Attachment A

Public Health and Environmental Benefits of Draft Scoping Plan Measures

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September 2008

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1. AB 32 REQUIREMENTS

The Global Warming Solutions Act of 2006 (AB 32) requires the California Air Resources Board (ARB) to evaluate the economic, public health and environmental benefits of the Scoping Plan. ARB must also evaluate the potential for localized effects before implementing market-based compliance programs. This document discusses public health and environmental impacts. Economic impacts are discussed in a separate document.

Addressing climate change effects expands the way we view how our actions affect our environment and our health. In California, there are a number of state agencies dedicated to protecting and restoring the state's environment and improving public health. ARB, through the implementation of the Scoping Plan, will meet California's greenhouse gas reduction target in ways that help the State meet other public health and environmental goals. Any adverse environmental impacts will be assessed and mitigated as required by the California Environmental Quality Act (CEQA). The necessary CEQA documents for the Draft Scoping Plan will be released concurrently with the Plan.

For the purposes of the Climate Change Draft Scoping Plan, June 2008 and Appendices, July 2008 (collectively "Draft Scoping Plan"), ARB investigated the recommended measures' potential direct and indirect physical effects on the environment: air quality, water quality and supply, land resources, and biological resources. ARB then used these evaluations to examine the Draft Scoping Plan's potential effects on public health, primarily through changes to air quality, and the potential for localized effects. For the purposes of evaluating implementation of the Draft Scoping Plan, we first established and examined a "business as usual" scenario for absent the Scoping Plan measures. The "business as usual" scenario includes implementation of existing ARB policies and plans such as the Diesel Risk Reduction Plan, the Goods Movement Emission Reduction Plan and the State Implementation Plan for criteria pollutants. ARB then examined each measure to evaluate potential changes the Draft Scoping Plan might cause.

The Draft Scoping Plan describes the framework of the proposed recommendation and Appendix C describes each measure, by sector, in detail. These documents were relied upon and are not necessarily repeated within this evaluation. Measures are described as needed to discuss the related environmental or public health effect.

This analysis of the Draft Scoping Plan focuses on measures in the transportation, land use, energy, and industrial sectors because they are the sectors identified to have the greater potential impact on public health. ARB is continuing to evaluate the environmental and public health impacts of the forest, water-energy, agricultural, high global warming potential (High-GWP) gases, and recycling/waste sectors. A complete analysis will be included in the Proposed Scoping Plan to be released in October 2008.

2. 2020 CONDITIONS WITHOUT PROPOSED AB 32 SCOPING PLAN – BASELINE FOR EVALUATION

There are two main drivers of the 2020 Business As Usual ("BAU" or "No Project") scenario: population growth and current laws and regulations. Population growth in California will result in 2020 conditions with more vehicle miles driven, more fuel used, greater electricity consumption, more consumer products, more goods movement, and greater water demand. Laws and regulations already in place or in process will continue to maintain and even improve our environmental resources, even with population growth.

The following describes the BAU scenario, which is used as a baseline for the evaluation of each proposed or evaluated measure. Descriptions of the 2020 BAU forecasts for the major sectors of the inventory are given below with key assumptions staff used to estimate these future emissions.

Transportation

GHG emissions in 2020 from the transportation sector as a whole are expected to increase from current levels to 225.4 million metric tons of carbon dioxide equivalents ($MMTCO_2E$). This forecasted increase is dominated by increases in emissions from on-road transportation, i.e., passenger cars and heavy-duty trucks. To forecast on-road transportation emissions, ARB staff used 2007 fuel sales data obtained from the California Board of Equalization and estimated 2020 emissions based on the growth in projected vehicle miles traveled (VMT) derived from the 2007 Emissions Factor Model (EMFAC2007). This BAU forecast assumes no change in vehicle fleet mix over time.

Goods movement activities in California are projected to increase up to 250 percent between 2006 and 2020, as the United States increases its exports and imports in the globalized economy. This increase translates to more ship and truck trips in and around ports, and more truck activity between and at rail yards and distribution centers. Rail trips will probably not increase, as improvements in locomotive efficiencies accommodate larger hauls. Some of this growth may require new infrastructure to relieve traffic congestion and improve efficiencies, such as port and highway expansions. ARB adopted and is implementing a Goods Movement Emission Reduction Plan to reduce emissions from goods movement activities and address regional ozone and particulate matter standards, as well as impacts on already adversely-impacted communities, which can be located near ports, rail yards, and distribution centers.

The 2007 Integrated Energy Policy Report indicates that by 2020, at current trends, more than 44 million Californians will consume more than 24 billion gallons of gasoline and diesel fuel each year. Such increased consumption would require major investments in petroleum refinery and delivery infrastructure expansions. Assembly Bill 1007 (Pavley, 2005) directed the California Energy Resources and Conservation Commission (CEC) and ARB to develop a plan to increase the use of alternative fuels in California, effectively reducing California's demand on refineries. California's refineries also supply other western states, which are currently expected to increase their demands for gasoline and diesel into the future due to population growth.

Local Government Actions and Regional Targets

California's population is continuing to grow at 1.2 percent per year. If the measures in the Scoping Plan are not implemented, land use patterns and decision making will likely continue to foster leap frog development and urban sprawl, which directly relates to a continued increase in VMT, further degradation of air quality, and an increase in detrimental health effects.

Continued urban development along the state's coastline, in historical floodplains and along riverine corridors will increase the risk of property damage and potentially increase the loss of life as a result of increased incidence of flood events and rising sea levels.

Most of the gains made by introducing cleaner vehicles and fuels will be eroded unless more efficient methods of urban and community planning, transit choices, and public safety measures are implemented.

Electricity and Natural Gas

Under a business as usual scenario, population growth in California will affect electricity demand in two ways: the number of residents will increase the overall demand for electricity and natural gas, and the location of those residents, primarily in the state's inland areas, will change the pattern of energy use. Trends toward larger homes and increases in electronic equipment will also increase demand. Historically, California's appliance and building efficiency standards were able to hold our per capita electricity and natural gas demands steady, but under a business as usual scenario these programs will not be able to continue this trend through 2020 and new capacity would be needed.[1] As demands increase, older, less efficient and dirtier power plants would be expected to operate more frequently.

The pattern of energy use is important, because the electrical system is sized to accommodate peak demands. The base of the state's electrical demand is a minimum amount of energy demanded by the state all the time. The peak demand is the difference between this base and the maximum amount of energy needed, usually during periods of extreme weather on weekends. Power plants that provide base energy are the most cost-effective, because they are run fairly constantly. "Peaker" power plants, on the other hand, can be run as little as 4 hours a day on a few very hot summer days, and the low duration of operation tends to result in higher co-pollutant emissions than their base counterparts on a per MW basis. The State uses a "loading order" to determine the priority of use of each power plant, prioritizing the lowest emitting or most efficient sources. But by 2020, many of the state's power plants will be aging - their efficiencies declining, resulting in increased fuel demands and co-pollutant emissions. There are also several coastal plants that could be closed in response to proposed environmental requirements for their once-through cooling systems.[2]

Power plants are typically located close to power recipients, suggesting that new power plants would most likely follow population growth in the state. Repowering old plants or constructing new plants in the South Coast, where the state's greatest demand is located, has been identified as particularly problematic due to the region's air quality constraints.

[1] 2007 Integrated Energy Policy Report.

[2] State Water Resources Control Board, proposed *Water Quality Control Policy on the Use of Coastal and Estuarine Waters for Power Plant Cooling*, March 2008.

Along with reliable power plants, important components of a reliable electricity system are distribution, transmission, and availability of fuel supplies. Like power plants, distribution systems are aging, and require substantial infrastructure investments to ensure their continued reliability. The construction of new transmission lines could be needed to increase the state's renewable electricity sources to meet the existing regulatory goals of 20 percent. If these goals are not met, the price of electricity will increase as utilities incur financial penalties. These issues have all been identified in the 2007 Integrated Energy Policy Report (2007 IEPR) as high priorities for the state in the near term.

A third challenge is from the effects of climate change such as increasing frequency and magnitude of extreme weather events. This could drastically affect the duration and magnitude of peak demands, increasing reliance on aging power plants. During the summer months, California also imports energy generated by hydropower from the Northwest to meet peak demand. Decreasing snowpack within California and throughout the west is likely to reduce the availability of this clean and relatively inexpensive hydropower source, further exacerbating the problem. In addition, a large number of power plants in California are located along the coast. The potential for sea level rise associated with climate change could impact the operation of those plants.

The 2020 business-as-usual greenhouse gas emissions forecast for the electric power sector is 139.2 $MMTCO_2E$. These emissions are the result of in-state power generation plus specified and unspecified imported power. BAU forecasted emissions assume that all growth in electricity demand by 2020 will be met by either unspecified imports or in-state natural gas-fired power plants. Expected growth in renewable power to meet the current and proposed Renewables Portfolio Standard (RPS) is not included in the BAU. This allows the Draft Scoping Plan reductions from increasing renewable power generation to be additive with the BAU forecasted 2020 emissions without double-counting the reductions.

The 2020 BAU forecast for emissions from specified sources of imported electricity (i.e., power received from specific out-of-state power plants) is assumed to decrease resulting from the closure of one coal-fired power plant (Mojave) previously supplying imported electricity. The demand previously served by the closed plant was replaced by in-state natural-gas generation. Based on outputs from the California Energy Commission's (CEC) electricity demand models, in-state electricity generation and specified imports would not meet the State's full electricity demand in 2020. The remaining demand is assumed to be met by unspecified imported electricity (i.e., power received from a mix of power generating sources outside the State).

Commercial and Residential

The Commercial and Residential sector is expected to contribute 46.7 $MMTCO_2E$ or about eight percent of the total statewide GHG emissions in 2020. Forecasted BAU emissions from the Commercial sector include combustion emissions from natural gas and other fuels (e.g., diesel) used by office buildings and small businesses. Residential emissions result primarily from natural gas combustion used for space heating and for hot water heaters. Growth in emissions from the Commercial and Residential sector is due primarily to the expected increase in population and assumed increased use of natural gas. Emissions from the use of other fuels, such as diesel fuel, are assumed to remain relatively constant over time.

Water

California's water system is stressed today, and will likely be more so in 2020. The California Water Plan Update 2005 presents three potential scenarios for conditions in 2030. All three scenarios indicate a growing demand for water and increasing stresses on a complicated system. The Colorado, Delta, and Klamath water supply systems are experiencing serious conflicts between ecosystem, agricultural, and urban needs, and many infrastructure solutions under discussion today will likely not be in place by 2020.

All sectors will be affected by the changing dynamic in the amounts of water stored in the state's snowpack. Balancing the water needs of the state -- the expected increase of demand for water for energy and industrial uses, consumption by an increasing population, an increase in demand to grow crops balanced with maintaining water quality and a sustainable ecosystem -- will become more complex, challenging and expensive.

Water is intricately linked with energy. Twelve percent of the state's electrical demand comes from transporting water around the state, from source to user. Seven percent of the state's electrical supply comes from large hydropower facilities. Electricity is used to transport water and treat water, and natural gas is used to heat water. Water is used to produce transportation fuels, generate electricity, grow food, and create products.

The State is already experiencing the need to conserve water. The measures recommended by the Draft Scoping Plan reflect the State's current planning to conserve additional water and to optimize available water supplies, considering water, energy, and associated GHGs. Without actions to improve water supplies, water shortages could get worse at rate of approximately two to three percent per year. This rate is likely to be much higher, given the likely impacts that global warming will have on the State's water system. These measures are needed, at a minimum, to meet increasing demand from a growing population.

The water system is likely to be further stressed by climate change, which can reduce the ability to store vast amounts of water as snowpack (rather than in reservoirs), and increase the need for water to maintain agriculture, landscaping, electricity, and industry, and to keep cool during extreme heat waves.

Green Buildings

Population growth in California will continue to increase electricity demand. Green building measures can help reduce the energy use associated with buildings in California.

There are several policies, codes, and plans in place to increase the environmental efficiency of new and existing commercial, residential, and state buildings by 2020, including the new California Green Building Standards Code adopted by the Building Standards Commission in July 2008. The California Public Utilities Commission (CPUC) also has established "zero net energy" (ZNE) goals for new construction in California. By 2020, the goal is that all new homes will be ZNE. For commercial buildings, the target date is 2030. In the best case, if the state is able to transform new housing and building stock into "net zero energy" stock, and existing buildings are retrofit for greater energy and water efficiency, the demand for water and energy from buildings will be similar to or lower than what it is today. This will depend on both the

degree to which new stock is built or existing stock is converted and the degree to which they incorporate environmental efficiency over the next twelve years.

During 2007 and 2008, an unprecedented number of communities across the state implemented environmentally sensitive, or "green" building requirements in order to increase energy efficiency and decrease greenhouse gas emissions and other environmental impacts within their jurisdictions. In the first half of 2008 alone, nearly a dozen mandatory green building ordinances have taken effect, requiring private developers to utilize and document green building practices used throughout the construction and life of the project. Other California cities, like San Francisco, San Leandro, Santa Rosa, Hayward and Los Altos Hills are currently developing ordinances for enactment in the near future. The experience of these cities has shown that bold, ambitious action to reduce carbon emissions is possible and easier than ever before.

Industry

The Industry Sector as defined in the Draft Scoping Plan includes refineries, oil and gas facilities, cement and glass manufacturing, and industrial facilities that employ boilers or general combustion engines. The business-as-usual assumptions for refineries are discussed in the transportation section above. Activity in oil fields in southern California and gas fields in northern California are driven by price and availability, and could therefore expand in the future if current price trends continue. Off-shore drilling would most likely hold steady, due to the limited yield and potential for sever environmental impacts. While the demand for cement will grow with population growth, most of the demand is likely to be met through out of state production while the current rate of in-state production holds steady. Overall manufacturing is expected to slightly decline, while the commercial sector increases. Manufacturing will likely remain concentrated in the South Coast and Bay Area, with agricultural and food processing concentrated in the San Joaquin Valley.

Emissions for this sector are forecasted to grow to 100.5 $MMTCO_2E$ by 2020, an increase of approximately five percent from the average emissions level of 2002-2004. BAU-forecasted emissions for this sector are variable, but overall are not expected to grow substantially. Most of the growth from this sector comes from the fuel use and process emissions of three industries: cement plants, oil and gas production, and refining. Emissions from the combustion of natural gas are expected to grow for some industries (e.g., cement plants) and decline for others (e.g., food processors). These assumptions of growth and decline in natural gas demand are based on outputs from energy demand modeling conducted by CEC staff for the 2007 IEPR.

Recycling and Waste Management

Currently, California disposes an estimated 42 million tons of waste in landfills each year, of which 30 percent is compostable organic materials, 22 percent is construction and demolition debris, and 21 percent is paper.[3] Fifty-four percent of California's waste is diverted from landfills and recycled or repurposed. Most of the remainder of California's waste is sent to landfills in the state. In the future, the need for new landfills will be determined by both population growth and by how well the State implements its waste management goals. The California Integrated Waste Management Board has a strategic goal of becoming a Zero Waste

[3] From the California Integrated Waste Management Board website: http://www.ciwmb.ca.gov/Climate/ Organics/ default.htm.

State. One supporting goal is to halve the volume of organics going to landfills by 2020. These goals will require the development of new facilities to recycle and repurpose waste, but will also reduce the need for new landfill capacity.

Forests

The forest sector is unique to California's GHG inventory because it combines both positive and negative emissions into a current sink of approximately -5 $MMTCO_2E$ (2002-2004 average). This net number is negative because the gross emission rate from fires, decomposition, harvesting, land conversion, and waste is less than the atmospheric uptake of carbon from forest growth. In addition to being a GHG sink, forests also provide multiple ecological benefits like habitat, structure, and nutrient cycling, as well as a suite of other human benefits or services such as water storage, soil stability, air and water quality, wood products, and recreation. The BAU inventory shows that forest sector emissions are increasing while forest growth is remaining the same. If this trend continues, emissions will equal uptake by about 2020 meaning that the inventory will increase to zero and this sink will be lost.

The degree to which we can reduce this loss of the forest sink will depend on the level of funding, and on the incidence of wildfires. As seen in summer 2008, wildfires can significantly impact air quality and threaten public safety. Wildfires in water supply watersheds can also impact drinking water quality for years after they occur. Population growth will increase pressure to develop forest lands and development in close vicinity of forests can further increase risk. Global warming is also likely to increase risks associated with the forest sector through changes to weather patterns which can impact forests both directly and indirectly, by creating hospitable conditions for pests and catastrophic fires.

High Global Warming Potential Gases (High-GWP)

Consumer demand, vehicle use patterns, and increased electrical demand due to population growth will increase the amount of high-GWP gases released to the atmosphere. The rates of increase vary by type of activity.

The forecasted 2020 BAU emissions of high-GWP gases are 46.9 $MMTCO_2E$. High-GWP gases, including sulfur hexafluoride (SF_6) from electric utility applications, substitutes for ozone depleting substances (ODS) (primarily hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs)), and other high-GWP gases used in semiconductor manufacturing and other industrial processes are combined under one sector for purposes of the Draft Scoping Plan. Assumptions used to forecast business-as-usual emissions of high-GWP gases vary by GHG. SF_6 emissions occur primarily from leaks in electrical transmission system equipment in which SF_6 is used as an electrical insulator. SF_6 leaks are constant from a given piece of electrical equipment and are not related to the use of the equipment. The probable expansion of the electrical transmission system infrastructure is assumed to result in more SF6 emissions from leaks. However, at the same time, technical improvements to the transmission system equipment result in fewer leaks, reducing SF_6 emissions. ARB assumes that the effect of an expansion of the electrical transmission system infrastructure, combined with the technical improvements to the equipment in the system, will result in no net change in emissions in 2020.

Agriculture

The agriculture sector includes emissions from livestock, i.e., digestive processes and manure management; combustion of liquid and gaseous fuels used for irrigation and crop production; emissions from fertilizer use and application of other soil additives; and emissions from agricultural residue burning. By 2020 there is significant potential for continued conversion of farmlands to urban, commercial or industrial development or other uses. The California Department of Food and Agricultural is currently developing a strategic plan for the future of agriculture in California.

Agricultural residue burning and livestock emissions were forecast using ARB's criteria pollutant forecasting approach. Forecasted emissions from the combustion of natural gas were estimated using outputs from the 2007 IEPR developed by CEC. Other agriculture-related emissions were either held constant or extrapolated using historical trends to obtain a 2020 BAU estimate. BAU emissions from the agriculture sector are forecasted to increase about seven percent from current levels to 29.8 $MMTCO_2E$ in 2020, due exclusively to the assumed increase in livestock population.

In spite of current measures to preserve farmlands and open space, through Williamson Act contracts, state land purchase, and general plan land zoning, population increases will continue to pressure the conversion of farmlands to urban, commercial and industrial development.

3. POTENTIAL ENVIRONMENTAL IMPACT OF CLIMATE CHANGE DRAFT SCOPING PLAN

A. AIR RESOURCES

ARB and local air quality management districts (AQMD) and air pollution control districts (APCD) have a long tradition of successfully regulating stationary sources, vehicles, fuels, and consumer products to improve California's air quality. California's weather and topography combine to trap air pollutants that commonly result in poor air quality. Twenty counties in California fail to meet the health-based state ambient quality standard for ozone (smog) and eleven counties fail to meet the health standards for fine particulate matter. In addition, some California communities experience disproportionate impacts from poor air quality due to the proximity to a concentration of pollution sources. California's numerous air quality plans, programs, and regulations collectively provide the mechanisms to continually improve air quality.

Climate change can lead to changes in weather patterns that can influence the frequency of meteorological conditions conducive to the development of high pollutant concentrations. High temperatures, strong sunlight, and stable air masses tend to occur simultaneously and increase the formation of ozone and secondary organic carbon particles. Weather conditions associated with warmer temperatures increase smog. Thus climate change effects are expected to exacerbate air quality problems in the future. This evaluation does not attempt to quantify the effects of climate change in 2020 nor evaluate Scoping Plan implementation in this context.

For the purposes of this section, criteria pollutant and toxic air contaminant emissions will often be referred to as "co-pollutants" since the focus of the Draft Scoping Plan is greenhouse gas emissions. This section focuses on the potential impacts on co-pollutant emissions since the recommended measures are designed to reduce greenhouse gases.

Criteria Pollutants

Both the California and federal governments have adopted health-based standards for the criteria pollutants, which include ozone, particulate matter (PM10, PM2.5), carbon monoxide (CO), nitrogen dioxide (NO_2) and sulfur dioxide (SO_2).

Ozone, a colorless gas that is odorless at ambient levels, is the chief component of urban smog. Ozone is not directly emitted as a pollutant, but is formed in the atmosphere when hydrocarbon and NOx precursor emissions react in the presence of sunlight. Meteorology plays a major role in ozone formation. Generally, low wind speeds or stagnant air, coupled with warm temperatures and cloudless skies provide the optimum conditions for ozone formation. As a result, summer is generally the peak ozone season. Because of the reaction time involved, peak ozone concentrations often occur far downwind of the precursor emissions. Therefore, ozone is a regional pollutant that often impacts a large area. Inhalation of ozone can lead to inflammation and irritation of the tissues lining the body's airways, which can cause spasm and contraction, reducing the amount of air that can be inhaled. Ozone in sufficient doses can also increase the permeability of lung cells, making them more susceptible to damage from environmental toxins and infection. Ozone exposure is associated with an increase in hospital admissions and emergency room visits, particularly for lung problems such as asthma and chronic obstructive

pulmonary disease. The elderly, children, adolescents, and adults who exercise or work outdoors are most susceptible to adverse impacts from ozone exposure.

Particulate matter (PM) is a mixture of substances that includes elements such as carbon and metals; compounds such as nitrates, sulfates, and organic compounds; and complex mixtures such as diesel exhaust and soil. These substances may occur as solid particles or liquid droplets. Some particles are emitted directly into the atmosphere. Others, referred to as secondary particles, result from gases that are transformed into particles through physical and chemical processes in the atmosphere. Exposure to PM aggravates a number of respiratory illnesses and may even cause premature death in people with existing heart and lung disease. Both long-term and short-term exposure can have adverse health impacts. Particulate matter less than 2.5 microns in diameter (PM2.5) poses an increased health risk because it can deposit deep in the lung and contains substances that are particularly harmful to human health.

ARB and local air districts have regulated the sources of criteria pollutants – cars, trucks, consumer products and industrial sources – for decades. The State Implementation Plan (SIP) describes California's comprehensive plan for reducing emissions of ozone and fine particle precursors to meet the federal standards for healthful air. Table 1 summarizes the Draft Scoping Plan measures that are already being pursued as part of the 2007 SIP, or were already underway before the enactment of AB 32.

The 2007 SIP calls for significant reductions in emissions of nitrogen oxides (a precursor to both ozone and fine particles) and direct emissions of fine particles. As seen in Table 2, the 2007 SIP is expected to reduce emissions of NOx by about 20 percent statewide in 2020, and direct emissions of fine particles by almost 15 percent.

