>2</sub> will be removed from cement production in California based on the 2004 production level, or 1.2 MMT and 4.2 MMT by 2010 and 2020 respectively assuming constant level of production. The Department is reducing its share of CO<sub>2</sub> by 0.036 MMT annually.

The Department is also researching 100-year pavement designed to last 100 years to significantly reduce maintenance and congestion caused by the current rate of rehabilitation/ maintenance and significant savings in construction material and GHG by increasing the pavement life cycle.

**2.5. Educating the public regarding the link between transportation and climate change, and related environmental, financial, economic and strategic security issues** - The intent is to explain GHG emissions in a language that the public, the legislature, and policy makers can readily understand and explain immediate economic and strategic security benefits and costs.

- Enhance outreach and public participation programs to bring a coordinated message of sustainable transportation and root causes of GHG emissions, as was done with electricity conservation during the energy crisis.
- Produce reports, brochures, web sites, public service announcements and other products to increase awareness of clean transportation, energy efficiency, transportation-related GHG emissions, and benefits/costs of GHG reduction alternatives.
- Convene educational forums for environmental and transportation stakeholders and reach out to local agencies, environmental advocates, industry, academic institutions, and elected officials to build broad and effective coalitions to address the challenges of climate change and clean transportation.

**2.6. Freight Transportation** – The Department is working with its partner, particularly CalEPA and ARB to accelerate improvement in California’s freight sector through better freight transport management, efficiency gains (shorter routes, better loading, etc.), reduced truck idling (fuel cell auxiliary systems, overnight idling, electrification of truck



parking), technology improvements, and alternative fueled heavy-duty vehicles. The Department supports implementation of short-, intermediate-, and long-term actions recommended in the Governor's Goods Movement Action Plan which is expected to have a positive impact on the level of CO<sub>2</sub> generated by movements of goods in the State.

**Economic Impact** – California's transportation future and its energy future are closely linked. This linkage is deepened by the near total reliance of transportation on petroleum and that over 50 percent of the petroleum consumed in California is imported with alarming economic and environmental costs. This interdependence exposes the cost of transportation to price spikes in the national or international markets, the outflow of capital from the State, and reduces the State's economic competitiveness and California's purchasing power and living standard.

The health of California's economy depends upon both safe and efficient movement of people and goods and affordable, adequate, and environmentally sound supply of energy. It is clear that diversifying transportation energy infrastructure and reducing fossil fuel consumption would significantly benefit California's economy and the environment.

The programs and strategies outlined in this report support both objectives and help reduce GHG emissions. By the year 2020, the GHG emission savings could reach 18.67 MMT if these strategies are fully implemented. The avoided social cost on the environment (\$ damage per ton) could amount to about \$1 billion (assuming a social cost of \$50 per ton - estimates vary from \$25 - \$180 per ton). This level of GHG savings also means reducing fuel consumption by 1.00 billion gallons of gasoline or 54.6 million barrels of oil annually, consequently retaining \$2.45 billion (at \$2.45 per gallon) in the California economy and reducing the State balance of payment by \$2.3 billion given the current level and price of imported oil. The savings will in turn improve gross personal annual income for the users of the transportation system by an estimated \$222.00 (not including travel time efficiency gains or maintenance cost). Considering that the cost of transportation is the second highest for households after housing, this gain is significant and will enhance consumers' disposable income.

Limiting GHG will require changes in behavior and investments in technology and could impose costs as well. Effectively understanding the potential costs and benefits of mitigating measures allows policy makers to achieve the greatest emissions abatement for the resources expended. However, many of the transportation efficiency measures are inherently beneficial and cost-effective. The macroeconomic and microeconomic impacts associated both with transportation system improvements and energy efficiency measures discussed in this report on the California economy are expected to be positive. Because climate change emissions originate from diverse sources, emission savings from transportation will provide the CAT and ARB more flexibility in adopting policies, standards, and market-based programs to achieve greenhouse gas emission reduction targets.

**The United Kingdom - Manitoba, Canada - California Agreements** – California has signed Memorandums of Understanding with the UK and Manitoba, Canada, committing

to build upon current efforts, share experiences, find new solutions, and work to educate the public on the need for aggressive action to address climate change and promote energy diversity. The Governor has also entered into agreement with other states, including New York to explore ways to link California's future GHG emission credit market and the Northeast and Mid-Atlantic states' Regional Greenhouse Gas Initiative (RGGI) upcoming market. The Department is prepared to fully support these efforts through the work of the CAT.

**Management Steering Committee and Technical Working Group** – The Management Steering Committee will oversee the Department's Climate Action Program. The committee is chaired by the Chief Deputy Director and consists of the Deputy Director for Planning and Modal Programs, the Deputy Director for Project Delivery, and the Deputy Director for Maintenance and Operations. The climate action technical working group consists of senior and supervisory staff from Transportation Planning, Resource Conservation, Traffic Operations, Environmental Analysis, Engineering Services, and Equipment programs.

**Conclusions** – The Department and the BTH are committed to a clean and energy efficient transportation. Efforts to reduce fossil fuel dependency will have significant environmental, economic, and strategic security benefits. Cleaner vehicles and a more energy efficient infrastructure should be pursued over the next few decades as part of California's strategy to meet the growing transportation demands in the most optimal way possible. Transportation and energy efficiency objectives must be fully integrated. The programs and strategies analyzed in this report have the potential to contribute significantly to GHG reduction targets established by the Governor in June 2005. The GHG emission savings could reach 18.67 MMT by the year 2020. Implementation of these strategies requires an adequate level of funding beyond those currently programmed and a concerted effort and collaboration on the part of the State, regional and local agencies.

The Department has taken tangible steps and will continue to explore feasible, cost-effective measures for further reduction of greenhouse gas emissions from transportation. The Department will work closely with the CAT, CalEPA, ARB, and California Energy Commission and other stakeholders to ensure an effective cross-agency policy framework to maintain California as a leader in protecting the environment and in the fight against climate change.

**Program Management and Contact** – The Office of Policy Analysis and Research in the Division of Transportation Planning is responsible for managing the Climate Action Program and provides technical analysis, policy evaluation, and coordination of the climate change effort at the California Department of Transportation. For further information, contact Dr. Reza Navai, Chief, Office of Policy Analysis and Research and Climate Action Program Manager, at (916) 653-3424, [reza.navai@dot.ca.gov](mailto:reza.navai@dot.ca.gov).