Toxic Air Pollutants

A toxic air contaminant (TAC) is defined as an air pollutant which may cause or contribute to an increase in mortality or serious illness, or which may pose a hazard to human health. TACs are usually present in minute quantities in the ambient air. However, their high toxicity or health risk may pose a threat to public health even at very low concentrations. In general, for TACs, there is no concentration that does not present some risk. In other words, there is no threshold level below which adverse health impacts are not expected to occur. This contrasts with the criteria pollutants for which acceptable levels of exposure can be determined and for which the State and federal governments have set ambient air quality standards.

The majority of the estimated health risk from TACs can be attributed to a relatively small number of compounds, with the highest risk from PM from diesel-fueled engines (diesel PM, or PM2.5 from diesel sources). In addition to diesel PM, benzene and 1,3-butadiene are also significant contributors to overall ambient public health risk in California. The other seven TACs posing the greatest ambient risk are acetaldehyde, carbon tetrachloride, hexavalent chromium, *para*-dichlorobenzene, formaldehyde, methylene chloride, and perchloroethylene. Over the past ten years, ARB programs have reduced TAC emissions in the State by 50 percent.[4]

[4] http://www.arb.ca.gov/toxics/brochure.pdf

Table 1: Draft Scoping Plan Measures Included in 2007 SIP

Measure	In 2007 SIP	Not in 2007 SIP but underway before AB 32	EAM or New in DSP
Cap and Trade Program			X
Pavley I and Pavley II-Light-Duty Vehicle GHG Standards	X	X	
Vehicle Efficiency Measures			X
Low Carbon Fuel Standard			X
Ship Electrification at Ports	X		
Goods Movement Efficiency Measures	X		X
Heavy Duty Vehicle GHG Emission Reduction – Aerodynamic Efficiency			X
Medium and Heavy-Duty Vehicle Hybridization			X
Heavy-Duty Engine Efficiency			X
High Speed Rail		X	
Local Government Actions and Regional Targets			X
Energy Efficiency and Conservation (Electricity)			X
Energy Efficiency and Conservation (Natural Gas)			X
Solar Water Heating		X	
Million Solar Roofs		X	
Increasing Combined Heat and Power			X
Renewables Portfolio Standard		X	
Energy Efficiency and Co-Benefits Audits for Large Industrial Sources			X

Table 2: Statewide Emission Reductions From Proposed New 2007 SIP Measures in 2020
(TPD)

	Baseline Emissions	Reductions from 2007 SIP Measures	Emissions with 2007 SIP
NOx	2254	441	1813
PM2.5	247	34	213

Today, particulate matter from diesel represents 70 percent of the known risk from air toxics in California. The Diesel Risk Reduction Plan sets a goal of reducing the risk from diesel particulate matter 85 percent by 2020. ARB has adopted 24 airborne toxic control measures to control TAC emissions from mobile and stationary sources for both diesel and for the other TACs.

Evaluation Process

For measures that have already been adopted as regulations or have been analyzed in broader plans, the pertinent environmental analysis is summarized in this section. For other proposed measures, existing evaluations of similar activities were identified and explored to identify the types of potential impacts associated with the measure. ARB also developed statewide emission factors to establish a correlation between avoided combustion of fuels or production of electricity and emissions of NOx and PM2.5.

1. CALIFORNIA CAP-AND-TRADE PROGRAM LINKED TO WESTERN CLIMATE INITIATIVE

A cap-and-trade program establishes an enforceable limit (or cap) on total emissions for sources covered by the program. In the Draft Scoping Plan, ARB recommends a cap-and-trade program under which emissions in 2020 from covered sources in the cap and trade program, plus expected emissions from uncapped (non-cap and trade) sources, would be no greater than what was emitted in the aggregate in 1990. A key component of a cap and trade program is an allowance, which is a permit to emit greenhouse gases. As fewer allowances are issued over time, the cap declines. This proposed measure would cover about 85 percent of California's greenhouse gas emissions in 2020.

Under the preliminary recommendations, capped sectors would include electricity, transportation fuels, natural gas, and large industrial sources. The recommended measure calls for a cap and trade program that would begin in 2012 with emissions declining through 2020. The total amount of greenhouse gas emissions from industrial sources and electricity generation would be capped beginning in 2012, and decline over time through 2020. Greenhouse gas emissions from commercial and residential fuel use (e.g., natural gas and propane) and transportation fuels would be capped after 2012, but no later than 2020.

The Draft Scoping Plan also discusses the potential for establishing longer term targets to further reduce greenhouse gas emissions in the 2020-2050 timeframe. The proposed measure would allow the limited use of surplus reductions from non-capped sources that are additional to reductions required by AB 32. These surplus reductions are called offsets. If permitted, offsets would be subject to stringent criteria and verification procedures to ensure their enforceability and consistency with AB 32 requirements.

Under the proposed measure, emissions and energy use from most of the sectors covered by a cap and trade program would also be governed by other regulatory measures and enforceable policies, including performance standards, efficiency programs, and direct regulations. All measures that otherwise apply to capped sectors would contribute to achieving the cap by reducing their need to obtain allowances.

In the proposed cap and trade program, allowances would be allocated in an amount equal to the total emissions allowed in a compliance period. Each compliance period would run for a specific time period, such as one or three years. At the end of each such period, covered firms in the program would be required to surrender allowances equal to their total emissions for the compliance period. Allowances that are held by a covered source could be banked for future use

if they are not needed to meet its compliance obligation. Alternatively, an unused allowance could be re-sold (traded) if the firm emits less than the number of allowances it holds.

This allowance value would reflect the average cost of reducing emissions; in other words, a firm would only go into the market to buy an allowance if the market value of the allowance is less than reducing emissions on site; alternatively, if a firm believes that selling its allowance in the market is worth more than banking the permit for future use, it would probably trade the allowance to another source at the current market price.

Failure of a facility to surrender sufficient allowances to cover its emissions would result in significant penalties. To maintain the environmental integrity of the system, non-compliance penalties would include purchasing and surrendering allowances at least equal to the facility's excess emissions.

ARB expects that the proposed cap and trade measure would provide air quality benefits. Because most greenhouse gas emission sources also emit criteria and toxic air pollutants, the proposed measure would generally result in overall air quality improvement. The recommended cap and trade program as well as other related measures applicable to capped sources would be designed to ensure that program implementation is consistent with State air quality plans and related statutory requirements.

There are concerns about the potential for localized environmental impacts as a result of the trading component of the cap and trade program. This concern arises from the possibility that under a cap and trade program, a source of greenhouse gas emissions that impacts a community adversely impacted by criteria pollutants or toxic air contaminants could choose to obtain allowances or offsets instead of reducing greenhouse gas emissions at their facility. While greenhouse gas emissions have no direct public health impacts, the processes involved in manufacturing and electricity generation from capped sources also emit criteria pollutants and toxic air contaminants. These pollutants can pose direct and adverse health effects on exposed populations. California air pollution regulatory programs at the federal, state, and local level address individual source emissions from a regional and localized perspective. ARB evaluated the potential impacts of a cap-and-trade program on an example community – Wilmington – and found that the emission impacts were extremely small. The assessment is described in Attachment C. However, recognizing that this is only one example, if the Board chooses to pursue a cap-and-trade program, during the regulatory development phase, staff will evaluate the program design to ensure that the program meets AB 32 requirements related to protection of public health as well as ARB's policies and actions for environmental justice (December 2001).[5] Local agencies, such as air pollution districts and planning commissions, could also impose more stringent requirements for sources of criteria pollutants and air toxics to address potential cumulative impacts.

[5] http://www.arb.ca.gov/ch/programs/ej/ejpolicies.pdf

2. TRANSPORTATION AND GOODS MOVEMENT

Regulatory Background

The transportation sector includes personal transportation vehicles (like cars and trucks) as well as vehicles that transport goods (such as heavy trucks, ships, planes and trains). The transportation sector does not include off-road sources like bulldozers and forklifts, which are included in the industrial sector. Farm equipment, like tractors, is included in the agricultural sector. Emissions from recreational off-road equipment like all-terrain vehicles and recreational boats are relatively small, and their emissions are counted in the industrial sector. In 2006, on-road mobile sources[6] emitted the most NOx and ROG (ozone precursors) statewide. Exhaust emissions from mobile sources contributed only a very small portion of directly emitted PM2.5 emissions, but were a major source of the ROG and NOx that contribute to the secondary formation of PM2.5. ARB's control programs will continue to focus on meeting more stringent ozone and PM standards as well as reducing the risk associated with diesel particulate.

ARB has a long history of regulating passenger vehicles and other transportation sources to reduce emissions of criteria and toxic air pollutants. ARB has many regulatory programs in place to reduce criteria and toxic pollutant emissions – and in some cases GHG emissions – from transportation sources including:

The **Low-Emission Vehicle Program** (LEV and LEV II) has set standards to reduce emissions of NOx, ROG, non-methane organic gases (NMOG) and PM from passenger vehicles, light-duty trucks, and medium-duty vehicles. Pavley regulations to control tailpipe CO_2 and other associated GHG emissions are complementary to the LEV II program and both programs are implemented through the Low Emission Vehicle Regulations and Test Procedures.

The State's **Smog Check Program** ensures that passenger vehicle emission control systems are properly maintained throughout their useful life.

ARB's fuel programs require the use of gasoline and diesel fuel that burn more cleanly, reducing emissions of criteria and toxic air contaminants from the transportation sector, as well as off-road and stationary engines that use gasoline and diesel fuel. As the next phase of these fuel regulations, ARB is currently pursuing a low-carbon fuel standard that will reduce the carbon intensity of transportation fuel by at least 10 percent by 2020. The Board is scheduled to consider this regulation in late 2008 or early 2009. Health and Safety Code § 43830.8 requires that any new fuel undergo an environmental assessment of the fuel's potential impact on air, water, soil, and as waste. The assessment must be peer reviewed, and any impacts minimized or mitigated.

The **Zero-Emission Vehicle Regulation** (ZEV), first adopted in 1990 and most recently modified in 2008, requires manufacturers to offer for sale in California an increasing number of hybrid, partial-zero, and zero emitting vehicles. Although the regulation focuses most directly on criteria pollutants, the emerging technologies encouraged by the regulation, such as battery electric, fuel cell and hybrid electric vehicles, also offer significant GHG benefits.

[6] 2008 Emissions Almanac.

Fuel cell, hydrogen, and electric vehicles are considered "zero emission vehicles" because they have either no exhaust or only water vapor. As a direct result of the ZEV program, over 750,000 Californians are currently driving vehicles that that receive partial-zero emission credit, conventional vehicles that achieve the most stringent emission tailpipe standards, zero evaporative emissions, and come with extended warranties. On March 27, 2008 the Air Resources Board directed staff to look at incorporating climate change considerations into the program.

A complementary effort by the State is the **California Hydrogen Highway Network**, which is a public-private partnership to build the infrastructure for hydrogen vehicles and to add hydrogen vehicles into public transportation fleets. The current goal of this program is to have at least 50 hydrogen stations in the state and 2,000 hydrogen-powered vehicles by 2010, followed by a second and third phase of implementation. The program examines the well-to-wheel emissions of various hydrogen sources, and has adopted goals of a 30 percent reduction in greenhouse gas emissions; the use of at least 20 percent new renewable energy resources to produce the hydrogen; and no increase in toxic or smog-forming emissions relative to comparable gasoline vehicles.

The **Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles** (October 2000) calls for all new diesel-fueled vehicles and engines to use state-of-the-art catalyzed diesel particulate filters and very low-sulfur diesel fuel, and proposes retrofitting existing vehicles and engines where feasible. The plan sets a goal of reducing the 2000 risk from diesel PM from diesel-fueled engines and vehicles by 85 percent in 2020. To implement this Plan, ARB has adopted regulations to reduce toxic diesel risk from a wide range of in-use engines including those used in trash trucks, buses, public fleet vehicles, stationary engines, cargo handling equipment, transportation refrigeration units, and off-road equipment. ARB is scheduled to consider regulations to reduce diesel particulate emissions from in-use on-road trucks later in 2008.

The **Emissions Reduction Plan for Goods Movement and Ports** (GMERP 2006) sets a goal of reducing the 2000 risk from diesel PM from goods movement and ports 85 percent by 2020. In order to accomplish this goal, the Plan identifies a number of measures to reduce diesel PM emissions from ships, harbor craft, off-road construction equipment, trucks, and rail. This Plan includes Ship Electrification at Ports, Ocean-Going Vessel Speed Reduction, and Port Drayage Truck regulations. ARB has already adopted a number of regulations to implement the GMERP including regulations on cargo handling equipment, drayage trucks, commercial harbor craft, and ocean-going ships.

(T-1) Pavley I and Pavley II-Light-Duty Vehicle GHG Standards 31.7 MMT CO_2E

The Pavley I and II regulations require reductions in tailpipe GHG emissions from passenger vehicles. The Pavley I regulations could affect the overall mix of fuels used by vehicles in 2020, by increasing the number of alternative fuel vehicles or low-emission vehicles. In the Initial Statement of Reasons for the regulation, the ARB estimated criteria pollutant emission reductions of approximately 1.4 tons per day (TPD) NOx and 4.6 TPD ROG in 2020 due to reduced petroleum shipping, storage and distribution.[7]

[7] Final Statement of Reasons, Pavley I Regulations.

The Pavley II measure is not yet defined well enough to quantify the potential to reduce air emissions; however it is also expected to reduce NOx, ROG, and PM2.5 emissions. Assuming Pavley II reductions are similar to Pavley I (reduced upstream emissions) they would reduce 0.2 TPD NOx, 0.7 TPD PM2.5, and 0.7 TPD ROG.

(T-3) Vehicle Efficiency Measures 4.8 MMT CO_2E

Under this measure, tire inflation, tire tread programs and solar-reflective paints on vehicles are proposed to increase vehicle engine efficiency or reduce air conditioning use. This measure is estimated to reduce gasoline use by 538 million gallons in 2020, which could potentially result in the reduction of 0.8 TPD PM2.5 through avoided combustion. Since future engines will have to meet NOx standards, this measure is not expected to result in new NOx emission reductions from the tailpipe. Similar to measure T-1, reductions of 0.2 TPD NOx and 0.8 TPD ROG could be achieved through upstream reductions in the transportation and refining of fuels.

Co-pollutant emissions from solar-reflective automotive paint and window glazing manufacturing and application are anticipated to be similar to existing paints and glazes, so there would be no change in associated emissions.

(T-2) Low Carbon Fuel Standard 16.5 MMT CO_2E

The Low Carbon Fuel Standard (LCFS) is currently undergoing regulatory development in parallel with the AB 32 Scoping Plan. The goal of LCFS is to reduce the carbon intensity – the amount of greenhouse gas emissions associated with the life cycle of the fuel – by 10 percent by 2020. It is anticipated that there will be a variety of options fuel producers can pursue to meet this standard, which makes the environmental impact of the LCFS a difficult measure to examine in the context of the Draft Scoping Plan. A reduction in carbon intensity does not directly relate to a specific change in criteria pollutants or in fuel combustion. The LCFS regulatory proposal will contain a more detailed analysis of these fuel paths, their life-cycle GHG emissions and environmental impacts, and potential combinations of use for compliance. This section highlights the potential sources and types of air emissions associated with identified lower-carbon fuel types that may be pursued in the implementation of the LCFS. One goal of the LCFS is to maintain or reduce criteria pollutant emissions. Although ARB expects the LCFS will reduce criteria pollutants, to be conservative in this analysis we have assumed no change in criteria pollutants. The regulation will more fully document and quantify potential air resource impacts or benefits.

Low carbon fuels that may be used to comply with the LCFS include low carbon ethanol (sugarcane, switchgrass, waste residues, etc.), electricity, hydrogen, natural gas, and renewable biodiesel (from soybean, animal fat, recycled cooking oil, etc.). Potential fuel sources will be discussed in this evaluation, and potential fuel end uses (e.g. vehicles, energy plants) are discussed under relevant measures in other sectors.

The goal of the LCFS measure is to reduce the carbon content of transportation fuel, which will reduce GHG emissions. Another goal of the LCFS is to maintain or reduce criteria pollutant emissions evaluated over the lifecycle of the fuel stock.

"Biofuels" is a general term used to describe various fuels produced from renewable sources. These include alcohol fuels, such as ethanol, various types of biodiesel and others. They can be produced from food crops (i.e., sugarcane, corn, etc.), non-food crops (i.e., switchgrass, algae, etc.), vegetable oils (often used cooking oil), or other waste residues (often called biomass and include agricultural residues, municipal waste, forest trimmings, etc.). The air emissions associated with each of these sources can vary considerably. Some factors that affect the air emissions are described below.

- Recycling of waste materials to produce biofuels does not typically create a new emission source, and is environmentally preferable to traditional disposal. There are emissions associated with truck trips for collecting these materials, but they most likely do not result in a net increase in co-pollutant or greenhouse gas emissions as they would replace disposal-related truck trips.

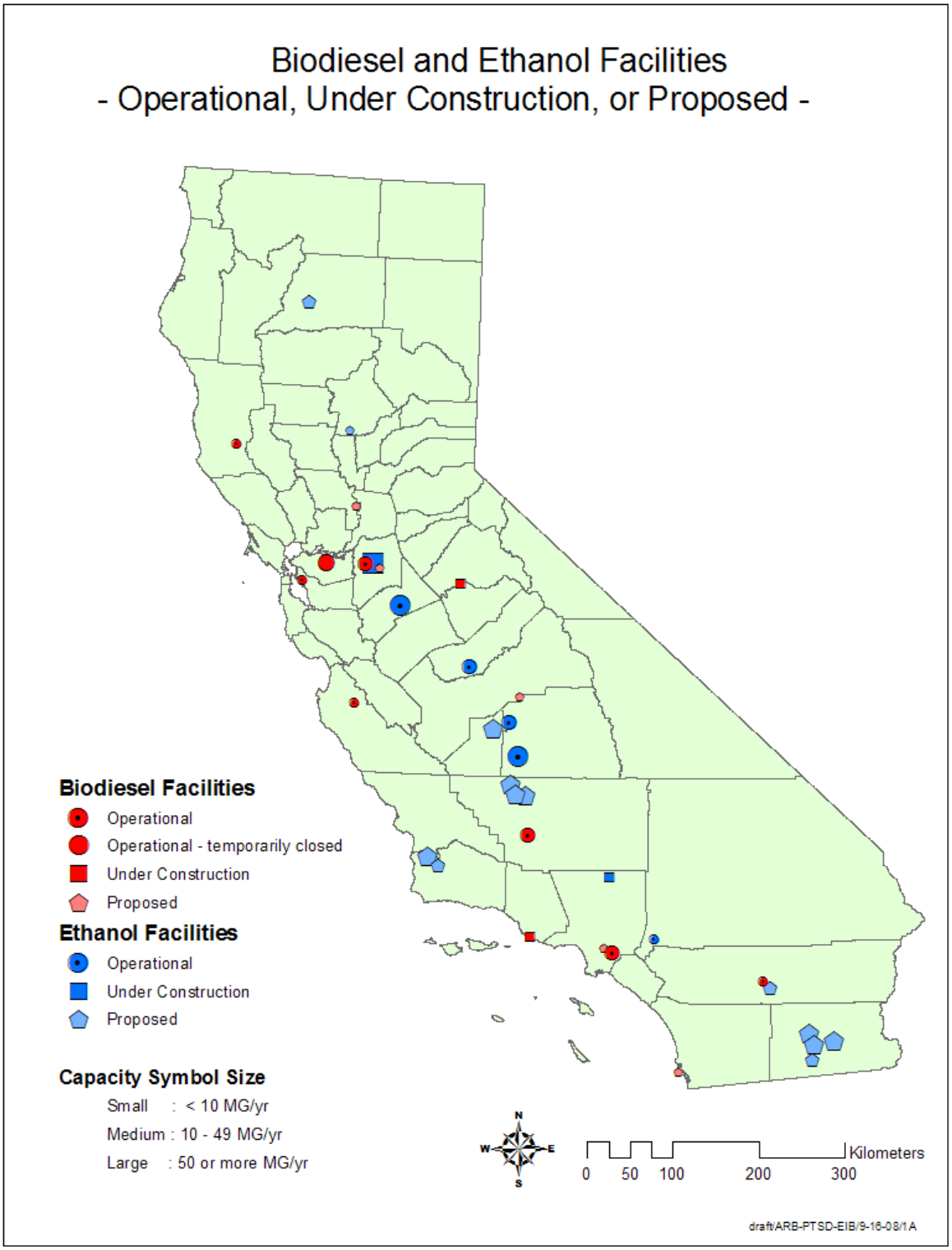
- Food crop production for biofuels may create new emission sources. Land use conversion is discussed in the Land Resources section of this evaluation. Critical factors in determining air emissions include where the feedstock is produced (which will impact both the resources needed for production, as well as rail and other transportation-related emissions), whether the biofuel crop is replacing another type of crop (and the difference in air emissions associated with the two crops), and whether the crop is competing with food crops for land. Crop production requires the use of off-road equipment, application of fertilizer and pesticides, and irrigation water. Air emissions from fertilizers and pesticides as well as run-off into streams, rivers and lakes result from traditional agricultural practices. Each of the biofuel production approaches mentioned above has associated air emissions. There are NOx, volatile organic compounds (VOCs), and PM emissions associated with agriculture, as well as emissions associated with truck trips to transport raw materials to intermediate processing facilities.

- Non-food crop production is generally less harmful than food crop production, using plants that are less resource-intensive, and thus have lower associated air pollutant emissions. The associated truck trip emissions would be expected to be similar to truck trip emissions from food crop production.

- Algae are a relatively newly identified source of biofuels and not yet fully studied. Early research shows that algae grow faster, contain significantly more energy per mass than other identified crop types, do not require the use of crop or valuable habitat lands, do not require fresh water (brackish and some wastewater can be used), and can consume waste CO_2 from refineries.

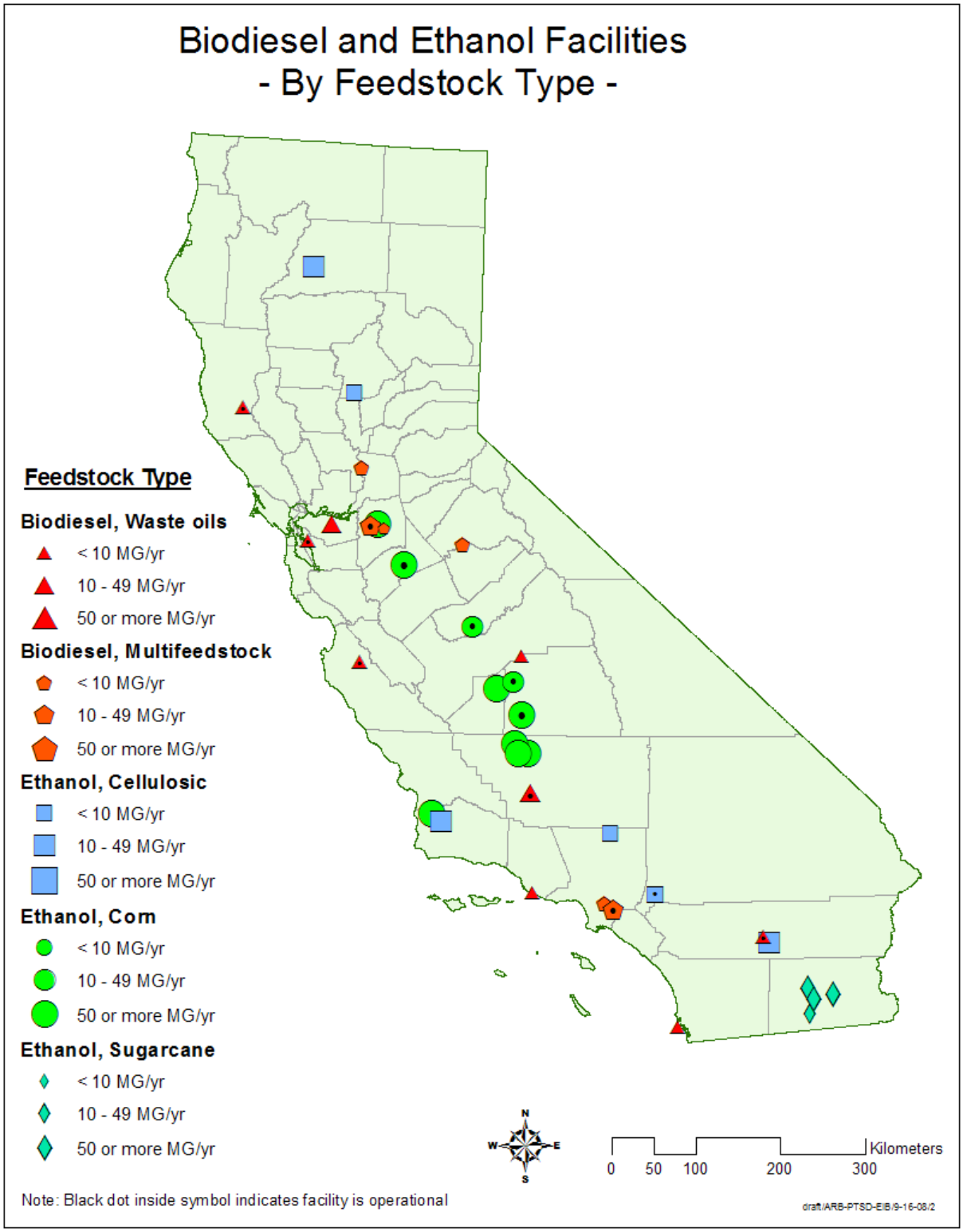
There are numerous current and proposed biofuel plants within California: Figure 1 displays the mixture of biodiesel and ethanol facilities, while Figure 2 displays the feedstocks these facilities are using or propose to use.

Figure 1: Location and Size of Known and Proposed Biodiesel and Ethanol Facilities[8]



[8] Based on ARB staff research.

Figure 2: Feedstocks of Known and Proposed Biodiesel and Ethanol Facilities[9]



[9] Based on ARB staff research.

Note that projections of fuel production will likely change since the use of biofuels (biodiesel and ethanol) will be partially driven by recent federal legislation[10] directing fuel producers to increase their use of renewable fuels and mandating amounts of advanced biofuels, cellulosic biofuels, including those derived from cellulosic and biomass resources.

Biodiesel: ARB estimates that 675 million gallons (MG) of biodiesel could be needed per year to meet the 2020 LCFS demand. In addition to the 72 MG per year[11] already built or planned, California could produce between 125 to 500 million gallons per year of biodiesel from waste oils and fats and 100 to 200 million gallons per year of biodiesel from soybean oil.[12, 13] Regulatory measures could require maximizing the use of waste materials for biodiesel production. Rather than dictate which specific fuels should be used, the LCFS will establish life cycle carbon intensity values for all available fuels. Fuel suppliers will use that information to decide how best to meet regulatory carbon limits. Waste materials would be expected to have lower carbon intensity than virgin materials. Several biodiesel plants are already under construction or planned for construction in California, using waste oils, waste grease, animal fats and some soybean oil. Additional demand could be met through construction of plants using other feedstocks, such as soybean oil, and through importation of biodiesel from outside the state.

Biodiesel production plants tend to be located close to their feedstocks and secondarily close to rail yards or freeways for distribution to retail sites. Methane emissions are associated with the biodiesel production process, which can be reduced by an estimated 90 percent through a condensation/recovery process. Other emissions are related to the energy source and demand of the plant. Production of biodiesel locally to meet California's projected needs could result in a net reduction in emissions associated with the truck and rail traffic generated by importing biodiesel from the Midwest.

Ethanol: The California Energy Commission estimates that by 2020, California will have a demand for 1.6 billion gallons of ethanol per year,[14] and that this demand will continue to grow beyond 2020. ARB estimates that California could meet this demand through production of up to 1 billion gallons per year of ethanol from waste products (municipal solid waste, forest residue, agricultural residues), and 600 million gallons per year of ethanol from corn.[15] As an example, this demand could be met through approximately 50 production plants, each producing around 50 MG per year.

Ethanol facilities tend to be located near rail or truck terminals. Siting may also consider proximity to the feedstocks or the users of ethanol co-products. As an example, one of the largest ethanol production facilities currently permitted in California is located in a rural

[10] The Federal Energy Independence and Security Act of 2007.
[11] Estimate based on CEC Staff Report in review (Yowell, 2007) and on the Crimson Renewable Energy Plant under development in Bakersfield (30 MG).
[12] Presentation at ARB Workshop, May 9, 2008.
[13] *Compliance Pathways for Meeting the Low Carbon Fuel Standard in California. Part I. Biofuel Supply Curves,* Nathan Parker et.al.; Western Governors' Association Report, *Transportation Fuels for the Future. Biofuels: Part II,* January 8, 2008.
[14] California Energy Commission estimate, presented at May 9, 2008 ARB Workshop: *Compliance Pathways for Meeting the Low Carbon Fuel Standard in California, Part I. Biofuel Supply Curves.*
[15] Ibid.

agricultural area close to users of their distilled grain by-product. The facility does not employ co-generation, so it burns natural gas to produce the steam needed to produce ethanol, and purchases electricity from the utility. The steam production is the primary source of NOx emissions, the largest sources of PM10 are associated with grain handling, and the largest sources of VOC emissions are associated with the fermentation, distillation, storage, and loading of the ethanol produced. Because VOC emissions from this facility triggered offset requirements, emissions above the trigger level of 20,000 lbs/yr were mitigated by procuring VOC emissions offsets. Emissions of NOx, CO, PM10, and SOx did not trigger offset requirements. Emission control technologies employed by this facility include ultra-low NOx burners on steam boilers, baghouses for PM control, and wet scrubbers to control VOC emissions. This 40 MG per year facility, as permitted, could emit up to 0.02 TPD of NOx, 0.07 TPD CO, 0.05 TPD VOC, 0.04 TPD PM10 and 0.005 TPD SOx.

The LCFS regulation will consider the impacts of the life cycle of each fuel path. For ethanol air pollutant emissions, this would also include indirect emissions associated with the transportation of the product and feedstock by truck and/or rail.

Hydrogen: Depending upon how it is produced, hydrogen can be a low carbon fuel. As a transportation fuel, hydrogen can be used in either modified internal combustion engines or in fuel cells. Unlike the burning of carbon-based fuels which produces CO_2, CO, NOx, VOC and PM and other potentially toxic compounds, combusting hydrogen produces heat, water, and some oxides of nitrogen. Hydrogen-fueled fuel cell vehicles only produce heat and water vapor.

Like other fuels, hydrogen must be examined over the entire process chain, including the energy needed to produce the fuel as well to compress or cool the hydrogen for storage. Potential hydrogen production methods include electrolysis of water, steam reformation of natural gas, biomass gasification and coal gasification. Today, the two most common ways to produce hydrogen are steam reformation of natural gas and electrolysis of water. Hydrogen produced using electricity generated from renewable resources and used to power fuel cell vehicles results in extremely low air emissions. Senate Bill 1505 (2006) directs ARB to develop environmental regulations for the production of hydrogen for transportation use, a process that started in late 2007.

Electricity: Increasing the number of electric vehicles and plug-in hybrids would substantially lower the carbon-intensity of transportation fuels. The co-pollutant emissions associated with electricity as a transportation fuel are expected to be the same as the co-pollutant emissions associated with electricity overall and are discussed in the Energy section. Off-peak loads would increase significantly as grid-rechargeable electric vehicle penetration increases. This increased load would produce some increase in GHGs and co-pollutants from base load power plants. Little to no increase in ozone would occur, since the increased load would occur between the late evening and the early morning. All such increases would be more than offset, however, by the displacement of internal combustion vehicles.

(T-4) Ship Electrification at Ports **0.2 MMT CO_2E**

(T-5) Goods Movement Efficiency Measures **3.5 MMT CO_2E**

The goods movement efficiency measures propose to reduce GHG. The recommended goods movement measures in the Draft Scoping Plan include regulations identified through the Goods Movement Action Plan and GMERP, as well as new measures for additional GHG emission reductions.

The GMERP prioritized implementation of air emission reductions based on health risk assessments, which identified how each port source category contributed to risk. The already adopted Goods Movement Sector regulations will reduce criteria and toxic air pollutants. For instance, ARB recently has passed a series of regulations to reduce emissions of diesel PM, SOx, and NOx from ocean-going vessels, cargo handling equipment, transport refrigeration units, port drayage trucks, and commercial harbor craft. Also, new engine standards have been adopted by the U.S. Environmental Protection Agency (U.S. EPA) for U.S. ships, off-road equipment, on-road trucks, harbor craft and locomotives. As these fleets turn over, we expect to see emissions reductions in criteria pollutant emissions and in some cases GHG emissions, as the vehicles and equipment become more fuel efficient.

California has also taken steps to reduce emissions from locomotives, entering into a Memorandum of Understanding (MOU) in 2005 with Union Pacific Railroad Company and BNSF Railway Company to reduce diesel PM. The MOU identifies actions including: reducing motor idling, accelerating the use of low sulfur diesel, reducing visible emissions, and conducting Health Risk Assessments for rail yards. Combined, these measures are expected to continue to reduce criteria and toxic air pollutant emissions from goods movement sources in the future, improving air quality and public health both in localized areas near goods movement sources and regionally.

The following section describes existing efforts to reduce emissions from goods movement activities as contained in the GMERP, as well as a new measure to improve the efficiency, and lower the greenhouse gas emissions, of goods movement activities in California.

Ship Electrification at Ports: The GMERP establishes a goal of utilizing shore power for 20 percent of the ship visits to California ports by 2010, 60 percent of visits by 2015, and 80 percent of visits by 2020. ARB has already adopted a regulation to require ship electrification at ports and another is under development. Ships include container ships, passenger ships, refrigerated cargo ships, bulk ships, tankers, and vehicle carriers. Over 2000 ocean-going vessels call at major California ports like the Ports of Los Angeles, Long Beach, Oakland, San Diego, San Francisco, and Hueneme each year. By 2020, hotelling of these ships are projected to emit 37 TPD NOx and 0.67 TPD PM without regulations; ship electrification will reduce these emissions by 9.6 TPD NOx and 0.6 TPD PM2.5. Although the Ship Electrification regulation was adopted primarily to reduce emissions of air toxics, it also provides GHG reductions and is a discrete early action under AB 32.

Ocean-going Vessel Speed Reduction: The ocean-going vessel speed reduction (VSR) builds upon a voluntary program at the Ports of Los Angeles and Long Beach. The voluntary program contributes to implementation of the 1994 Ozone State Implementation Plan to reduce NOx in

the South Coast Air Basin. Preliminary estimates from the Port of Los Angeles indicates this measures can reduce emissions from this source by 37 percent for NOx (3 TPD), 49 percent for SOx (2 TPD), and 49 percent for diesel PM (0.3 TPD). ARB will be assessing the results of the program to estimate the statewide potential for reductions in emissions of NOx, SOx, diesel PM, and CO_2.

Clean (Green) Ships: This measure recommends incenting NOx controls for ship engines. Reductions of NOx will depend on the penetration rates of Selective Catalytic Reduction technologies on new and existing ships.

Port Drayage Trucks: The adopted Port Drayage Truck Regulation[16] is expected to reduce NOx, PM10 and CO_2, by either accelerating the fleet's turnover to higher standard trucks or retrofitting existing trucks. Drayage trucks are on-road, diesel-fueled, heavy-duty trucks that transport containers, bulk, and break-bulk goods to and from the ports and intermodal rail yards and many other locations. ARB estimates that there are approximately 100,000 drayage trucks statewide, of which approximately 20,000 frequently service the ports and rail yards. This segment of the drayage fleet consists largely of independent owner/operators and ARB estimates that approximately 80 percent of such drayage trucks are operator owned. ARB estimates that drayage trucks emit an estimated 2.3 TPD diesel PM and 48 TPD NOx while moving goods to and from California's ports and intermodal rail yards.[17] Under the regulation adopted in 2007, regulatory compliance has two phases. By 2009, all pre-1994 truck engines must be retired or replaced with 1994 or newer engines. In addition, all 1994-2003 model year engines must achieve an 85 percent PM emission reduction through the use of an ARB-approved level 3 verified diesel emission control strategy. ARB estimates a statewide diesel PM emissions reduction of approximately 2.0 TPD PM2.5. In the second phase, drayage trucks would need to comply with the 2007 heavy-duty diesel-fueled on-road emission standards by 2014, which would reduce NOx emissions by approximately 33 TPD.

Commercial Harbor Craft: This measure would develop best management practices and outreach to encourage regular maintenance, vessel speed reduction, and other operational and maintenance practices to improve efficiency of commercial harbor craft. Air emission reductions have not been quantified.

Cargo Handling Equipment: Reducing the idling times of diesel-powered equipment could potentially reduce associated criteria pollutants. A future study of idling occurrences and emissions will determine the potential for air emission reductions.

Transport Refrigeration Units (TRUs): Transport Refrigeration Units (TRUs) are refrigeration systems powered by diesel internal combustion engines designed to refrigerate or heat perishable products that are transported in various containers, including semi-trailers, truck vans, shipping containers, and rail cars. ARB adopted an Airborne Toxic Control Measure (ATCM) regulation to reduce emissions from in-use TRUs in 2004. ARB is now evaluating the feasibility of regulations to further reduce air toxic emissions from TRUs on trucks, shipping

[16] Regulation to Control Emissions from In-Use On-Road Diesel –Fueled Heavy Duty Drayage Trucks, adopted December 7, 2007.
[17] Drayage Truck Fact Sheet, http://www.arb.ca.gov/msprog/onroad/porttruck/drayagetruckfactsheet.pdf.

containers, and railcars by eliminating their use of diesel fuel for extended cold storage at distribution, grocery stores, and other facilities where TRUs operate. This measure could reduce diesel fuel use by approximately 1.7 MG per year starting in 2011, reducing PM2.5 emissions by 0.1 TPD in 2020.

Rail: Other than addressing rail through the goods movement system-wide efficiency improvement measure, the Draft Scoping Plan does not recommend any specific control measures for rail. Rail does play a critical role in goods movement, and reducing emissions from locomotives is a focus of ARB's efforts to improve public health in California. As fuel prices increase, increased demand for transport may be met through rail more than trucks, because rail can be up to four times more fuel efficient than trucks. ARB has worked with the federal government and railroads to reduce the criteria pollutants and air toxics associated with locomotives through fuel regulations, idling reduction requirements, increased fuel efficiency and pollutant control technologies. There are no direct effects from rail due to the Draft Scoping Plan.

Goods Movement Efficiency Improvements: The GMERP and Goods Movement Action Plan identify the opportunity to improve the efficiency of goods movement activities, including more efficient engines and vehicles and through tracking and better scheduling of activities. This recommended measure in the Draft Scoping Plan would identify and implement strategies to improve goods movement efficiency within the four key goods movement corridors in California in excess of the measures already contained in the GMERP. This measure would take advantage of available low carbon technologies and operational improvements to improve efficiency at the equipment/vehicle level, at goods movement facilities such as ports and intermodal railyards, and within the goods movement network within each trade corridor. Because in most cases, improvements in efficiency would result in decreased fossil fuel usage, air emission reductions are expected. If these measures reduce GHGs by 3.5 $MMTCO_2E$ through fuel efficiency and through some electrification of internal combustion engines, the emission reductions that could occur within California are approximately 16.6 TPD of NOx and 0.6 TPD PM2.5.[18]

(T-6) Heavy Duty Vehicle GHG Emission Reduction – Aerodynamic Efficiency 1.4 MMT CO_2E

This measure recommends improving the aerodynamic efficiency of heavy-duty trucks to reduce GHG emissions, an efficiency that is estimated to reduce NOx emissions by 1.5 TPD.

(T-7) Medium and Heavy-Duty Vehicle Hybridization 0.5 MMT CO_2E

This measure recommends hybridization of medium and heavy-duty trucks that make frequent stops and starts, reducing diesel combustion by 500,000 gallons per day and reducing tailpipe criteria pollutants by 4.1 TPD NOx and 0.2 TPD PM2.5.

(T-8) Heavy-Duty Engine Efficiency 0.6 MMT CO_2E

This measure recommends engine efficiency improvements to reduce GHG tailpipe emissions, but due to existing NOx and PM2.5 regulations for future engine models it is not expected to result in additional co-pollutant reductions.

[18] This estimate was made using an emission factor for heavy-duty vehicles (conservative for the goods movement inventory categories) and assuming 50 percent of emission reductions occur outside of California land boundaries.

(T-10) High Speed Rail 1 MMT CO_2E

The Draft Scoping Plan supports the implementation of a high speed rail system. The recommended High Speed Rail (HSR) program has undergone environmental review under CEQA and National Environment Policy Act (NEPA) (http://www.cahighspeedrail.ca.gov/). ARB reviewed this documentation for its air emissions analysis. The programmatic Environmental Impact Report/Environmental Impact Statement (EIR/EIS) examined the potential impacts of the HSR on existing air quality. Regional pollutant burdens were calculated for each alternative, considering highway VMT, number of plane operations, number of train movements, and electrical power requirements for the recommended HSR system. Localized air quality impacts were also evaluated. In 2020, the air emission reductions based on the avoided fuel consumption of 18.7 million annual passenger trips in light duty vehicles would be 1.1 TPD NOx and 0.2 TPD PM2.5. If the HSR uses electrical grid natural gas power plants, it would increase emissions by 0.2 TPD NOx and 0.1 TPD PM2.5. HSR has informed ARB that it may seek renewable power supplies, which would eliminate the emissions associated with its electrical demand.

Feebates (Under Evaluation) 4 MMT CO_2E

This measure considers financially incenting the transition from high-GHG emitting vehicles to low-GHG emitting vehicles by imposing a fee on the former and offering a rebate on the latter. Air emission effects from this measure will largely depend on the success of the incentive and the types of vehicles included. Under this measure, fuel would be more efficiently used and less fuel would be combusted statewide (essentially similar to an increase in average miles per gallon). Avoided fuel combustion would reduce NOx, PM2.5, and ROG.

Summary of Co-Pollutant Emissions

Table 3 presents the co-pollutant benefit estimations for the Recommended Regulations for the Transportation Sector. Recommended Pavley (T-1) and Goods Movement measures (T-4 and T-5) have been quantified within existing regulations and within the SIP, and are therefore included in the “Business As Usual” scenario, and separated appropriately.

Table 3: Estimated Co-Pollutant Emission Changes from Recommended Transportation Sector Regulations in Draft Scoping Plan
(tons per day in 2020)

Measure	Included in 2007 SIP or GMERP		Additional to 2007 SIP and GMERP	
	NOx	**PM 2.5**	**NOx**	**PM 2.5**
(T-1) Pavley I and Pavley II – Light-Duty Vehicle GHG Standards	-0.2	-0.5	-1.4	-0.7
(T-3) Vehicle Efficiency Measures			-0.2	-0.8
(T-2) Low Carbon Fuel Standard			0	0
(T-4) Ship Electrification at Ports	-9.6	-0.6		
(T-5) Goods Movement Efficiency Measures			-16.6	-0.6
Ocean Going Vessel Speed Reduction	-18.9	-1.6		
Clean (Green) Ships	-74	-0.8		
Port Drayage Trucks	-33	-2.0		
Commercial Harbor Craft	--	--	--	--
Cargo Handling Equipment	--	--	--	--
Transport Refrigeration Unit		-0.1		
(T-6) Heavy Duty Vehicle GHG Emission Reduction – Aerodynamic Efficiency			-1.5	-0
(T-7) Medium and Heavy-Duty Vehicle Hybridization			-4.1	-0.2
(T-8) Heavy-Duty Engine Efficiency			--	--
(T-9) Local Government Actions and Regional Targets			-3.5	-0.6
(T-10) High Speed Rail[a]			-1.1	-0.2
Transportation Sector Total: [b]	**-135.7**	**-5.6**	**-28.4**	**-3.0**

[a]High Speed Rail emission reductions were not included in the public health analysis, due to difficulty in proportioning among air basins.
[b]Numbers may not add up as presented due to rounding.

3. LOCAL GOVERNMENT AND REGIONAL TARGETS

Local governments are key players in ensuring that the State meets its GHG targets. They have approval authority over land uses, zoning, ordinances, and over projects subject to CEQA, such as utility-scale facilities, urban, commercial and industrial development patterns on the landscape. They have the authority to conserve open spaces and agricultural lands or to allow leapfrog development that encourages urban sprawl. They approve or disapprove facility siting or expansion. In short, local governments are key to successful AB 32 implementation.

Local governments are responsible for the day-to-day operations and maintenance of the programs within the realm of local government management. As stewards of the public's health, safety and welfare, it inevitably becomes the responsibility of these individuals and their staff to ensure the health and safety of their communities. The broad spectrum of local government agencies can both provide a range of community and environmental protection programs and

services and identify where local adverse impacts are most likely to occur. In these ways, local governments also set air quality goals and influence their attainment.

Regulatory Background

Local governments have the authority to set local air quality goals within their **General Plans**. **Government Code § 65040.2** directs cities and counties to develop these comprehensive, long-term plans to guide future development. The Governor's Office of Planning and Research provides guidance for General Plans. General Plans must also comply with CEQA and be consistent with state and regional air quality plans and regulations:

> **CEQA** requires General Plans to describe the potential for environmental impacts through a public process.
>
> **Air Quality Management Districts** review the CEQA analysis for effects on air quality, and can adopt regulations that influence general plans. For example, the San Joaquin Valley Air Pollution Control District has adopted an indirect source rule for mitigation of particulate matter pollution from new development.
>
> **Local Agency Formation Commissions** (LAFCO) in each county adopt spheres of influence for each city within the county, and make determinations on changes to those boundaries. Their decisions can influence air quality in the way in which they allow additional development to occur.

(T-9) Local Government Actions and Regional Targets 2 MMT CO_2E

This measure recommends requiring regional and local governments to collaborate to develop GHG reduction targets and incorporate these targets into their planning and regulatory authorities. One way to implement this target is to reduce vehicle use, which also has the potential to improve air quality. To achieve the target would require a two percent reduction in vehicle miles traveled statewide by 2020, and associated criteria pollutants would decrease by 3.5 TPD of NOx, 5.6 TPD of ROG and 0.6 TPD of PM2.5.

Congestion Pricing (Under Evaluation) up to 1 MMT CO_2E
Pay-As-You-Drive Insurance Premiums (Under Evaluation) up to 1 MMT CO_2E
Indirect Source Rules for New Development (Under Evaluation) up to 1 MMT CO_2E
Programs to Reduce Vehicle Trips (Under Evaluation) up to 1 MMT CO_2E

These measures under evaluation are tools that could reduce vehicle use, which would also reduce both criteria and toxic air pollutants. The magnitude of the emission reductions would depend upon the effectiveness of implementation, in approximately the same ratio as for Measure T-9.

4. ELECTRICITY AND NATURAL GAS

Regulatory Background

The air emissions of all stationary sources in California are regulated. For power plants or energy facilities, the **CEC Certification process** serves as an equivalent to the otherwise required state and local permitting requirements. The CEC has authority to certify (permit) the

construction and operation of thermal electric power plants 50 megawatts or larger and all related facilities. The site certification process provides a review and analysis of all aspects of a proposed project, including public health and environmental impacts, safety, efficiency, and reliability, equivalent to the **CEQA** process. The process is also a public process. Smaller facilities with no potentially significant environmental impacts can apply for an exemption process, similar to a mitigated negative declaration approach under CEQA.

The CEC works with power plant proponents and local air pollution control districts (APCDs) or air quality management districts (AQMDs) to complete a functionally equivalent permitting process. CEC prepare the necessary evaluation in a "Preliminary Staff Assessment", working with the local AQMD to ensure it provides the information needed for the AQMD to approve the project. The final site certification from the CEC serves as its air quality permit, compliant with New Source Review requirements,[19] and including monitoring, reporting, and inspection requirements.

(E-1) Energy Efficiency and Conservation 15.2 MMTCO_2E
(CR-1) Energy Efficiency and Conservation 4.2 MMTCO_2E
Additional Energy Efficiency and Conservation (Under Evaluation) 4.8 MMT CO_2E

Activities recommended under these measures would affect air quality by reducing the overall demand for electrical generation and the overall combustion of natural gas in California's residential and commercial sectors. California's appliance standards improve the operation and efficiency of refrigerators, freezers, air conditioners, and other appliances. All of the technologies utilized to implement the recommended energy efficiency standards are considered "off the shelf" in that they are readily available in the marketplace.

Efficiency and conservation measures that reduce peak demand are the most likely to reduce air emissions, as aging, less efficient plants are more likely to be operated when demand is high.

Measure E-1 recommends reducing electricity demand by 32,000 gigawatt-hours (GWh). ARB is also evaluating an option to reduce electricity demand by an additional 8,000 GWh through additional efficiency and conservation program. Translating these reductions into the avoided operation (or possibly construction) electrical grid natural gas power plants,[20] ARB estimates that Measure E-1 would reduce statewide NOx by 7.0 TPD and statewide PM2.5 by 4.0 TPD in 2020. Similarly, and additional reduction of 8,000 GWh would further reduce statewide NOx emissions by 1.7 TPD and statewide PM2.5 emissions by 1.0 TPD.

Measure CR-1 recommends reducing residential and commercial natural gas combustion for heating by 800 million therms and ARB is evaluating is an option to reduce residential and commercial combustion an additional 200 million therms. The avoided air emissions associated with Measure CR-1 are 10.4 TPD of NOx statewide and 0.8 TPD of PM2.5 statewide in 2020, assuming emissions from residential and commercial natural gas units are similar in 2020 to

[19] New Source Review requirements are discussed in greater detail in the Regulatory Background discussion of the Industry Sector and Attachment E.
[20] Co-pollutant emission factors for electric grid natural gas power plants were developed using the state inventory of these sources projected out to 2020 with existing district control measures.

today's emission rates.[21] Expanding the measure to reduce an additional 200 million therms would provide an additional 2.6 TPD of NOx reductions and 0.2 TPD of PM2.5 reductions statewide in 2020.

(CR-2) Solar Water Heating **0.1 MMT CO_2E**
Expansion of Solar Water Heating (Under Evaluation) **1 MMT CO_2E**

This measure recommends an alternative, zero-emission way to heat residential water that works with traditional water heating to replace a portion of the natural gas that would normally be burned. The recommended measure would replace an estimated 26 million therms of residential natural gas use each year. The avoided air emissions associated with the recommended measure is 0.3 TPD of NOx and 0.03 TPD of PM2.5 statewide in 2020. ARB is also evaluating expansion of the measure to reach 75 percent of new homes which would replace 1.2 billion therms of natural gas. This expanded measure would provide an additional 3 TPD of NOx reductions and an additional 0.3 TPD of PM2.5 reductions statewide in 2020.

(E-4) Million Solar Roofs **2 MMT CO_2E**
Expanded Million Solar Roofs (Under Evaluation) **1.3 MMT CO_2E**

This measure is an existing program that predates AB 32 and the Draft Scoping Plan. The additional measure under evaluation recommends expanding the existing incentive program to install zero-emission solar panels on California homes, replacing a portion of residential electrical demand. Translating the recommended measure's avoided electricity into the avoided operation (or possibly construction) electrical grid natural gas power plants,[22] they would equate to 1.0 TPD of NOx and 0.6 TPD of PM2.5 statewide in 2020. The measure under evaluation would equate to an additional 0.7 TPD of NOx and 0.4 TPD of PM2.5.

(E-3) Increasing Combined Heat and Power **6.8 MMT CO_2E**

Combustion-based power plants do not convert all of their available energy into electricity and typically lose more than half of the energy as excess heat. At the same time, there are many industrial facilities that require both electricity and heat which currently purchase electricity from the grid and burn natural gas in industrial boilers to generate thermal energy (heat). Combined heat and power (CHP) systems generate both electricity and thermal energy on site. When the systems are optimally sized to provide the maximum amount of electricity that the facility could use during peak demand, excess electricity is produced during off-peak hours that could be distributed to other electricity users. Combined heat and power is a more efficient use of the energy contained in fuel, and can also reduce the need to develop new or expand existing power plants.

Combined heat and power systems would be developed to improve energy efficiency in situations that also result in net reductions of GHG and co-pollutant emissions. While existing AQMD/APCD regulations on CHP systems and industrial boilers limit co-pollutant emissions, they do not necessarily evaluate the net change in emissions between CHP systems and the grid

[21] Co-pollutant emission factors for commercial and residential natural gas combustion were developed using recent (1997 and 2000) methodologies and inventories of these sources with existing district control measures.
[22] Co-pollutant emission factors for electric grid natural gas power plants were developed using the state inventory of these sources projected out to 2020 with existing district control measures.

electricity they replace. Installation of CHP systems has the potential to affect local air emissions and should be examined for this potential at a project level.

Nearly all CHP systems are currently regulated by AQMDs and APCDs. A combined heat and power system can be fueled with natural gas or with renewable fuels. Co-pollutant emissions may vary by fuel type, similar to the discussion under measure E-2. ARB estimates that increasing the use of combined heat and power systems by 4,000 MW has the potential to reduce natural gas combustion by 2.1 billion British thermal units (Btu).[23] Assuming that on-site boiler use is reduced when cost-effective CHP systems are installed and that CHP systems are optimized for thermal load, the net change in co-pollutants due to the shift from industrial boiler to CHPs would be reductions of 2.0 TPD of NOx and 0.7 TPD of VOCs and increases of 0.6 TPD PM2.5 and 0.1 TPD SOx.

Using CHP systems to displace grid electricity also reduces co-pollutant emissions. Translating these reductions into the avoided operation (or possible construction) of electrical grid natural gas power plants, they would equate to 6.5 TPD of NOx and 3.7 TPD of PM2.5 statewide in 2020.

(E-3) Renewable Portfolio Standard 21.2 MMT CO_2E

This recommended measure would increase the overall percentage of renewable energy sources such as wind, solar, biomass and geothermal, of each utility's energy sources. Currently, California's energy profile includes 12 percent renewable sources. This requirement could be met through any potential mixture of renewable energy sources, and will most likely be driven by a number of factors, including the availability of renewable sources within the geographic region of each utility. For these reasons the benefits and impacts of each renewable resources are evaluated relative to electrical grid natural gas power plants, and are not individually quantified for potential air emissions.

There are air quality impacts associated with the construction of facilities to harness renewable resources– primarily from fugitive dust and diesel particulates from operation of construction equipment. These are assumed to be similar in nature to the construction-related emissions from natural gas-powered power plants, although the location and size of facilities can affect the magnitude and duration of these impacts. These impacts could be significant but would be temporary and would also most likely employ best management practices to minimize dust. ARB's implementation of the Diesel Risk Reduction Plan began reducing diesel particulates from construction equipment in 2002.

The remainder of this section focuses on the operation and maintenance of renewable resource facilities.

Wind energy is harnessed through large turbines. Wind power operation does not have any associated air emissions.

There are two major types of **solar** energy. The first concentrates the heat in sunlight using mirrors or lenses. This concentrated heat can be converted to electricity in a process similar to

[23] For reference, a *therm* is equal to 10,000 *BTUs.*

that used in a power plant. The second uses photovoltaic (PV) panels. When sunlight hits the PV cells, it is converted directly to electricity. Solar power does not have any associated air emissions from its operation.

Biomass energy is harnessed through the combustion of organic waste materials, residuals or agricultural products. Air emissions from biomass sources depend on the fuel type. These are also indirect emissions associated with the production, transportation, and/or disposal of the fuel source. Indirect emissions (from trucks and/or rail) are discussed in the Transportation section above (Measure T-2). The life cycle of biomass includes the sequestration of carbon within the biomass and the avoided carbon emissions from alternative methods of disposal. The trade-offs between energy production and the alternative methods of disposal are the primary source of potential environmental benefits.

Biomass (forest or agricultural residuals) or **municipal solid waste** (MSW) may be pre-processed and then combusted to produce steam to generate electricity. Biomass combustion must be controlled to limit emissions of NOx, particulate matter and carbon monoxide, as biomass combustion generates 17 times the amount of NOx and 27 times the amount of PM as electrical grid natural gas power plants (per MWh).[24] MSW combustion must also be controlled to limit emissions of NOx, particulate matter and carbon monoxide, as MSW combustion generates 24 times the amount of NOx and 5 times the amount of PM as electrical grid natural gas power plants (per megawatt-hour (MWh)). In some areas of the state, agricultural residuals are burned in open fires as a means of disposal. If the residuals used in a biomass plant would otherwise have been disposed of in open fires, burning the residuals in a biomass plant would reduce the air emissions while also producing electricity.

The **anaerobic digestion** of human, animal, or wet organic wastes produces a gas of 50 to 80 percent methane. This "biogas" can be combusted to produce electricity. Anaerobic digesters must also be controlled to limit emissions of NOx, particulate matter and carbon monoxide, as digester gas-based electricity generation generates 22 times the amount of NOx and 9 times the amount of PM as electrical grid natural gas power plants (per MWh).

Combustion of **landfill gases** (mostly methane) to produce electricity puts methane to use that would otherwise be flared to control the methane emissions. Combustion is also used to reduce the toxic air contaminants associated with some landfills. Combustion of landfill gases must be controlled to limit emissions of NOx, particulate matter and carbon monoxide, as its combustion generates 27 times the amount of NOx and 7 times the amount of PM as electrical grid natural gas power plants (per MWh).

Geothermal energy harnesses naturally occurring geothermal formations, using the steam to produce electricity and returning spent brine to the geothermal resource. Emissions associated with geothermal sources can include hydrogen sulfide, arsenic, mercury, radon 22, and ammonia. The cooling towers at geothermal power plants can emit particulate matter. All of these emissions can be minimized with modern control technologies or through good plant design.

[24] Estimates are based on renewable power generation emission factors developed from ARB surveys and emission inventories in 2000-2001, conducted during the California electricity crisis.

Hydroelectric power uses the potential energy of water to turn turbines that generate electricity. Small hydropower projects that capture the energy of water (100 kilowatts to 30 MW) without requiring a new or increased appropriation or diversion of water are considered a renewable resource under current California law. These types of projects would take advantage of constructed waterways, such as aqueducts, canals, pipelines and ditches. These types of projects do not have associated air emissions.

If natural gas-powered power plants were substituted entirely with zero-emission renewable sources through the RPS, air emissions would be reduced by 3.6 TPD NOx and 2.1 TPD PM2.5 for an increase in renewable sources from 2006 levels to 20 percent, and by 6.2 TPD NOx and 1.6 TPD PM2.5 for an increase in renewable sources from 20 to 33 percent.

The addition of significant new renewable resources may also alter the needed transmission infrastructure as renewable facilities are constructed to maximize resource capture at sites with optimal wind, solar, and geothermal resources. ARB has not evaluated the air quality impacts of changes or additions to transmission infrastructure, but notes that there is an ongoing process to examine this issue for several western states and provinces – the Renewable Energy Transmission Initiative (RETI). The RETI is also prioritizing the addition of specific renewable projects to optimize the efficiency and minimize the environmental impact of new transmission infrastructure. There are no long-term air emissions associated with transmission lines, but there are short-term co-pollutant emissions associated with construction that can be minimized through best practices and project design.

Coal Emission Reduction Standard (Under Evaluation) Up to 8 MMTCO$_2$E

This measure would require electric retail providers and other applicable entities to reduce the CO_2 emissions associated with their current coal-based power purchases or ownership shares beginning in 2013; ultimately achieving a 40 percent reduction in coal-based CO_2 emissions by 2020 (32,000 GWh). Almost 90 percent of these emissions originate from out-of-state facilities in New Mexico, Utah, Arizona, Oregon and Nevada.[25] The GHG emission reduction would be the difference between the emissions from existing coal-based generation and the emissions of a baseload natural gas fueled plant. These entities could also be required to eliminate or offset 100 percent of GHG emissions from any new sources of coal-based generation added to their portfolios.

If load-serving entities sold their coal contracts to comply with this measure, to the degree that they retained rights to transmission lines, electricity produced from natural gas could be imported into the state. Electricity that was previously supplied by coal-fired power plants could also be replaced by new natural gas plants and/or renewable resource projects in California, with the existing coal plants either serving other states or shutting down. New facilities will most likely be located as close as possible to electricity demands; most likely in heavily populated areas. Due to tight regulatory controls in the South Coast air basin, any new natural gas power plants in the South Coast would be limited to those needed to meet its regional demand.

Coal-fired electricity generating facilities emit high levels of criteria pollutants; therefore, reducing coal-fired electricity generation could reduce regional emissions of sulfur oxides,

[25] California Energy Commission, 2008, *2007 Net System Power Report*, CEC-200-2008-002-CMF.

nitrogen oxides, mercury, and particulate matter. Transitioning the state away from coal-based electricity will have air quality benefits for the western region of the United States, as it will prevent new coal-fired power plant construction to meet California's future demand. Coal-fired electricity has associated emissions from coal mining, transportation of coal, onsite materials handling, combustion, and storage of petroleum. In-state coal combustion (with air control technologies) generates 4 times the amount of NOx and 3 times the amount of PM as electrical grid natural gas power plants (per MWh). Out of state coal generation can generate 27 times the amount of NOx, 10 times the amount of PM and 309 times the amount of SO_2 as natural gas-powered power plants (per MWh).[26]

If 40 percent of the out-of state coal-fired generation (27,840 GWh, or 87 percent of 32,000 GWh) were replaced with natural gas-fired generation, statewide emissions could increase by as much as 2.6 TPD of NOx and 1.5 TPD of PM2.5. Replacing 4,160 GWh of in-state coal-fired generation with natural gas would reduce statewide emissions by 0.9 TPD of NOx and 0.2 TPD of PM2.5.

Summary of Co-Pollutant Emissions

Tables 4 and 5 present the co-pollutant benefit estimations for the Recommended Regulations and the Measures under Evaluation for the Electricity and Natural Gas Sector.

Table 4: Estimated Co-Pollutant Emission Changes from Electricity and Natural Gas Sector Regulations in Draft Scoping Plan
-- Recommended Measures --
(tons per day in 2020)

Measure	NOx	PM 2.5	ROG	CO	SOx
(E-1) Energy Efficiency and Conservation	-7.0	-4.0	-1.0	-14.2	-0.6
(CR-1) Energy Efficiency and Conservation	-10.4	-0.8	-0.6	-4.9	-0.1
(CR-2) Solar Hot Water	-0.3	-0.03	-0.02	-0.2	0
(E-4) Million Solar Roofs	-1.0	-0.6	-0.1	-2.0	-0.1
(E-3) Increasing Combined Heat and Power (change from boiler to CHP)[a]	-2.0	+0.6	-0.7	-12.7	+0.1
(E-3) Increasing Combined Heat and Power (avoided grid electricity)[a]	-6.5	-3.7	-0.9	-13.7	-0.6
(E-2) Renewables Portfolio Standard	-9.8	-3.7	-1.4	-19.9	-0.8
Electricity and Natural Gas Sector Total[b]	**-36.6**	**-12.3**	**-4.6**	**-67.5**	**-2.1**

[a]Combined Heat and Power emission changes were not included in the public health analysis, due to uncertainty in where they would occur.
[b]Numbers may not add up as presented due to rounding.

[26] Based on the historical emissions and operational output of out-of-state coal plants for which California has contracts beyond 2020.

Table 5: Estimated Co-Pollutant Emission Changes of Electricity and Natural Gas Sector Measures in Draft Scoping Plan
-- Measures Under Evaluation --
(tons per day in 2020)

Measure	NOx	PM 2.5	ROG	CO	SOx
Expanded Energy Efficiency and Conservation	-1.7	-1.0	-0.2	-3.6	-0.2
Expanded Energy Efficiency and Conservation	-2.6	-0.2	-0.1	-1.2	-0.02
Expanded Solar Hot Water	-3.0	-0.3	-0.2	-1.4	-0.02
Expanded Million Solar Roofs	-0.7	-0.4	-0.1	-1.3	-0.1
Reduce Coal Emissions	+2.6	+1.5	+0.4	+5.2	+0.2

7. INDUSTRY

Regulatory Background
The air emissions of all stationary sources in California are regulated. Before a facility can be constructed, it must obtain permits to emit air pollutants, use water resources, and to develop land. Applicable air quality regulations are described in Attachment E.

(I-1) Energy Efficiency and Co-Benefits Audits for Large Industrial Sources **TBD MMTCO$_2$E**

This recommended measure would require large stationary sources of greenhouse gas emissions to conduct an audit to determine whether cost-effective greenhouse gas reductions that also provide needed co-pollutant emission reductions are available. Based on the results of these audits, ARB will consider rule revisions or permit conditions to ensure the best combination of pollution reduction. This recommended measure is designed to balance greenhouse gas and co-pollutant reductions. The co-pollutant benefits of this measure will depend on the results of the audits so are unknown at this time. The greenhouse gas measures for industrial sources (described below) provide some indication of the possible control measure, and some indication of the potential magnitude of co-pollutant reductions from large industrial sources.

Carbon Intensity Standard for Cement Manufacturers (Under Evaluation) **1.1-2.5 MMTCO$_2$E**

Carbon Intensity Standard for Concrete Batch Plants (Under Evaluation) **2.5-3.5 MMTCO$_2$E**

Waste Reduction in Concrete Use (Under Evaluation) **0.5-1 MMTCO$_2$E**

ARB has identified and is evaluating a number of ways in which cement manufacturing could reduce its GHG emissions: energy efficiency to reduce fuel combustion, alternative fuels to reduce direct emissions, and blended cements to reduce direct emissions from the calcination of limestone. The measures under evaluation would establish a carbon intensity standard that could be met through a combination of GHG reduction measures. Because the ultimate mix of reduction measures that could be pursued is unknown, ARB evaluated the air quality effects of each of the three identified emission reduction paths separately.

Energy efficiency measures would improve practices and technologies in cement production to decrease energy requirements and GHG emissions. The effectiveness of this measure is highly

dependent on the electricity used in cement manufacture and the indirect emissions from coal-burning power plants. By reducing the amount of coal-fired electricity used in cement manufacture, the energy efficiency measure for cement would reduce criteria pollutants such as NOx, SOx, PM, and CO, as well as TACs such as mercury. As the measure is still being refined, the effects cannot be quantified at this time.

Most cement manufacturers in California currently use coal as the main fuel to heat their kilns; changing the **fuel mix** could provide GHG reductions by increasing the use of lower-carbon fuels like natural gas and other alternative fuels such as biomass and biosolids. Air emissions depend on the fuel mix. In general, reducing the amount of coal used in cement manufacture would reduce NOx and SOx emissions. As seen in the evaluation of the recommended RPS (E-2), the extent of these reductions would be dependent on the alternative fuel employed. Some alternative fuels may have associated air toxics or criteria pollutants and this potential for localized impacts would be evaluated during the regulatory process.

The combustion of coal, the calcination of limestone, and the production of clinker (an intermediate product of cement manufacturing) may emit TACs such as mercury. Improving energy efficiency, switching fuels, and/or **blending** have the potential to decrease TAC emissions. The potential for mercury emissions is dependent on the mercury content in the raw materials and fuels, which can vary by geographic source and the effectiveness of air pollution control devices at cement plants. Blending supplementary cementitious material (SCM), such as fly ash, slag and pozzolans, into Portland cement can reduce the amount of Portland cement needed to produce concrete material. While fly ash may contain varying amounts of mercury, air pollution control devices at the blending facility should minimize mercury emissions to the air. Particulate matter emissions could also increase if SCMs are ground on site; generally these emissions would be controlled through the use of baghouses or other control devices.

The regulatory development would also evaluate the potential for transportation emissions associated with the increased use of SCMs that are produced out of State.

Refinery Energy Efficiency Process Improvement (Under Evaluation) 2-5 MMTCO$_2$E

ARB is evaluating a suite of measures that would require oil refineries to reduce GHG emissions by improving the efficiency of fossil fuel use in a number of refinery processes. GHG sources at refineries that are considered for the evaluation include, but are not limited to, flares, process heaters, boilers, fluid catalytic crackers, and hydrogen plants. Potential efficiency improvements include replacing and/or retrofitting inefficient equipment. Assuming avoided combustion of natural gas in refinery processes, this measure could reduce PM2.5 by 0.09 to 0.23 TPD. ARB is establishing a technical working group to explore the potential GHG and other air emission reductions that can be achieved through improving process efficiencies.

Removal of Methane Exemption from Existing Refinery Regulations (Under Evaluation) 0.01-0.05 MMTCO$_2$E

ARB is evaluating a measure to remove existing fugitive methane exemptions from the regulations applicable to equipment and sources within refineries. Storage tanks, wastewater treatment facilities, and process losses (leaks) are all sources of fugitive methane emissions.

Practices employed to implement this measure, including improved inspection and repair, could also reduce 0.04-0.22 TPD of VOC emissions.

Oil and Gas Extraction GHG Emission Reduction (Under Evaluation) 1-3 MMTCO$_2$E

This measure under evaluation would address emissions from the oil and gas extraction process, including both on and off-shore sources. Approximately 95 percent of the oil and gas extraction-related emissions come from combustion. The remainder is from fugitive sources. Both GHG and criteria pollutant emissions are produced mainly from the combustion of natural gas in generators, boilers, pumps and other related equipment. The measure under evaluation could include: repowering, replacing or repairing existing equipment; electrifying equipment; installing monitoring equipment to detect leaks; use of cogeneration systems; and other efforts. Cogeneration equipment could also provide steam for enhanced oil recovery and allow the retirement of existing steam generators. Net criteria pollutant emission reductions are estimated to be 0.6-1.7 TPD NOx, 0.04-0.11 TPD PM2.5, 0.2-0.7 TPD VOC, and 0.02-0.05 TPD SOx.

GHG Leak Reduction from Oil and Gas Transmission (Under Evaluation) 0.5-1.5 MMTCO$_2$E

ARB is evaluating a measure to address emissions from the transmission and distribution of natural gas throughout California. This transmission involves approximately 12,000 miles of pipeline. Transmission-related emissions consist primarily of methane and carbon dioxide and come primarily from fugitive sources and secondarily from combustion sources. Net criteria pollutant emissions reductions from controlling these sources are estimated to be 0.02-0.04 TPD NOx and 0.7-2.1 TPD VOC. This measure does not measurably reduce emissions of PM2.5 or SOx.

Industrial Boiler Efficiency (Under Evaluation) 0.5-1.5 MMTCO$_2$E

Industrial boilers are currently regulated to control ozone-forming criteria pollutants. ARB is evaluating a measure to improve efficiency by updating older equipment, optimizing air control technologies over a broader range of operations, or replacing equipment with advanced technologies, like fuel cells. This improved efficiency would reduce the combustion of natural gas by 1.8 to 2.8 million therms and reduce criteria pollutants by 0.3-0.4 TPD NOx, 0.2 TPD PM2.5, and 0.05-0.07 TPD VOC.

Stationary Internal Combustion Engine Electrification (Under Evaluation-Revised) 0.1-0.5 MMTCO$_2$E

The measure under evaluation would electrify natural gas and diesel fueled internal combustion engines. Electricity to operate these engines would be provided through either distributed generation systems or from the grid. Distributed generation units can generate electricity using a variety of technologies including solar/photovoltaics, wind, fuel cells, and microturbines, which would reduce criteria pollutants compared to diesel engines, but would relocate and potentially increase criteria pollutants compared to natural gas engines. The availability of grid power, power reliability, and costs and benefits specific to the application would drive the choice of electrical supply.

As ARB continued to evaluate this measure, it became apparent the high end of the range – 1 MMTCO$_2$E, was unrealistic. Such a large reduction would require electrifying almost two-thirds of the engines in this category by 2020. This level is not achievable due to both logistical

difficulties (access to electrical service and/or required duty cycles) and high cost for engines that are not operated a high percentage of the time. To reflect this, ARB has modified the range of potential GHG reductions to 0.1 to 0.5, and has determined potential co-pollutant reductions based on this new range. Assuming all of the electrification comes from electrical grid natural gas power plants, the net changes in criteria pollutants are estimated to be 0.2-1.3 TPD NOx, 0.01-0.03 TPD PM2.5, 0.01-0.05 TPD SOx, and 0.03-0.1 TPD VOC.

Glass Plant Energy Efficiency—Equipment Efficiency and Use of Recycled Materials (Under Evaluation) 0.1-0.2 MMTCO$_2$E

This measure under evaluation consists of two parts – improving efficiency in glass plants, and increasing the use of recycled materials. The co-pollutant impacts of improving efficiency in glass plants are expected to be largely positively and similar to that of improving efficiency at other industrial facilities, as described above.

Glass manufacturing – the production of glass from its raw materials - is one of the most energy-intensive industries in the United States. Essentially, sand, soda ash, and lime are melted at extremely high temperatures to form glass, with the addition of other materials (like metal oxides) for color or other properties. Recycled glass, called cullet, can also be crushed and added to the raw materials to manufacture glass, which reduces the amount of energy required to form the new glass. This measure proposes increasing the amount of cullet use by glass manufacturers, reducing their use of natural gas and associated criteria pollutants, as well as particulate emissions related to the melting of raw materials. This improved efficiency would reduce the combustion of natural gas and reduce criteria pollutants by 0.2-0.4 TPD NOx, 0.3-0.6 TPD PM2.5, 0.03-0.07 TPD ROG and 0.05-0.11 TPD SOx.

In addition, some TACs, including arsenic, chromium, lead, formaldehyde, phenol and methanol, are emitted during the fiberglass manufacturing process. Only the metal TACs (i.e., arsenic, chromium, and lead) are emitted from the glass melting operation. If implemented, this measure would be expected to decrease emissions of TACs because of the reduced melting of raw materials. These reductions are expected to be small, and not yet been calculated.

Off-Road Equipment (Under Evaluation) Up to 0.5 MMTCO$_2$E

Off-road equipment is primarily diesel-powered. This measure recommends adapting other vehicle and truck efficiency measures, like measures T-3, T-6, T-7, and T-8, for off-road equipment. Because this is a very broad category of equipment, and because the measure will follow the development of these other measures, it is too early to quantify the associated potential criteria pollutant reductions.

Summary of Co-Pollutant Emissions

Table 6 presents co-pollutant benefit estimations for the Measures under Evaluation for the Industry Sector. Changes in co-pollutant emissions could not be estimated for all measures due to the specificity of the measures or lack of underlying data. Emission reductions that could not be estimated are not included in the table.

Table 6: Estimated Co-Pollutant Emission Changes from Industry Sector Measures in Draft Scoping Plan
-- Measures Under Evaluation --
(tons per day in 2020)

Measure	NOx	PM 2.5	CO	SOx	VOC
Refinery Energy Efficiency Process Improvement		0.09-0.23			
Removal of Methane Exemption from Existing Refinery Regulations [a]					0.04 - 0.22
Oil and Gas Extraction GHG Emission Reduction	0.6-1.7	0.04-0.11	0.6-1.7	0.02-0.05	0.2-0.7
GHG Leak Reduction from Oil and Gas Transmission [a]	0.02-0.06		0.2-0.6		0.7-2.1
Industrial Boiler Efficiency [a]	0.3-0.4	0.02			0.05-0.07
Stationary Internal Combustion Engine Electrification [a]	0.2-1.3	0.01-0.03		0.01-0.05	0.03-0.1
Glass Plant Energy Efficiency—Equipment Efficiency and Use of Recycled Materials [a]	0.2-0.4	0.3-0.6	0.03-0.07	0.05-0.11	

[a]Changes in co-pollutant emissions could not be estimated for all measures due to the specificity of the measures or lack of underlying data. Emission reductions that could not be estimated are not included in the table.

B. LAND RESOURCES

California is the third largest state in the United States, encompassing almost 100 million acres of land and 5 million acres of water areas. The federal government holds approximately 23 million acres and manages them as federal parks, forests, and conservation areas. The federal government also holds and manages mineral and resource rights on an additional 45 million acres. The State holds 1.5 million acres of land as parks, forests, and conservation areas. Approximately 27 million acres are in agricultural production (27 percent of total state acreage) and 3.9 million acres are urbanized. There are 56 cities with populations over 100,000, including four of the country's 25 largest cities: Los Angeles, San Diego, San Jose, and San Francisco.

Regulatory Background

Open spaces and agricultural resources are special categories of land resources where there are concerns about impacts and conversions. These resources in California are currently protected in two ways:

> The **California Land Conservation Act of 1965**, known as the Williamson Act, enables local governments to enter into contracts with private landowners to restrict properties to agricultural and open space activities.
>
> **CEQA** requires proponents of proposed projects to describe the potential for environmental impacts, including impacts to Williamson Act contracts and to established land uses, through a public process.

Evaluation Context

ARB examined the potential effects of the recommended measures in the Draft Scoping Plan on land resources in California. Potential impacts that extend outside of the state are identified, but the potential effects on land resources out of state were not evaluated.

Evaluation Process

Where possible, existing studies, environmental documentation, and regulatory documentation for measures were reviewed for pertinent information. Documentation and studies for existing activities were used to estimate expansion of those types of activities. Where no information was available, ARB consulted experts at state agencies, including at the Air Resources Board and Climate Action Team agencies. More detailed information about the recommended regulations and the measures under evaluation is provided in Appendix C of the Draft Scoping Plan, as well as in the discussion of the potential impact on air resources (Section 3A) of this attachment.

1. CALIFORNIA CAP-AND-TRADE PROGRAM LINKED TO WESTERN CLIMATE INITIATIVE

Land use considerations are under the authority of local governments and no land use or planning requirements would be mandated or altered by the recommended measure. Instead, the recommended measure would require capped entities that have already received permits to operate consistent with existing land easements and ordinances to comply with AB 32 requirements and the cap and trade regulation.

2. TRANSPORTATION AND GOODS MOVEMENT

(T-1) Pavley I and Pavley II-Light-Duty Vehicle GHG Standards 31.7 MMT CO_2E
(T-3) Vehicle Efficiency Measures 4.8 MMT CO_2E

There are no anticipated changes to land use as a result of these measures, as they are not projected to affect the total number of vehicles in the state.

(T-2) Low Carbon Fuel Standard 16.5 MMT CO_2E

Although the Low Carbon Fuel Standard is still in the regulatory development process, there are likely to be a variety of ways in which the final regulatory requirements can be met. There are potential land resource issues associated with the biofuels pathways, particularly those related to the potential for biofuel crops to replace food crops. The impacts associated with renewable energy to generate hydrogen or electricity for vehicles is evaluated in the electricity and natural gas section.

Biofuel Raw Materials – Waste Materials: The conversion of waste materials to fuels would reduce the need for landfill space in the state.

Biodiesel – Soy: The majority of soybeans needed to fill the anticipated 2020 demand for soy-based biodiesel is projected to be produced out of state. Midwestern states and Texas are currently the largest growers of soybeans, and out-of-state biodiesel plants using soybeans tend to be located close to production fields. California could meet future biodiesel demands either through importing soybeans and other raw materials or through importing finished biodiesel. Potential land resource issues related to the use of soybeans to produce fuel include the conversion of undeveloped/natural habitats to agriculture and the conversion of food-based agriculture lands to fuel-based agriculture lands. These issues will be further evaluated as part of the LCFS regulatory development process.

Biodiesel Production Facilities: Biodiesel production facilities are usually sited based on access to feedstock and the market for the finished product. Production facilities processing out-of-state feedstocks need to be accessible to truck and rail routes. Facilities processing recycled waste tend to be located closer to the sources of that waste – restaurants and industrial facilities. Facilities sited in industrial-zoned areas will already be compatible with existing land use designations since biodiesel production falls into the industrial category. Potential land use impacts could occur if non-compatible areas are rezoned to accommodate the siting of new production facilities. Preliminary analysis for the LCFS estimates a projected maximum demand for biodiesel in California by 2020 that could require the equivalent of almost 30 new 25 million gallon-capacity biodiesel production facilities.

Ethanol – Corn: Food-to-fuel crop conversion acreage estimates are currently under development as part of the LCFS regulatory process. Potential land resource issues related to the use of corn to produce fuel include the conversion of undeveloped/natural habitats to agriculture and the conversion of food-based agriculture lands to fuel-based agriculture lands. These issues will be further evaluated in the LCFS regulatory development.

Ethanol – Cellulosic: Less is known about the potential land use issues with cellulosic agriculture, which may be heartier than food crops and thus can be cultivated in locations where food cannot be economically cultivated. Most cellulosic feedstocks will consist of

woody waste materials (corn stover and other crop residues, waste wood chips, and municipal solid waste) which would derive from existing land uses. The only potential land resource issues related to the use of cellulosic materials to produce fuel would occur where (and if) undeveloped/natural habitats or food-based agriculture lands are converted to fuel-based agriculture lands. These issues will be further evaluated in the LCFS regulatory development.

Ethanol Production Facilities: Ethanol production facilities typically need access to sources of feedstock, users of their waste products, and to the market for this finished product. Facilities sited in industrial-zoned areas generally will not cause as many land use concerns as siting in undeveloped areas. Potential land use impacts could occur if non-compatible areas are rezoned to accommodate siting of new ethanol production facilities. The preliminary analysis for the LCFS proposal estimates a maximum projected need for ethanol in California by 2020 that could require the equivalent of over 50 new 50 million gallon-capacity plants.

Hydrogen: Land use issues related to renewably-produced hydrogen resources are discussed in the Electricity and Natural Gas Section. Hydrogen production stations are typically constructed in developed, populated areas and within zoning that allows for a production station. Stations that use natural gas or on-site solar power as the energy source for production would probably not raise land resource issues if located in developed areas.

(T-4) Ship Electrification at Ports 0.2 MMT CO_2E

(T-5) Goods Movement Efficiency Measures 3.5 MMT CO_2E

Ports and highway infrastructure may continue to expand to meet the increasing demand for goods movement. No new ports or rail yards are currently anticipated and existing rail yards are not expected to expand.[27] ARB does not anticipate that implementation of the Draft Scoping Plan will affect port infrastructure activities beyond the business as usual scenario. ARB will develop strategies for improving the efficiency of goods movement, with the goal of improving air quality. The majority of the measures expected to be included in these strategies will essentially recommend physical or operational and maintenance changes to vehicles and equipment, but not change the future numbers of vehicles and equipment. In general, these measures are not expected to effect changes in land uses. Some measures recommend replacing diesel engines with grid electricity, which would increase the demand for electricity. If construction of new facilities or repowering of existing facilities is required to meet this increased demand, these measures could collectively impact land resources. The impacts of new facilities are described in the Electricity and Natural Gas sector evaluation.

(T-6) Heavy Duty Vehicle GHG Emission Reduction – Aerodynamic Efficiency 1.4 MMT CO_2E

(T-7) Medium and Heavy-Duty Vehicle Hybridization 0.5 MMT CO_2E

(T-8) Heavy-Duty Engine Efficiency 0.6 MMT CO_2E

There are no anticipated changes to land use as a result of this measure, as this measure would not affect the total number of vehicles in the state.

[27] Goods Movement Action Plan.

(T-10) High Speed Rail **1 MMT CO_2E**

The Draft Scoping Plan supports the implementation of a high speed rail system. The recommended HSR program has undergone environmental review under CEQA and NEPA. ARB reviewed this documentation for its land use analysis. The programmatic EIR/EIS examined the impacts of the HSR on land resources, land planning, agricultural lands, and environmental justice. The analysis finds the recommended HSR would be compatible with local and regional plans that support rail systems and transit-oriented development, as well as improved inter-modal connectivity with existing local and commuter transit systems. As new transportation corridors would be developed with the HSR, there is the potential for localized land use impacts and property right impacts. The programmatic EIR/EIS identifies additional land use incompatibilities and significant impacts on agricultural lands at regional levels. Mitigation strategies and design practices are proposed to compensate these impacts. For example, the California High Speed Rail Authority has established policies regarding the use of smart growth and transit oriented development strategies for station areas to help to avoid secondary growth impacts on agricultural lands.

Feebates (Under Evaluation) **4 MMT CO_2E**

This measure considers financially incenting the transition from high-GHG emitting vehicles to low-GHG emitting vehicles by imposing a fee on the former and offering a rebate on the latter. There are no anticipated changes to land use as a result of this measure, as this measure would not affect the total number of vehicles in the state.

3. LOCAL GOVERNMENT AND REGIONAL TARGETS

Regulatory Background

Local governments have the authority to establish allowable land uses within their spheres of influence in **General Plans**. **Government Code § 65040.2** directs cities and counties to develop these comprehensive, long-term plans to guide future development.

The **California Land Conservation Act of 1965**, known as the Williamson Act, enables local governments to enter into contracts with private landowners to restrict properties to agricultural and open space activities.

CEQA requires General Plans to describe the potential for environmental impacts through a public process.

Local Agency Formation Commissions in each county adopt spheres of influence for each city within the county, and make determinations on changes to those boundaries. Their decisions can influence air quality in the way in which they allow additional development to occur.

(T-9) Local Government Actions and Regional Targets **2 MMT CO_2E**

This measure recommends requiring regional and local governments collaborate to develop GHG reduction targets and incorporate these targets into their planning and regulatory authorities. One way to implement this target is to reduce vehicle use, usually through land use planning and zoning, and development of mass transit. One way to reduce vehicle use is through high density

development, which would reduce potential future impacts on currently agricultural or conserved lands. This could have the effect of preserving open spaces and agricultural fields.

Congestion Pricing (Under Evaluation)	**up to 1 MMT CO_2E**
Pay-As-You-Drive Insurance Premiums (Under Evaluation)	**up to 1 MMT CO_2E**
Indirect Source Rules for New Development (Under Evaluation)	**up to 1 MMT CO_2E**
Programs to Reduce Vehicle Trips (Under Evaluation)	**up to 1 MMT CO_2E**

The measures are proposed as mechanisms to reduce vehicle use and to encourage higher density developed areas. Increasing density also preserves land from development, and would complement measure T-9.

4. ELECTRICITY AND NATURAL GAS

Regulatory Background

The air emissions of all stationary sources in California are regulated. For power plants or energy facilities, the **CEC Certification process** serves as an equivalent to the otherwise required state and local permitting requirements. The CEC has authority to certify (permit) the construction and operation of thermal electric power plants 50 megawatts or larger and all related facilities. The site certification process provides a review and analysis of all aspects of a proposed project, including public health and environmental impacts, safety, efficiency, and reliability, equivalent to the CEQA process. The process is also a public process. Smaller facilities with no potentially significant environmental impacts can apply for an exemption process, similar to a mitigated negative declaration approach under CEQA.

The CEC works with local governments to ensure a functionally equivalent permitting process. CEC prepare the necessary evaluation in a "Preliminary Staff Assessment", working with the local government to ensure it provides the information needed for the local government to approve the project. The final site certification serves as the local permit to construct.

(E-1) Energy Efficiency and Conservation	**15.2 MMTCO_2E**
(CR-1) Energy Efficiency and Conservation	**4.2 MMTCO_2E**
Additional Energy Efficiency and Conservation (Under Evaluation)	**4.8 MMT CO_2E**

There are no expected direct land use impacts from these recommended and under evaluation measures. Avoided demand for electricity would potentially result in a reduction of the number of power plants constructed in the future. A conventional natural gas plants uses approximately 1 acre per 9.6 MW; solar fields (the most land intensive source of electrical power) would require 5 to 10 acres per MW. Avoiding 32,000 to 40,000 GWh of electrical demand could avoid development of 520 to 62,500 acres. This avoided land use type could be developed land, agricultural lands, or natural habitat.

(CR-3) Solar Water Heating	**0.1 MMT CO_2E**
Expansion of Solar Water Heating (Under Evaluation)	**1 MMT CO_2E**

There are no expected direct land use impacts from these recommended and under evaluation measures. Avoided demand for natural gas for home and commercial water heating would slightly reduce the impacts around the world from development of natural gas and production of liquefied petroleum natural gas.

(E-4) Million Solar Roofs **2 MMT CO_2E**
Expanded Million Solar Roofs (Under Evaluation) **1.3 MMT CO_2E**

Avoided demand for electricity could potentially result in a reduction of the number of power plants constructed in the future. A conventional natural gas plants uses approximately 1 acre per 9.6 MW; solar fields (the most land intensive source of electrical power) would require 5 to 10 acres per MW. Avoiding 2,000 MW of electrical demand could avoid development of 208 to 20,000 acres. This avoided land use type could be developed land, agricultural lands, or natural habitat.

(E-3) Increasing Combined Heat and Power **6.8 MMT CO_2E**

Combined heat and power systems would be installed within existing facility boundaries, typically located in already disturbed, industrial areas. Generally, these projects are not expected to impact land resources.

The increased efficiency of combined heat and power systems would lead to avoided demand for electricity, potentially resulting in a reduction of the number of power plants constructed in the future. A conventional natural gas power plant uses approximately 1 acre per 9.6 MW; a solar field (the most land intensive source of electrical power) requires 5 to 10 acres per MW. Avoiding 4,000 MW of electrical demand could avoid development of 416 to 40,000 acres. This avoided land use type could be developed land, agricultural lands, or natural habitat. Avoided demand for natural gas could slightly reduce the impacts around the world from development of natural gas and production of liquefied petroleum natural gas.

(E-2) Renewables Portfolio Standard **21.2 MMT CO_2E**

This recommended measure would increase the overall percentage of renewable energy sources such as wind, solar, biomass and geothermal, of each utility's energy sources. This requirement could be met through any potential mixture of renewable energy sources, and will most likely be driven by a number of factors, including the availability of renewable sources within the geographic region of each utility. For these reasons the benefits and impacts of each renewable resources are evaluated relative to natural gas, and are not individual quantified for potential air emissions. Land resource impacts are best evaluated at the project-level, as the quality of the land resource being impacted is more important than the quantity. Project-level evaluations are currently evaluated within the CEC certification process.

Wind farms are generally located on undeveloped lands, but have a relatively small land footprint. Modern wind turbines are more powerful and require fewer turbines per acre than older generation wind turbines.

Solar thermal fields use 8 acres of land per MW on average[28] and are generally proposed in undeveloped lands in unshaded areas. The mirrors and lenses at solar thermal facilities require periodic washing, so unvegetated soils are treated to reduce erosion, but they remain porous.

There are no current large-scale **solar photovoltaic** plants operating in California, although there are several proposed. Photovoltaic plants use more land per MW than solar thermal plants, and about 80 times the acreage of a combined-cycle natural gas plant per MW. The

[28] 2007 Environmental Performance Report. California Energy Commission. 2007.

2007 Environmental Performance Report states that current technological advances may reduce the land footprint by up to 50 percent.

There is a current example of potential land impacts from large scale collective development of wind and solar power. The Bureau of Land Management has received applications to develop 66,200 MW of renewable energy on the lands they manage in the California desert, which could encompass up to 1.16 million acres, some of which is important biological habitat and difficult to offset in high volumes.

The land resource effects of **biomass** sources depend on the fuel type.

- The use of biomass (forest or agricultural residuals) or municipal solid waste (MSW) requires a physical plant, similar in land use patterns to natural gas power plants but generally located close to the source materials (such as landfills) to reduce transportation costs. Land use impacts associated with these facilities are highly dependent on their location. Use of waste materials precludes the need to destroy or landfill them in other manners, reducing future land resource impacts. These materials do not require additional lands for production, and the collection of the waste usually complements the operational needs of forest and agricultural practices. **Municipal solid waste** may contain hazardous materials, which could result in solid and gaseous hazardous by-products. Air emissions and ash can be treated to reduce this hazard.
- The **anaerobic digestion** of human or animal wastes reduces the physical amount of waste and improves the quality of the waste for disposal, requiring less land for disposal.
- Combustion of **landfill gases** occur within existing landfill facility footprints and therefore have no additional effects on land resources.

Geothermal-fueled power plants use less land than fossil-fuel power plants, but have to be located near their source, which can be undeveloped land or native habitat.

Small hydropower projects take advantage of existing disturbed environments (man made channels, aqueducts, pipelines, etc.) and therefore have a minimal impact on land resources.

New transmission infrastructure may be required to fully develop renewable sources. New transmissions lines may require more land resources than for natural gas power plants of similar capacity. We do not anticipate significant land resource impacts at a statewide level, since the maximum amount of difference would be around 488,850 acres.

Coal Emission Reduction Standard (Under Evaluation) Up to 8 MMT CO_2E

This measure recommends reducing coal GHG emissions through direct controls, replacement of out-of-state coal plants with other types of power plants either out-of-state or in-state, or mix of all three. Coal-fired power plants impact land resources through facility siting (including water needs) and through mining activities. Mining activities can significantly impact land sources, completely removing vegetation from large areas (around 9 acres per MW for a new, highly energy-efficient plant) and potentially leading to subsidence from the removal of underground materials. The footprint of power generating facilities is not substantially larger than natural gas

power plants per MW, but their associated coal-processing facilities essentially double their facility footprint.

ARB staff estimates that replacing out-of state coal-fired generation (27,840 GWh, or 87 percent of 32,000 GWh) with natural gas-fired generation would require 453 acres of land for in-state replacement energy facility development (natural gas or renewable sources).

7. INDUSTRY

Regulatory Background

Before a facility can be constructed, it must obtain permits to emit air pollutants, use water resources, and to develop land. Regarding land resources, the stationary source must comply with:

> **CEQA** requires proposed industrial facilities to analyze and describe the potential for environmental impacts, identify ways to reduce adverse impacts and offer alternatives to the project, and to disclose this information to the public. A Local, Regional, or State government agency serves as the lead or responsible agency for a CEQA document. Local, Regional, and State government agencies also both establish guidance for CEQA analyses and review documents for consistency with established plans and regulations. This process examines projects for localized impacts and proposes measures to mitigate significant impacts.
>
> **Land Use/Zoning Laws** determine where industrial sources can be constructed and operated. New stationary sources have to obtain a local permit determining compliance with the **General Plan** and authorizing construction. If the proposed location is not within an approved land use area, the facility will have to undergo a public process to obtain a zone change, variance, or conditional use permit, dependent on the compatibility of the facility with the location. Land use permits require environmental review. There are also local building codes in effect that require local construction permits.

(I-1) Energy Efficiency and Co-Benefits Audits for Large Industrial Sources **TBD MMTCO$_2$E**

This recommended measure focuses on improving efficiency at large industrial sources. It is anticipated that most efficiency improvements would take place on-site at existing industrial facilities, and would therefore not affect land resources.

Carbon Intensity Standard for Cement Manufacturers (Under Evaluation) 1.1-2.5 MMTCO$_2$E

Carbon Intensity Standard for Concrete Batch Plants (Under Evaluation) 2.5-3.5 MMTCO$_2$E

Waste Reduction in Concrete Use (Under Evaluation) 0.5-1 MMTCO$_2$E

Measures under evaluation to improve energy efficiency and increase blending are not expected to impact land resources. As with any sector where biofuels could be considered as alternatives to fossil fuels there is the potential to affect land use changes to support the production of the biological feedstocks.

Refinery Energy Efficiency Process Improvement (Under Evaluation) 2-5 MMTCO$_2$E

Removal of Methane Exemption from Existing Refinery Regulations (Under Evaluation) 0.01-0.05 MMTCO$_2$E

There are no anticipated changes to land use as a result of these measures, as all changes would occur on land that is already developed.

Oil and Gas Extraction GHG Emission Reduction (Under Evaluation) 1-3 MMTCO$_2$E

GHG Leak Reduction from Oil and Gas Transmission (Under Evaluation) 0.5-1.5 MMTCO$_2$E

There are no anticipated changes to land use as a result of these measures.

Industrial Boiler Efficiency (Under Evaluation) 0.5-1.5 MMTCO$_2$E

There are no anticipated changes to land use as a result of this measure, as all changes would occur on land that is already developed.

Stationary Internal Combustion Engine Electrification (Under Evaluation-Revised) 0.1-0.5 MMTCO$_2$E

There are no anticipated changes to land use as a result of this measure, as all changes would occur on land that is already developed.

Glass Plant Energy Efficiency—Equipment Efficiency and Use of Recycled Materials (Under Evaluation) 0.1-0.2 MMTCO$_2$E

There are no anticipated changes to land use as a result of this measure, as all changes would occur on land that is already developed.

Off-Road Equipment (Under Evaluation) Up to 0.5 MMTCO$_2$E

There are no anticipated changes to land use as a result of this measure, as the overall number of vehicles and equipment would not change.

C. WATER RESOURCES

Surface water quality around the state qualifies as impaired under the Clean Water Act. Population trends will add to these stresses by adding demand for water supplies, food supplies, and wastewater services. Development creates impervious surfaces which contribute to flood and water quality problems. Development in flood plains exacerbates flooding and increases the risk of property damage and loss of life.

Regulatory Background

Water resources, both supply and quality, are regulated at both the federal and state levels. Federal Laws and Regulations include:

The **Clean Water Act** (33 U.S.C. § 1251 et seq.) serves to protect the nation's surface waters. As part of the Clean Water Act, the federal government develops water quality standards to protect aquatic and human life (including recreational use) which are enforced by the state. The state then identifies surface waters that do not meet standards, prioritize their remedies, and develop mass-based loading programs to improve water quality (§ 303, Total Maximum Daily Load program). The federal government also certifies that projects will not impair water quality (§ 404) and requires that waters discharged into surface waters meet prescribed standards (National Pollutant Discharge Elimination Source program).

Section 10 of the **Rivers and Harbors Act** (33 U.S.C. § 401 et seq.) protects navigable rivers and harbors, requiring federal permits to make physical changes.

State Laws and Regulations include:

The California Department of Fish and Game Code (§ 1601–1603 [**Streambed Alteration**]) protects aquatic species by requiring a state permit to physically alter stream or lake beds or banks.

The **Porter-Cologne Water Quality Act** (Water Code § 13000 et seq.) authorizes the state to implement the Clean Water Act in California.

Cobey-Alquist Flood Plain Management Act (Water Code § 8400 et seq.) authorizes the Board that directs state flood control activities and requires permits for encroachments in known flood plains to minimize flood impacts.

A mix of local governments, special districts, and private companies provide water and wastewater services in California. These service providers have their own process for determining how new demands for water or wastewater services can or should be provided. **Senate Bills 610 and 221 (2001)** require development projects to demonstrate that water is available to reliably support the project.

Evaluation Process

Where possible, existing studies, environmental documentation, and regulatory documentation for measures were reviewed for pertinent information. Documentation and studies for existing

activities were used to estimate expansion of those types of activities. Where no information was available, ARB consulted experts at state agencies, including at the Air Resources Board and Climate Action Team agencies. More detailed information about the recommended regulations and the measures under evaluation is provided in Appendix C of the Draft Scoping Plan, as well as in the discussion of the potential impact on air resources (Section 3A).

1. CALIFORNIA CAP-AND-TRADE PROGRAM LINKED TO WESTERN CLIMATE INITIATIVE

The recommended measure is not expected to have any adverse impacts on water resources. Instead, we expect the declining cap to incentivize utilities to promote local conservation programs to reduce water demand and wastewater discharge. These programs would in turn reduce load demand on public utilities that would otherwise provide electricity for pumping and treatment.

2. TRANSPORTATION AND GOODS MOVEMENT

(T-1) Pavley I and Pavley II-Light-Duty Vehicle GHG Standards 31.7 MMT CO_2E
(T-3) Vehicle Efficiency Measures 4.8 MMT CO_2E

At times, the refining, marketing and distribution of gasoline adversely affects water quality due to leaks, spills, and wastewater discharge. Any reduction in fuel use would reduce the opportunity for such occurrences. Consequently, the ARB staff projects that the recommended measure would likely have a positive impact on water quality.

(T-2) Low Carbon Fuel Standard 16.5 MMT CO_2E

For this evaluation, ARB compared the potential water resources effects of the LCFS to traditional petroleum fuels. Refinement of crude oil in California consumes 1.5 gallons of water per gallon of gasoline produced.[29] Crude oil is imported from foreign sources (45 percent), Alaska (16 percent), and in-state sources. The two largest uses of water associated with oil production are for drilling and for enhanced recovery. Drilling for crude oil does require water use to form drilling muds, which are used to lift drill cuttings to the surface. These muds contain fine clays, which are often not allowed to be disposed of directly in surface waters, and require treatment prior to disposal. Some crude oils are too heavy to flow, so steam is injected in the vicinity to thin the oil – an enhanced recovery process requiring both water and energy.

The majority of the potential LCFS pathways are evaluated below. The electrification pathway (plug-in electric vehicles) is addressed in the energy section, under the recommended RPS measure.

Biofuels: Water use at biorefineries can vary. Fermentation requires water for hydrolysis, fermentation, and distillation processes, currently around 4 gallons of water consumed per gallon

[29] Pate, R., M.Hightower, C.Cameron, and W.Einfeld,. *Overview of Energy-Water Interdependencies and the Emerging Energy Demands on Water Resource,*. Report SAND 2007-1349C, Los Alamos, NM: Sandia National Laboratories, 2007.

of ethanol produced.[30] Cellulosic feedstocks are broken down with enzyme additions prior to fermentation, generally more water intensive on the whole, but projected to actually consume 2 to 6 gallons of water per gallon of ethanol produced.[31] Biodiesel refining is the least water intensive, consuming around 1 gallon of water per gallon of biodiesel produced.[32] Also, wastewater from biorefineries can contain high levels of biological oxygen demand (BOD) grease and salts. Some facilities in the Midwest have been cited for breaching the limits allowed under the National Pollutant Discharge Elimination System permits the facilities are required to hold.

But the greatest potential impact on water resources by biofuels is the production of feedstock. Agriculture in the United States relies on a mixture of natural rainfall and irrigation, the ratio of which depends on the local climate. Irrigation practices can have a very large effect on the overall water consumption by biofuels. Just as irrigation water demand is highly dependent on location, so is the impact of that water demand. In addition to water demand, the chemicals and fertilizers used on these crops can end up in surface or ground waters, affecting water quality. These issues will be further discussed in the LCFS regulatory development.

The location of these water demands determines their ultimate effect. In the Midwest, where much of the corn and soy beans are grown, historic overdraw of groundwater resources and high organic loading of surface waters would suggest that the additional water demand of biofuel production and increase nitrogen loading of feedstock production could impact existing water resources.

Hydrogen: Hydrogen fuel can be created from water (through electrolysis) or from hydrocarbon sources such as natural gas, methanol, or petroleum products (steam reforming). Steam reformation of natural gas is the most common form of hydrogen production in the United States.[33] Each of these processes uses water: in electrolysis energy is used to break apart water bonds to create hydrogen, in reforming steam is used to break apart hydrocarbon bonds. The consumptive water resource requirements for these processes are not well documented, but given the pressures on California's water supplies, these requirements should be quantified within the LCFS regulatory process or within the siting process for hydrogen production facilities.

(T-4) Ship Electrification at Ports 0.2 MMT CO_2E

(T-5) Goods Movement Efficiency Measures 3.5 MMT CO_2E

At times, the refining, marketing and distribution of diesel and gasoline adversely affects water quality due to leaks, spills, and wastewater discharge. Any reduction in fuel use would reduce the opportunity for such occurrences. Consequently, the recommended goods movement measures that result in reduced fuel consumption would have a positive impact on water quality. Redirected effects due to electrification are addressed in the energy section.

One maintenance practice to be considered in the commercial harbor craft measure is the use of anti-fouling products on the hulls to improve hull smoothness. The active ingredient of a number

[30] Ibid.
[31] Ibid.
[32] Ibid.
[33] U.S. Department of Energy. http://www1.eere.energy.gov/hydrogenandfuelcells/education/basics_production.html

of anti-fouling products is copper. The copper is slowly leached out of the product and thereby inhibits the growth of species that foul vessel hulls. The potential adverse impacts are associated with the leached copper, particularly in harbors and marinas that are relatively shallow and experience a reduced level of water circulation. The use of anti-fouling products containing copper could negatively impact water quality. ARB staff would promote the use of non-toxic anti-fouling products by vessel owner/operators and educate them about the dangers associated with other products. With non-toxic products, a vessel owner/operator would have to clean the hull more frequently than if they were to use copper-based anti-fouling products. However, non-toxic products do not need to be reapplied as often as copper-based products.

(T-6) Heavy Duty Vehicle GHG Emission Reduction – Aerodynamic Efficiency 1.4 MMT CO_2E

(T-7) Medium and Heavy-Duty Vehicle Hybridization 0.5 MMT CO_2E

(T-8) Heavy-Duty Engine Efficiency 0.6 MMT CO_2E

There are no anticipated changes to water resources as a result of measures T-6 and T-8, as these measures would not affect the total number of vehicles in the state or the overall use of fuel. Measure T-7, however, is anticipated to result in 48 million gallons of avoided diesel use. This would have upstream impacts on water quality similar to measures T-1 and T-3.

(T-10) High Speed Rail 1 MMT CO_2E

The Draft Scoping Plan supports the implementation of a high speed rail system. The recommended HSR program has undergone environmental review under CEQA and NEPA. ARB reviewed this documentation for its water resources analysis. The programmatic EIR/EIS examined the impacts of the High Speed Rail on existing water resources. The impacts are typical of a large-scale infrastructure project, and would have to minimize and mitigate impacts in order to obtain appropriate approvals and permits. Impacts would be less than those associated with an equivalent expansion of highway infrastructure.

Feebates (Under Evaluation) 4 MMT CO_2E

This measure considers financially incenting the transition from high-GHG emitting vehicles to low-GHG emitting vehicles by imposing a fee on the former and offering a rebate on the latter. This would have upstream impacts on water quality similar to measures T-1 and T-3.

3. LOCAL GOVERNMENT AND REGIONAL TARGETS

Regulatory Background

Local governments have the authority to establish allowable land uses within their spheres of influence in **General Plans**. **Government Code § 65040.2** directs cities and counties to develop these comprehensive, long-term plans to guide future development.

The **California Land Conservation Act of 1965**, known as the Williamson Act, enables local governments to enter into contracts with private landowners to restrict properties to agricultural and open space activities.

CEQA requires General Plans to describe the potential for environmental impacts through a public process.

LAFCOs in each county adopt spheres of influence for each city within the county, and make determinations on changes to those boundaries. Their decisions can influence air quality in the way in which they allow additional development to occur.

(T-9) Local Government Actions and Regional Targets 2 MMT CO_2E

Generally, this measure encourages more compact development patterns and reduced vehicle use. In so far as compact development patterns reduce traditional large lot development patterns, this measure has the potential to significantly reduce water demand from landscaping, as well as reduce future degradation of surface water quality associated with impervious surfaces. Reductions in vehicle use from this measure could also have water resource benefits similar to measures T-1 and T-3, due to avoided fuel use.

Congestion Pricing (Under Evaluation) up to 1 MMT CO_2E
Pay-As-You-Drive Insurance Premiums (Under Evaluation) up to 1 MMT CO_2E
Indirect Source Rules for New Development (Under Evaluation) up to 1 MMT CO_2E
Programs to Reduce Vehicle Trips (Under Evaluation) up to 1 MMT CO_2E

Reductions in vehicle miles traveled could have water resource benefits similar to measures T-1 and T-3, due to avoided fuel use.

4. ELECTRICITY AND NATURAL GAS

Electricity and water are intricately linked in California. Many forms of electricity production require water for steam generation or cooling or use water resources directly as in hydropower and geothermal projects. As water resources are limited in California, technological advances have optimized and minimized water use. Electricity is also used to power the state's water system – transporting water from its source to where it is used, and for heating water for residential, commercial, and industrial uses. The measures recommended in the Draft Scoping Plan for the electricity sector were analyzed for direct and indirect effect on water resources, but electricity savings were not translated into water savings. It is possible that electricity savings will result in water savings, but ARB did not quantify these potential savings.

Regulatory Background

For large energy facilities, the **CEC Certification process** serves as an equivalent to the otherwise required state and local permitting requirements. The CEC has authority to certify (permit) the construction and operation of thermal electric power plants 50 megawatts or larger and all related facilities. The site certification process provides a review and analysis of all aspects of a proposed project, including water supply availability and wastewater impacts, equivalent to the CEQA process. The process is also a public process. Smaller facilities with no potentially significant environmental impacts can apply for an exemption process, similar to a mitigated negative declaration approach under CEQA.

The CEC works with local governments to ensure a functionally equivalent permitting process. CEC prepare the necessary evaluation in a "Preliminary Staff Assessment", working with the local government to ensure it provides the information needed for the local and state governments to approve the project and either serves as the appropriate permit or basis for the appropriate permit.

The State Water Resources Control Board's "**Water Quality Control Policy on the Use and Disposal of Inland Waters Used for Powerplant Cooling**" (Order No. 75-58) encourages the use of alternative sources of cooling water and/or the use of alternative cooling technology. Alternative sources of cooling water identified in the policy include wastewater, irrigation return flows, and naturally brackish water. The policy also encourages the evaluation of dry or wet/dry cooling technology for those facilities that may require water from the Sacramento-San Joaquin River Delta.

(E-1) Energy Efficiency and Conservation 15.2 MMTCO_2E
(CR-1) Energy Efficiency and Conservation 4.2 MMTCO_2E
Additional Energy Efficiency and Conservation (Under Evaluation) 4.8 MMT CO_2E

The California Energy Commission has authority to set efficiency standards for appliances and buildings that include water. Some types of appliance achieve their energy savings partially through reducing the amount of water used, such as washing machines and dishwaters, which are significant contributors to household water demand. Green building measures also encourage water efficiency and conservation in connection with energy efficiency and conservation. These types of measures, provided the water-energy linkage continues to hold, are more likely to reduce water use than to increase it.

Water efficiency and conservation can also result in energy efficiency and conservation, lowering the need for energy to heat or cool water, or electricity to move water. Decreases in fossil-fired electricity use could slightly decrease demand for water associated with fossil-fired electricity production. Reductions in water demand can reduce the electricity associated with the transport, treatment and delivery of water.

(CR-3) Solar Water Heating 0.1 MMT CO_2E
Expansion of Solar Water Heating (Under Evaluation) 1 MMT CO_2E

These measures are expected to have minimal effect on water resources. Although photovoltaic systems require periodic washing, the impact on water resources is expected to be very small.

(E-4) Million Solar Roofs 2 MMT CO_2E
Expanded Million Solar Roofs (Under Evaluation) 1.3 MMT CO_2E

These measures are expected to have minimal effect on water resources. Although photovoltaic systems require periodic washing, the impact on water resources is expected to be very small. Decreases in fossil-fired electricity use could slightly decrease demand for water associated with fossil-fired electricity production.

(E-3) Increasing Combined Heat and Power 6.8 MMT CO_2E

The potential impacts on water resources from this recommended measure depends on the technology(ies) deployed. If a combined heat and power system, including its air pollution control technologies, is more efficient than the electricity source it is replacing, water use could decrease. It is not possible to quantify this effect, but ARB recommends that the potential water resource impacts be considered in development of this measure.

(E-2) Renewables Portfolio Standard 21.2 MMT CO_2E

This recommended measure would increase the overall percentage of renewable energy sources such as wind, solar, biomass and geothermal, of each utility's energy sources. This requirement could be met through any potential mixture of renewable energy sources, and will most likely be driven by a number of factors, including the availability of renewable sources within the geographic region of each utility. For these reasons the benefits and impacts of each renewable resources are evaluated relative to natural gas, and are not individual quantified for potential air emissions.

Water use for energy production is trending away from freshwater resources and toward recycled water or air cooling processes. Wastewater is also transitioning from surface water disposal towards disposal to municipal wastewater facilities or the elimination of wastewater altogether. For comparison purposes, the 2007 Environmental Performance Report examined water use by plant type and cooling system. Combined-Cycle natural gas plants with re-circulating wet cooling consume 676 to 1,380 gallons per MWh. Dry cooling reduces water use to 50 to 180 gallons per MWh. Peaking plants are generally simple-cycle plants with inlet cooling, and consume 80-600 gallons per MWh. Renewable sources (except hydropower) are generally within or less than the range of combined-cycle natural gas plants with recirculated cooling.

Wind power does not have any associated water use.

Solar thermal plants can be wet or dry cooled. Parabolic trough plants consume 960 to 1,120 gallons per MWh (similar to a wet cooled natural gas plant), while sterling engines consume 4 to 6 gallons per MWh, mostly for mirror washing. Porous surfaces in the project area minimize impacts on surface water storm flows. Solar **photovoltaic** plants require periodic washing but do not require cooling.

Biomass (forest or agricultural residuals) may use water to clean materials prior to combustion. Other water requirements are similar to wet cooled natural gas-fueled plants, 760 to 1,170 gallons per MWh.

The **anaerobic digestion** of human or animal wastes (wastewaters) produces a gas of 50 to 80 percent methane (biogas) that can be combusted to produce electricity. Wastewaters are regulated by the State Water Resources Control Board and Regional Water Quality Control Boards to ensure they do not impair surface waters of the state. Digester projects would need to obtain a permit for wastewater discharge if they are not already part of a permitted wastewater treatment facility.

Landfill gases (mostly methane) plants using simple-cycle engines consume 80 to 830 gallons per MWh, whereas reciprocating engines consume less than 1 gallon per MWh. Both engines are currently in use, but are both less consumptive than wet cooled natural gas-fueled plants. In the future, use of reciprocating engines should be encouraged to minimize water resource impacts.

Geothermal sources of energy production rely on hot waters and concentrated steams that tend to have high mineral contents. These waters are used to create thermal power and then re-

injected into the ground, consuming 8 to 30 gallons per MWh. Geothermal wells are designed to minimize impacts on nearby water resources. Monitoring is usually required to ensure there are no water quality impacts on nearby surface or ground waters.

Small **hydropower** projects are used in locations where water resources are already disturbed. They do not consume additional water resources, impair water quality, or create waste waters.

Coal Emission Reduction Standard (Under Evaluation) Up to 8 MMT CO_2E

Coal-fired turbine-generator plants use water for condenser cooling, boiler make-up water, flue gas desulfurization system spray, ash transport and other plant uses. Non-consumptive water use averages 25,000 gallons per MWh, while consumptive water use averages 470 gallons per MWh. Coal mining can result in acid mine drainage or pools of poor-quality water, brought to the surface by mining activities. The employment of carbon capture storage systems would further increase water resource impacts.

If reducing coal emissions results in a transition to sources of energy with lower water demands, water resource benefits could occur both by reducing water demands and resultant wastewaters.

7. INDUSTRY

Regulatory Background

Before a facility can be constructed, it must obtain permits to emit air pollutants, use water resources, and to develop land. For water supply, water quality and wastewater, the stationary source must comply with:

> To obtain water service or a water right, applications are made to the appropriate local water provider or the State Water Resources Board. Water administered by a local agency may be obtained through an application process which may or may not require an environmental review. It may also require the facility to prove it meets a specified degree of water conservation. Water regulated by the state requires a **water right**, which is a lengthy public application process that requires CEQA compliance.
>
> To obtain wastewater service or a permit to discharge to surface waters, applications are made to the appropriate local wastewater provider or the State Water Resources Board. Local wastewater providers will require an engineering analysis to support issuance of a **Permit to Discharge** into the municipal sewer service.[34] Industrial facilities can also fall under a local agency's wastewater **Pretreatment Program**, which may require additional onsite pre-treatment of industrial wastewaters. Facilities with **Zero-Discharge Waste** systems may also have to obtain a local permit. Facilities that wish to discharge wastewater directly into surface waters must comply with the **National Pollutant Discharge Elimination System,** which is administered by the State Water Resources Control Board. This permit restricts magnitude and quality of discharges to avoid degradation of the receiving water body.

[34] In this case, the municipal wastewater treatment plant is the holder of the state permit to discharge to surface waters.

Depending on the scale and nature of water and wastewater associated with a facility, it may have to comply with **CEQA** to support its permit applications. CEQA requires proposed industrial facilities to analyze and describe the potential for environmental impacts, identify ways to reduce adverse impacts and offer alternatives to the project, and to disclose this information to the public. A Local, Regional, or State government agency serves as the lead or responsible agency for a CEQA document. Local, Regional, and State government agencies also both establish guidance for CEQA analyses and review documents for consistency with established plans and regulations. This process examines projects for localized impacts and proposes measures to mitigate significant impacts.

(I-1) Energy Efficiency and Co-Benefits Audits for Large Industrial Sources TBD $MMTCO_2E$

This measure is not anticipated to affect water resources, unless measures are identified and implemented that improve energy efficiency through improving water use efficiency.

Carbon Intensity Standard for Cement Manufacturers (Under Evaluation) 1.1-2.5 $MMTCO_2E$

Carbon Intensity Standard for Concrete Batch Plants (Under Evaluation) 2.5-3.5 $MMTCO_2E$

Waste Reduction in Concrete Use (Under Evaluation) 0.5-1 $MMTCO_2E$

Energy efficiency and blended cements are not expected to impact water resources. As with any sector where biofuels are being considered as alternatives to fossil fuels there is the potential to impact water supply and water quality.

Refinery Energy Efficiency Process Improvement (Under Evaluation) 2-5 $MMTCO_2E$

This measure is not anticipated to affect water resources, unless measures are identified that improve energy efficiency through improving water use efficiency.

Removal of Methane Exemption from Existing Refinery Regulations (Under Evaluation) 0.01-0.05 $MMTCO_2E$

This measure would not affect water resources, as methane is an air emission.

Oil and Gas Extraction GHG Emission Reduction (Under Evaluation) 1-3 $MMTCO_2E$

GHG Leak Reduction from Oil and Gas Transmission (Under Evaluation) 0.5-1.5 $MMTCO_2E$

This measure is not anticipated to affect water resources, as this measure addresses combustion and air emissions.

Industrial Boiler Efficiency (Under Evaluation) 0.5-1.5 $MMTCO_2E$

This measure is not anticipated to affect water resources.

Stationary Internal Combustion Engine Electrification (Under Evaluation-Revised) 0.1-0.05 $MMTCO_2E$

Under this measure that is under evaluation, electrification or distributed generation (combined heat and power systems) would replace some large fossil-fuel based combustion engines at

industrial facilities. Water effects would depend upon both the engine being replaced and the new source of electricity, but overall the impact on water resources is expected to be minimal.

Glass Plant Energy Efficiency—Equipment Efficiency and Use of Recycled Materials (Under Evaluation) 0.1-0.2 MMTCO$_2$E

This measure is not anticipated to affect water resources.

Off-Road Equipment (Under Evaluation) Up to 0.5 MMTCO$_2$E

This measure is not anticipated to affect water resources.

D. NATIVE SPECIES AND BIOLOGICAL RESOURCES

Currently there are 58 species on the endangered list in California. Growing population and associated development will also continue to stress California's native species and biological resources, by removing or impairing habitat, or severing habitat corridors. By 2020, several listed or endangered species have the potential to become extinct due to the continued degradation of the natural system. Pressures from population growth come from the development of land for population support infrastructure, the overharvesting of food species, the introduction of invasive species and predation by household pets, and other disturbances to natural features, like the alteration of stream flows.

The Attorney General has suggested that it is difficult to provide a general statement regarding the impacts the changing climate has on the State's varied ecosystems. It is clear that rising temperatures, altered water supplies, and other environmental variations will make some habitats less hospitable for sensitive plants and animals.

Regulatory Background

Native species and biological resources include native and introduced aquatic and terrestrial species, plants, and their habitats. Biological resources are regulated at both federal and state levels, and many water resource regulations also protect biological resources. These regulations help protect and recover resources, by requiring special review and permits of actions that may impact those resources.

Federal Laws and Regulations include:

> The **Endangered Species Act (ESA)** (16 U.S.C. 1531–1543) established a program for the conservation of threatened and endangered plants and animals and the habitats in which they are found. The U.S. Fish and Wildlife Service (FWS) of the Department of the Interior maintains a worldwide list which includes 1574 endangered species (599 are plants) and 351 threatened species (148 are plants). Species include birds, insects, fish, reptiles, mammals, crustaceans, flowers, grasses, and trees. The law requires federal agencies, in consultation with the FWS and/or the U.S. National Oceanic and Atmospheric Administration (NOAA) Fisheries Service, to ensure that actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of designated critical habitat of such species. The law also prohibits any action that causes a "taking" of any listed species of endangered fish or wildlife.[35]
>
> The **Fish and Wildlife Coordination Act** (16 U.S.C. 661–666) requires government agencies to consult with FWS prior to modifying the waters or channel of a body of water, with a view to the conservation of wildlife resources. The Act also authorizes land and water acquisition by federal construction agencies for wildlife conservation and development.

[35] http://www.epa.gov/lawsregs/laws/esa.html

The **Coastal Zone Management Act** (16 U.S.C. 1456) establishes federal programs for the management of the nation's coastal resources and the Great Lakes in order to balance economic development with environmental conservation, and for the study of human influences on estuaries. The programs are administered by NOAA's Office of Ocean and Coastal Resource Management (OCRM).

State Laws and Regulations include:

The **California Endangered Species Act (CESA)** (Fish and Game Code § 2050 et seq.) was enacted to protect or preserve all native species of fishes, amphibians, reptiles, birds, mammals, invertebrates, and plants, and their habitats, threatened with extinction and those experiencing a significant decline which, if not halted, would lead to a threatened or endangered designation. The Department of Fish and Game (DFG) is charged with enforcing the Act and with issuing permits authorizing incidental "take" to otherwise lawful development projects.

The **Native Plant Protection Act** (Fish and Game Code § 1900–1913) was enacted to preserve, protect and enhance endangered or rare native plants of this state. Habitats are threatened with destruction, drastic modification, or severe curtailment, or because of commercial exploitation or by other means, or because of disease or other factors. DFG maintains a list of protected plants and negotiates agreements to protect threatened plants.

The **Natural Community Conservation Planning Act** (Fish and Game Code § 2800 et seq.) expands the Endangered Species Act to conserve natural communities at the ecosystem scale while accommodating compatible land use. The program seeks to anticipate and prevent the controversies and gridlock caused by species' listings by focusing on the long-term stability of wildlife and plant communities and including key interests in the process. This program is implemented by DFG.

The **California Coastal Act** (Public Resources Code § 30000, et seq.) is California's version of the federal Coastal Zone Management Act. To protect California's coastal resources, the California Coastal Commission reviews all proposed construction in the defined coastal zone.

Process of Evaluation

Where possible, ARB reviewed existing studies, environmental documentation, and regulatory documentation for pertinent information. Documentation and studies for existing activities were used to estimate expansion of those types of activities. Where no information was available, ARB consulted experts at state agencies, including at the Air Resources Board and Climate Action Team agencies. More detailed information about the recommended regulations and the measures under evaluation is provided in Appendix C of the Draft Scoping Plan, as well as in the discussion of the potential impact on air resources (Section 3A).

1. CALIFORNIA CAP-AND-TRADE PROGRAM LINKED TO WESTERN CLIMATE INITIATIVE

No direct impacts from the recommended measure were identified at this time that could adversely affect plant or animal species or the resources on which they rely as a result of a compliance-based trading program that complies with AB 32 requirements. Indirect impacts of this recommended measure would be evaluated as part of the rule development process.

2. TRANSPORTATION AND GOODS MOVEMENT

(T-1) Pavley I and Pavley II-Light-Duty Vehicle GHG Standards 31.7 MMT CO_2E
(T-3) Vehicle Efficiency Measures 4.8 MMT CO_2E

At times, the refining, marketing and distribution of gasoline adversely affects water quality due to leaks, spills, and wastewater discharge. These water quality impacts can also impair important habitat, or interfere with critical life-cycles of native species. Any reduction in fuel use would reduce the opportunity for such occurrences. Consequently, the ARB staff projects that the recommended measures could have a positive impact on biological resources.

(T-2) Low Carbon Fuel Standard 16.5 MMT CO_2E

At times, the refining, marketing and distribution of petroleum fuels adversely affects water quality due to leaks, spills, and wastewater discharge. These water quality impacts can also impair important habitat, or interfere with critical life-cycles of native species. Any reduction in petroleum fuel use would reduce the opportunity for such occurrences.

Some biofuels feedstocks have the potential to affect native species and biological resources, if feedstocks are produced though conversion of important habitat to agriculture or increase agricultural activities in species' corridors.

Hydrogen production and use should have little or no affect on native species and biological resources outside of any potential effects from its energy and water source.

(T-4) Ship Electrification at Ports 0.2 MMT CO_2E
(T-5) Goods Movement Efficiency Measures 3.5 MMT CO_2E

Ports affect the coastal and ocean environments, intersecting with shallow aquatic habitat and species, pelagic species including migrating mammals, and bird species. Some of these species are endangered or threatened. Species and habitats can be impacted by physical activity within or changes to their habitat, water quality degradation through wastes and accidental discharges, and through the introduction of invasive species by international vessels. Ports regularly undertake programmatic and project-level CEQA documentation for their proposed activities, and many coastal environments in California have special environmental regulations and oversight.

One maintenance practice to be considered in the commercial harbor craft measure is the use of anti-fouling products on the hulls to improve hull smoothness. The active ingredient of a number of anti-fouling products is copper. The copper is slowly leached out of the product and thereby inhibits the growth of species that foul vessel hulls. The potential adverse impacts to biological

resources are associated with the leached copper, particularly in harbors and marinas that are relatively shallow and experience a reduced level of water circulation. The use of anti-fouling products containing copper could negatively impact biological resources. ARB staff would promote the use of non-toxic anti-fouling products by vessel owner/operators and educate them about the dangers associated with other products. With non-toxic products, a vessel owner/operator would have to clean the hull more frequently than if they were to use copper-based anti-fouling products. However, non-toxic products do not need to be reapplied as often as copper-based products.

The recommended goods movement measures are to improve efficiencies in port activities to reduce GHG emissions. Many of these efficiencies could result in reduced fossil-fuel combustion. Reduced fossil-fuel combustion at ports has similar potential benefits described in the evaluation of measures T-1 and T-3. Improvements in ocean and harbor vessels could also potentially reduce regular and accidental discharges to water.

(T-6) Heavy Duty Vehicle GHG Emission Reduction – Aerodynamic Efficiency 1.4 MMT CO_2E

(T-7) Medium and Heavy-Duty Vehicle Hybridization 0.5 MMT CO_2E

(T-8) Heavy-Duty Engine Efficiency 0.6 MMT CO_2E

Measures T-6 and T-8 are not expected to affect native species or biological resources, as they are not expected to change the number of vehicles in 2020. Measure T-7 is estimated to avoid some fossil-fuel combustion, and in that respect could have benefits similar to measures T-1 and T-3.

(T-10) High Speed Rail 1 MMT CO_2E

The Draft Scoping Plan supports the implementation of a high speed rail system. The recommended HSR program has undergone environmental review under CEQA and NEPA. ARB reviewed this documentation for its analysis of biological resources. The programmatic EIR/EIS examined the impacts of the High Speed Rail on biological resources at a statewide level, finding that the HSR has the potential for significant impacts on biological resources and wetlands. This is largely due to the need for new infrastructure corridors in areas of biological resources. The PEIR/EIS identifies program design, mitigation, and further evaluation strategies to minimize these impacts.

Feebates (Under Evaluation) 4 MMT CO_2E

This measure considers financially incenting the transition from high-GHG emitting vehicles to low-GHG emitting vehicles by imposing a fee on the former and offering a rebate on the latter. This would have upstream impacts on biological resources similar to measures T-1 and T-3.

3. LOCAL GOVERNMENT AND REGIONAL TARGETS

Regulatory Background

Local governments have the authority to establish allowable land uses within their spheres of influence in **General Plans**. **Government Code § 65040.2** directs cities and counties to develop these comprehensive, long-term plans to guide future development.

The **California Land Conservation Act of 1965**, known as the Williamson Act, enables local governments to enter into contracts with private landowners to restrict properties to agricultural and open space activities.

CEQA requires General Plans to describe the potential for environmental impacts through a public process.

LAFCOs in each county adopt spheres of influence for each city within the county, and make determinations on changes to those boundaries. Their decisions can influence air quality in the way in which they allow additional development to occur.

(T-9) Local Government Actions and Regional Targets 2 MMT CO_2E

Development that emphasizes low impact, compact growth in urban areas can also emphasize biological-species friendly development, incorporation of wildlife corridors, conservation of open spaces and valuable habitat and reduced overall footprint. These types of activities would benefit biological resources and native species directly. Indirectly, reducing impacts on water quality and air quality could also benefit biological resources and native species.

Congestion Pricing (Under Evaluation) up to 1 MMT CO_2E
Pay-As-You-Drive Insurance Premiums (Under Evaluation) up to 1 MMT CO_2E
Indirect Source Rules for New Development (Under Evaluation) up to 1 MMT CO_2E
Programs to Reduce Vehicle Trips (Under Evaluation) up to 1 MMT CO_2E

The measures are proposed as mechanisms to reduce vehicle use and to encourage higher density developed areas. Increasing density also preserves land from development, and would complement measure T-9.

4. ELECTRICITY AND NATURAL GAS

Regulatory Background

For large energy facilities, the **CEC Certification process** serves as an equivalent to the otherwise required state and local permitting requirements. The CEC has authority to certify (permit) the construction and operation of thermal electric power plants 50 megawatts or larger and all related facilities. The site certification process provides a review and analysis of all aspects of a proposed project, including water supply availability and wastewater impacts, equivalent to the CEQA process. The process is also a public process. Smaller facilities with no potentially significant environmental impacts can apply for an exemption process, similar to a mitigated negative declaration approach under CEQA.

The CEC works with local governments to ensure a functionally equivalent permitting process. CEC prepare the necessary evaluation in a "Preliminary Staff Assessment", working with federal, state, and local government to ensure it provides the information needed for the respective agencies to approve the project and either serves as the appropriate permit or basis for the appropriate permit.

The State Water Resources Control Board's "**Water Quality Control Policy on the Use and Disposal of Inland Waters Used for Powerplant Cooling**" (Order No. 75-58) encourages the

use of alternative sources of cooling water and/or the use of alternative cooling technology. Alternative sources of cooling water identified in the policy include wastewater, irrigation return flows, and naturally brackish water. The policy also encourages the evaluation of dry or wet/dry cooling technology for those facilities that may require water from the Sacramento-San Joaquin River Delta. A fundamental purpose of this regulation is to protect species from impingement and entrainment by cooling tower intakes and from thermal discharges of cooling towers.

(E-1) Energy Efficiency and Conservation 15.2 MMTCO_2E
(CR-1) Energy Efficiency and Conservation 4.2 MMTCO_2E
Additional Energy Efficiency and Conservation (Under Evaluation) 4.8 MMT CO_2E

These measures are not expected to directly affect native species or biological resources. Avoided demand for electricity would potentially result in a reduction of the number of power plants constructed in the future, some of which may have developed in areas with important habitat.

(CR-3) Solar Water Heating 0.1 MMT CO_2E
Expansion of Solar Water Heating (Under Evaluation) 1 MMT CO_2E

These measures are not expected to affect native species or biological resources, as they are located in developed areas. Avoided demand for electricity would potentially result in a reduction of the number of power plants constructed in the future, some of which may have developed in areas with important habitat.

(E-4) Million Solar Roofs 2 MMT CO_2E
Expanded Million Solar Roofs (Under Evaluation) 1.3 MMT CO_2E

These measures are not expected to directly affect native species or biological resources, as they are located in developed areas. Avoided demand for electricity would potentially result in a reduction of the number of power plants constructed in the future, some of which may have developed in areas with important habitat.

(E-3) Increasing Combined Heat and Power 6.8 MMT CO_2E

This recommended measure would not directly impact native species or biological resources, as CHP systems would be installed in existing facilities. Avoided demand for electricity could potentially result in a reduction of the number of power plants constructed in the future, some of which may be developed in areas with important habitat.

(E-2) Renewables Portfolio Standard 21.2 MMT CO_2E

This recommended measure would increase the overall percentage of renewable energy sources such as wind, solar, biomass and geothermal, of each utility's energy sources. This requirement could be met through any potential mixture of renewable energy sources, and will most likely be driven by a number of factors, including the availability of renewable sources within the geographic region of each utility. For these reasons the benefits and impacts of each renewable resources are evaluated relative to natural gas, and are not individual quantified for potential air emissions.

Wind, solar, and geothermal facilities are located where they can best harness these resources, often in rural areas. Although biological resources and native species are best addressed on a

project-level basis, a higher-level analysis indicates that projects in rural areas and using greater amounts of land have a significantly greater potential for impacts than their urban, small acreage counterpoints.

Wind energy projects have potential direct and indirect impacts to birds and bats, including death. Siting and design of wind turbines and related infrastructure can minimize potential impacts. Advances in turbine and wind farm design have resulted in the use of fewer, more powerful turbines and better protection for birds. Wind project developers can also use guidelines developed by the California Energy Commission and the California Department of Fish and Game to evaluate and minimize these impacts.

A solar thermal plant requires around 50 times more land than combined-cycle natural gas-fueled power plant per MW. Construction activities associated with solar thermal plants disturb the land, and fencing can interfere with wildlife corridors. Specific impacts will depend on the biological characteristics of the land being developed for solar thermal plants, and sensitive populations and habitat should be avoided as a matter of state policy. The 2007 Environmental Performance Report from the California Energy Commission identifies and discusses the potentially significant and cumulative impacts of a large number of solar plants proposed on Bureau of Land Management (public) lands, including on sensitive species in the Mojave Desert. Projects located in areas where the vegetation and habitat have already been disturbed are preferable. There are also potential issues associated with uncompleted projects, where vast amounts of land are disturbed in facility preparation, but plants are not constructed. Nitrogen dioxide deposition from cooling towers can also degrade vegetation, which is generally mitigated through additional provision of habitat compensation.

There are no current large-scale **solar photovoltaic** plants operating in California, although there are several proposed. Photovoltaic plants use more land per MW than solar thermal plants, and about 80 times the acreage of a combined-cycle natural gas plant per MW. The 2007 Environmental Performance Report states that current technological advances may reduce the land footprint by up to 50 percent. Affects on biological resources and native species would be determined by the location of the plant.

Biomass (forest or agricultural residuals), **anaerobic digesters**, and combustion of **landfill** gases are not expected to affect biological resources and native species outside of their physical construction impacts.

Geothermal projects are frequently located in rural areas and undisturbed areas, but have a relatively small footprint. It is possible that new projects would impact biological resources and would be required to reduce or minimize those impacts through habitat compensation. Nitrogen dioxide deposition from cooling towers can also degrade vegetation.

Small hydropower projects could potentially affect biological species and native species, if they are present in the already-disturbed habitat that manmade channels may provide.

New transmission infrastructure can also impact biological resources and native species through habitat disturbance and alteration (during and following construction) and through direct harm of

birds and bats from operating power lines. The RETI project is examining these issues and is expected to have recommendations this year.

Coal Emission Reduction Standard (Under Evaluation) Up to 8 MMT CO_2E

The operation of coal plants has associated air emissions and local depositions of selenium, mercury, and other toxics, as well as sulfates and nitrates. These toxics, nitrates and sulfates have the potential to impact biological resources and native species. Acid mine drainage and habitat destruction associated with coal mining also pose significant impacts to local biological resources and native species. Reducing coal-fired power plants in the future could potentially avoid these types of impacts in new locations. Replacement of those plants with energy sources in California could result in affects on biological resources and native species. Types and scale of effects are described in the evaluation of measure E-2.

7. INDUSTRY

Regulatory Background

Before a facility can be constructed, it must obtain various permits to emit air pollutants, use water resources, and to develop land. If the proposed facility construction occurs in a location with identified habitat or species, or occurs in the vicinity of a surface water or protected area, the stationary source must comply with:

> **CEQA** requires proposed electricity and natural gas facilities to analyze and describe the potential for environmental impacts, identify ways to reduce adverse impacts and offer alternatives to the project, and to disclose this information to the public.

(I-1) Energy Efficiency and Co-Benefits Audits for Large Industrial Sources TBD MMTCO_2E

These measures are not expected to affect native species or biological resources, as all actions would occur on already developed lands.

Carbon Intensity Standard for Cement Manufacturers (Under Evaluation) 1.1-2.5 MMTCO_2E

Carbon Intensity Standard for Concrete Batch Plants (Under Evaluation) 2.5-3.5 MMTCO_2E

Waste Reduction in Concrete Use (Under Evaluation) 0.5-1 MMTCO_2E

Energy efficiency and blended cements are not expected to impact biological resources. As with any sector where biofuels are being considered as alternatives to fossil fuels there is the potential to impact biological resources through changes in land and water resources.

Refinery Energy Efficiency Process Improvement (Under Evaluation) 2-5 MMTCO_2E

Removal of Methane Exemption from Existing Refinery Regulations (Under Evaluation) 0.01-0.05 MMTCO_2E

These measures are not expected to affect native species or biological resources, as all actions would occur on already developed lands.

Oil and Gas Extraction GHG Emission Reduction (Under Evaluation) 1-3 $MMTCO_2E$
GHG Leak Reduction from Oil and Gas Transmission (Under Evaluation) 0.5-1.5 $MMTCO_2E$

These measures are not expected to affect native species or biological resources, as all actions would occur on already developed lands.

Industrial Boiler Efficiency (Under Evaluation) 0.5-1.5 $MMTCO_2E$
Stationary Internal Combustion Engine Electrification (Under Evaluation-Revised) 0.1-0.5 $MMTCO_2E$

These measures are not expected to affect native species or biological resources, as all actions would occur on already developed lands.

Glass Plant Energy Efficiency—Equipment Efficiency and Use of Recycled Materials (Under Evaluation) 0.1-0.2 $MMTCO_2E$

This measure is not expected to affect native species or biological resources, as all actions would occur on already developed lands.

Off-Road Equipment (Under Evaluation) Up to 0.5 $MMTCO_2E$

This measure is not expected to affect native species or biological resources, as the number of vehicles and equipment would not change as a result of this measure.

E. WASTE DISPOSAL AND HAZARDOUS WASTE

Regulatory Background

Solid waste and hazardous materials are regulated at a federal level by the U.S. EPA.

> Solid and hazardous waste management is regulated through the **Resource Conservation and Recovery Act** (RCRA, Title 40 of the Code of Federal Regulations parts 239 through 299)**.** RCRA established a solid waste program (subtitle D) that set guidelines for solid waste management and disposal facilities and prohibits open dumping; a hazardous waste program (subtitle C) which established a "cradle to grave" approach of hazardous material handling; and an underground storage tank program (subtitle I) that regulates tanks storing hazardous substances and petroleum products.

States have developed permitting programs to implement RCRA. In California, there are a number of statutes:

> **Title 14 of the California Code of Regulations (CCR)** enacted the State's solid waste management program. **Title 27 CCR** imposes restrictions on land disposal to protect water resources. The California Integrated Waste Management Board (CIWMB) is the state agency charged with overseeing enforcement of these regulations. Local agencies are responsible for developing, implementing, and enforcement waste management programs that are certified and enforced by the CIWMB.
>
> The Department of Toxic Substances Control (DTSC) implements and enforces California's hazardous materials management program **(Title 22 Division 4.5 CCR)**, in conjunction with Certified Unified Program Agencies (CUPA). Hazardous materials are codified as materials that are toxic, reactive, ignitable or corrosive and have special disposal requirements. Hazardous materials are tracked from generator to waste facility, and handlers have to meet tracking and handling requirements.

Process of Evaluation

Where possible, ARB reviewed existing studies, environmental documentation, and regulatory documentation for pertinent information. Documentation and studies for existing activities were used to estimate expansion of those types of activities. Where no information was available, ARB consulted experts at state agencies, including at the Air Resources Board and Climate Action Team agencies. More detailed information about the recommended regulations and the measures under evaluation is provided in Appendix C of the Draft Scoping Plan, as well as in the discussion of the potential impact on air resources (Section 3A).

1. CALIFORNIA CAP-AND-TRADE PROGRAM LINKED TO WESTERN CLIMATE INITIATIVE

The recommended measure is not anticipated to result in a substantial increase in the generation of solid or hazardous wastes. There may be a potential for GHG emission reduction technologies to result in the use of hazardous materials (e.g., ammonia from electricity generation). The cap and trade program will comply with the environmental considerations required by AB 32 as well

as existing state and federal regulations. As part of the regulatory development of this measure, this potential will be further examined.

2. TRANSPORTATION AND GOODS MOVEMENT

(T-1) Pavley I and Pavley II-Light-Duty Vehicle GHG Standards 31.7 MMT CO_2E
(T-3) Vehicle Efficiency Measures 4.8 MMT CO_2E

These measures are not expected to affect waste disposal or hazardous materials, as they do not recommend significantly or materially changing vehicles. Reduced upstream transport of fuels would reduce the potential for accidental spills.

(T-2) Low Carbon Fuel Standard 16.5 MMT CO_2E

Biodiesel: Biodiesel production uses sodium hydroxide, hexane, sulfuric acid, and methanol. These will be present in any waste generated and stearates are also likely generated during the esterification process. An EIR for a Biodiesel facility in CA lists: "Glycerol Disposal– The glycerol by-product contains unused catalyst, salt, water, methanol, and soaps that the facility is planning to dispose of as a dust inhibitor for roads or used for producing hydrogen." Biodiesel biodegrades much more rapidly than regular diesel.

Ethanol: Current state-of-the-art dry milling plants are expected to generate minimal waste, including little to no waste water (due to recycling). EIRs for facilities indicate hydraulic oil as being the only hazardous waste that needs disposal.

Hydrogen: Precious metals, such as platinum, are expected to be recovered from fuel cells at the end of their useful life. Carbon fiber used in hydrogen tanks is highly valuable as a recycled material.

(T-4) Ship Electrification at Ports 0.2 MMT CO_2E
(T-5) Goods Movement Efficiency Measures 3.5 MMT CO_2E

These measures are not expected to affect waste disposal or hazardous materials, as they do not recommend significantly or materially changing vehicles, vessels, structures, or equipment. Reduced upstream transport of fuels would reduce the potential for accidental spills.

(T-6) Heavy Duty Vehicle GHG Emission Reduction – Aerodynamic Efficiency 1.4 MMT CO_2E
(T-7) Medium and Heavy-Duty Vehicle Hybridization 0.5 MMT CO_2E
(T-8) Heavy-Duty Engine Efficiency 0.6 MMT CO_2E

These measures are not expected to affect waste disposal or hazardous materials, as they do not recommend significantly or materially changing vehicles. Reduced upstream transport of fuels would reduce the potential for accidental spills.

(T-10) High Speed Rail 1 MMT CO_2E

The Draft Scoping Plan supports the implementation of a high speed rail system. The recommended HSR program has undergone environmental review under CEQA and NEPA. ARB reviewed this documentation for its analysis of biological resources. The programmatic EIR/EIS examined the impacts of the High Speed Rail on waste and hazardous resources at a

statewide level, finding no specific statewide impacts on waste and hazardous materials, but identifying the need to further evaluate this issue through the subsequent project-level EIR/EIS.

Feebates (Under Evaluation) 4 MMT CO_2E

This measure considers financially incenting the transition from high-GHG emitting vehicles to low-GHG emitting vehicles by imposing a fee on the former and offering a rebate on the latter. This would have upstream impacts on land resources similar to measures T-1 and T-3.

3. LOCAL GOVERNMENT AND REGIONAL TARGETS

(T-9) Local Government Actions and Regional Targets 2 MMT CO_2E

Reductions in vehicle miles traveled would have effects similar to those described for vehicle measures (T-1, T-3).

Congestion Pricing (Under Evaluation) up to 1 MMT CO_2E
Pay-As-You-Drive Insurance Premiums (Under Evaluation) up to 1 MMT CO_2E
Indirect Source Rules for New Development (Under Evaluation) up to 1 MMT CO_2E
Programs to Reduce Vehicle Trips (Under Evaluation) up to 1 MMT CO_2E

Reductions in vehicle miles traveled would have effects similar to those described for vehicle measures (T-1, T-3).

4. ELECTRICITY AND NATURAL GAS

(E-1) Energy Efficiency and Conservation 15.2 MMTCO_2E
(CR-1) Energy Efficiency and Conservation 4.2 MMTCO_2E
Additional Energy Efficiency and Conservation (Under Evaluation) 4.8 MMT CO_2E

Appliance and building efficiency standards are designed to reduce energy and water consumption. Overall, the appliance and building turnover rate would not change with this recommended measure, so the production of waste would not be accelerated. Efficiency standards occasionally result in the use of new or new versions of products that contain hazardous materials and require special recycling. One example of this is the fluorescent lamp, which uses a small amount of mercury vapor. To minimize impacts on the environment and landfills, new technologies are being researched and consumers are being encouraged to recycle the lamps.

(CR-3) Solar Water Heating 0.1 MMT CO_2E
Expansion of Solar Water Heating (Under Evaluation) 1 MMT CO_2E
(E-4) Million Solar Roofs 2 MMT CO_2E
Expanded Million Solar Roofs (Under Evaluation) 1.3 MMT CO_2E

In operation, solar water heaters do not produce any waste materials. However, some solar cell manufacturing requires trace amounts of potentially toxic chemicals, and many solar cells are being manufactured in California. The Public Interest Energy Research Program of the California Energy Commission investigated this issue and concluded:

> "The greatest environmental risk with silicon cells is associated with the use of gases (arsine and phosphine) during the manufacturing process. Thin-film technologies, such as cadmium

telluride cells and copper indium diselenide cells, are being developed to increase conversion efficiency and decrease production costs. The most likely routes for environmental release of trace elements are from accidental spills during the manufacturing process. At sites with installed PV modules, release of trace elements from sealed modules is unlikely except due to explosion or fire. Leaching of trace metals from modules is not likely to present a significant risk due to the sealed nature of the installed cells and the plan for recycling of spent modules in the future."[36]

(E-3) Increasing Combined Heat and Power 6.8 MMT CO_2E

Waste or hazardous materials associated with combined heat and power systems are a function of the fuel used for the system. Natural gas would not produce physical waste. Potential waste impacts of biomass, solar, wind, and fuel cells are discussed in the Electricity and Natural Gas section.

(E-2) Renewables Portfolio Standard 21.2 MMT CO_2E

Wind projects do not generate waste during operation, or require hazardous materials for construction.

Solar thermal plants do not produce any waste materials or require toxic or hazardous materials to manufacture. **Photovoltaic** operation and manufacturing is discussed under measures CR-3 and E-4.

Biomass energy is a promising use of waste to create energy and reduce the lands needed for landfill, or the air pollutants associated with open-air combustion. Waste materials used for biomass include corn stover, rice hulls, wheat straw, orchard prunings, forest residuals wooden construction debris, and yard and tree trimmings. The combustion by-product (ash) can be mixed with soils for use as landfill cover, or in pavement aggregate.

Anaerobic digestion is a form of biological waste processing that destroys harmful biological microorganisms, reduces odors, and physically reduces overall waste mass. This anaerobic process produces methane that would otherwise need to be combusted.

Landfill gas is a byproduct of our current waste management practices, which can be harvested either as natural gas or through combustion.

Municipal solid waste may contain hazardous materials, which could result in solid and gaseous hazardous by-products. Air emissions and ash can be treated to reduce this hazard, ash can be shipped to special landfills, or hazardous materials can be diverted from the waste prior to combustion.

Geothermal projects do not produce waste or hazardous materials, other than those described in the air and water resources sections.

[36] *Potential Health and Environmental Impacts Associated with the Manufacture and Use of Photovoltaic Cells,* EPRI, Palo Alto, CA, and California Energy Commission, Sacramento, CA:2003, 1000095.

Small hydropower projects do not generally have any waste or hazardous materials impacts.

Coal Emission Reduction Standard (Under Evaluation) Up to 8 MMT CO_2E

Switching from coal to other sources of energy also offers some waste benefits: Coal mining, processing, and combustion all have waste products associated with them that are regulated by the U.S. EPA and by the Office of Surface Mining, Reclamation and Enforcement under the United States Bureau of Reclamation. Some combustion byproducts, such as fly ash, are currently repurposed in construction, mine reclamation, and landscaping applications. Several environmental groups are currently petitioning the U.S. EPA to regulate coal combustion byproducts.[37]

7. INDUSTRY

(I-1) Energy Efficiency and Co-Benefits Audits for Large Industrial Sources TBD MMTCO_2E

The potential energy efficiency improvements that may result from this measure are not expected to impact waste disposal.

Carbon Intensity Standard for Cement Manufacturers (Under Evaluation) 1.1-2.5 MMTCO_2E

Carbon Intensity Standard for Concrete Batch Plants (Under Evaluation) 2.5-3.5 MMTCO_2E

Waste Reduction in Concrete Use (Under Evaluation) 0.5-1 MMTCO_2E

The potential energy efficiency improvements associated with these measures under evaluation are not expected to impact waste disposal. Blended cements could reduce problems associated with the disposal fly ash and slag by recycling those materials.

Refinery Energy Efficiency Process Improvement (Under Evaluation) 2-5 MMTCO_2E

Removal of Methane Exemption from Existing Refinery Regulations (Under Evaluation) 0.01-0.05 MMTCO_2E

These measures are not expected to affect waste disposal or hazardous materials.

Oil and Gas Extraction GHG Emission Reduction (Under Evaluation) 1-3 MMTCO_2E

GHG Leak Reduction from Oil and Gas Transmission (Under Evaluation) 0.5-1.5 MMTCO_2E

These measures are not expected to affect waste disposal or hazardous materials.

Industrial Boiler Efficiency (Under Evaluation) 0.5-1.5 MMTCO_2E

This measure could potentially accelerate the turnover of industrial boilers, in favor of newer models or fuel cell systems. This is not anticipated to have a significant effect on waste disposal.

Stationary Internal Combustion Engine Electrification (Under Evaluation-Revised) 0.1-0.5 MMTCO_2E

This measure is not expected to affect waste disposal or hazardous materials.

[37] Earthjustice, et. al., *Proposal for the Federal Regulation of Coal Combustion Waste*, January 2007.

Glass Plant Energy Efficiency—Equipment Efficiency and Use of Recycled Materials (Under Evaluation) 0.1-0.2 MMTCO$_2$E

This measure under evaluation proposes the use of additional cullet (waste glass) in container glass manufacturing and fiberglass manufacturing, which would reduce the amount of raw material needed for the processes, and reduce the overall waste disposal needs.

Off-Road Equipment (Under Evaluation) Up to 0.5 MMTCO$_2$E

This measure is not expected to affect waste disposal or hazardous materials.

4. PUBLIC HEALTH AND SAFETY

Public health and safety in California can be expected to be adversely impacted by climate change. Several recent studies have addressed potential implications for human health at the national and international levels.[38] Greater climate variability and changes in climate patterns would potentially cause both direct and indirect health effects. Direct health and safety impacts would result from extreme events, such as heat waves, droughts, increased fire frequency, and increased storm intensity resulting in flooding and landslides. Secondary or indirect health effects would be associated with damages to infrastructure that cause, for example, sanitation and water treatment problems that increase water-borne infections. Air quality impacts such as increases in tropospheric ozone due to higher temperatures would also have health impacts.

A. AIR QUALITY AND PUBLIC HEALTH

ARB has many program and plans that are designed to identify and mitigate public health problems due to air quality throughout the State. ARB has identified harbor communities and sensitive populations as a priority when addressing toxic and criteria air contaminants. The Draft Scoping Plan builds on ARB's priorities and on-going efforts to reduce air pollution. Within this environmental evaluation ARB staff has quantified, where possible, the potential changes to NOx, VOC, primary and secondary PM2.5, and air toxics that would result from implementation of the recommended measures and measures under evaluation in the Draft Scoping Plan.

For this section of the evaluation, staff estimated the health impacts associated with PM2.5 exposure on a State level. This evaluation focuses on PM 2.5 because this pollutant accounts for the majority of premature deaths associated with air pollution in California. Although we have estimated statewide changes to emissions of key criteria pollutants in 2020, we have not specifically assigned emission changes to individual facilities or transportation corridors. Because of this, we cannot reliably model future air quality conditions across the state. Without such modeling, it is difficult to estimate health outcomes of criteria pollutants like ozone, whose chemistry is highly dependent on precursors and weather conditions and whose health outcomes are highly dependent on length and magnitude of exposure.

We have estimated statewide health outcomes for PM2.5 because the sources of PM2.5 are distributed in similar proportions and patterns to populations, and are not strongly dependent on meteorology for their formation or for their direct emission and exposure pathways. Staff based the evaluation on the GMERP public health methodology, which is provided as a reference in Attachment F. The GMERP methodology is based on diesel sources of PM2.5, and the majority of criteria pollutant reductions from the Draft Scoping Plan are from diesel sources. There are many assumptions made in this exercise which add to the uncertainty of the estimates, including translating regional emission and health outcome information to statewide information, estimating criteria pollutant reductions for measures, and assuming that emissions and exposures are geographically proportional. This analysis is intended to provide the public with comparative information on the recommended measures.

[38] Patz et al., 2000.

Regulatory Background

ARB's first priority continues to be the protection of public health, and now it joins with other agencies, states, and countries to protect public health on a global level, through the reduction of greenhouse gases. All of the recommended measures and measures under evaluation in this Draft Scoping Plan are designed to reduce greenhouse gases, and many of these measures would also contribute to ARB's goals of reducing criteria pollutants and toxic air contaminants. Some of the recommended measures may result in minor increases to co-pollutants, but these minor increases must be evaluated in the overall context of both the AB 32 program and existing ARB programs, which are briefly described below:

Federal clean air laws require areas out of attainment with national ambient air quality standards to prepare **State Implementation Plans (SIP)** identifying actions to bring areas into compliance in a set timeframe. Under State law, ARB has the responsibility to develop SIP strategies for mobile sources and consumer products, to coordinate SIP strategies with the Bureau of Automotive Repair and the Department of Pesticide Regulation, and to oversee local district programs for stationary sources. In 2007, ARB adopted the State Strategy for Implementation of Ozone and PM2.5 Standards.

The **Air Toxics "Hot Spots" Information and Assessment Act** (AB 2588, 1987, Connelly) requires stationary sources to report the types and quantities of certain substances routinely released into the air. The goals of the Air Toxics "Hot Spots" Act are to collect emission data, to identify facilities having localized impacts, to ascertain health risks, to notify nearby residents of significant risks, and to reduce those significant risks. The public has access to facility emissions and risk data for specific facilities. The "Hot Spots" Act also requires local air districts to prioritize which facilities must perform a health risk assessment based on the potency, toxicity, and quantity of emissions released from the facility to determine if the facility poses a significant risk. High-risk facilities must reduce their toxic emissions and risk to acceptable levels that are determined by the local air districts. District annual reports summarize the results and progress of health risk assessments, and rank and identify facilities that pose a risk to public health.[39]

An important source of directly emitted PM2.5 is diesel exhaust. The particulate matter from diesel-fueled engines (diesel PM) was identified as a toxic air contaminant by the ARB in 1998. Nearly 70 percent of the known cancer risk caused by air toxics in California is attributed to diesel PM. In 2000, ARB adopted a **Diesel Risk Reduction Plan** to reduce diesel PM emissions by 85 percent by 2020. ARB has since adopted a number of regulatory measures to reduce diesel PM emissions statewide including requirements for in-use trash trucks, public agency-owned trucks, buses, stationary engines, transportation refrigeration units, cargo handling equipment, and off-road equipment. ARB will soon consider adoption of a regulation to reduce emissions from in-use heavy-duty trucks. Diesel control measures reduce both direct diesel PM and NOx emissions through a combination of engine retrofits and replacements. Upcoming mobile source fleet measures to reduce diesel PM and NOx emissions are a critical part of the new State Implementation Plan strategy, Diesel Risk Reduction Plan, and the Draft Scoping Plan.

The **Emission Reduction Plan for Ports and Goods Movement in California (GMERP)**, approved by ARB in April 2006 identified key new measures necessary to meet federal air

39 http://www.arb.ca.gov/ab2588/reports.htm

quality standards and reduce health risk in communities near ports and railyards. Ships are the largest source of SOx emissions in the State. Heavy-duty trucks move most goods within and through the state, and are the largest statewide source of NOx emissions. This makes it essential to address goods movement emissions in order to meet PM2.5 air quality standards. Likewise, emission reduction targets for ozone will not be met without reducing emissions related to goods movement.

The strategies included in the GMERP target ships and trucks, as well as the other three main sources of goods movement emissions: harbor craft, cargo handling equipment, and locomotives. By 2020, these strategies will cut statewide goods movement emissions of NOx by 63 percent, SOx emissions by 78 percent, and will also reduce the statewide health risk from goods movement-related diesel particulate matter by 85 percent.

Many of the strategies in the GMERP are adopted and will provide essential new emission reductions needed for regional attainment, while they reduce the air pollution-related health risk for those who live near our ports, rail yards, distribution centers, and other goods movement facilities.

In addition, ARB's **Harbor Communities Monitoring Study (HCMS)** is designed to improve tools for measuring pollutant concentrations in the air and detecting areas where concentrations of these pollutants are high. This study consists of three types of air pollution sampling: a network of passive samplers, a mobile platform, and a network of particle counters. The sampling will characterize temporal and spatial variations of air pollution in the study region. The sampling was conducted during 2007. The pollutants being measured include, but are not limited to black carbon, carbon monoxide, nitrogen oxides, particulate matter, ultrafine particles, volatile organic chemicals, and hydrogen sulfide.

The communities being studied include Wilmington and parts of San Pedro, West Long Beach, and Carson. These communities were chosen because of the emission sources in the area and the close proximity of residents to these emission sources. The Harbor Communities are located just north of the Ports of Los Angeles and Long Beach, which handle 40 percent of all container traffic entering the United States; the area is also surrounded by some of the most heavily traveled freeways in Southern California, is home to several large refineries, and a number of rail facilities.

Health Impacts of Ozone (Criteria Pollutant)

The formation and health impacts of ozone are well studied.[40] Ozone is a highly reactive gas that forms in the atmosphere through reactions between chemicals emitted from motor vehicles, industrial plants, consumer products and many other sources. It forms in greater quantities on hot, sunny, calm days making the summer season the key exposure period.

Considerable research over the past 35 years has investigated how people respond to inhaling ozone. These studies have consistently shown that inhalation of ozone can lead to inflammation and irritation of the tissues lining the human airways. This causes inflammation and also causes

[40] CARB, 2005; Anderson, et al, 2004; Thurston, et al 2001; Stieb, et al, 2003; Bell et al, 2004; Levy et al, 2001; and Gryparis, et al, 2004.

the muscle cells in the airways to constrict, thus reducing the amount of air that can be inhaled. Symptoms and responses to ozone exposure vary widely, even when the amount inhaled and length of exposure is the same. Typical symptoms include cough, chest tightness, and increased asthma symptoms. Ozone in sufficient doses can also increase the permeability ("leakiness") of lung cells, making them more susceptible to damage from environmental toxins and infection.

Studies of large populations have found that ozone exposure is associated with an increase in hospital admissions and emergency room visits, particularly for lung problems such as asthma and chronic obstructive pulmonary disease. Several studies have also associated ozone exposure with increased premature mortality in elderly people with chronic diseases of the lungs and circulatory system.

People who exercise or work outdoors are at greater risk of experiencing adverse health effects from ozone exposure because they inhale more ozone. Some evidence has linked the onset of asthma to exposure to elevated levels of ozone in exercising children. Children and adolescents are at increased risk because they are more likely to spend time outdoors engaged in vigorous activities than adults and because they inhale more ozone per pound of body weight.

In order to protect public health, the federal government previously set the national ozone standard at 0.08 parts per million for 8 hours, not to be exceeded, based on the fourth highest concentration averaged over three years. ARB and local air districts have proposed a State Implementation Plan describing the strategies and measures that California will pursue to reduce ozone.[41] However, in March 2008, due to new studies that show health effects at lower concentrations of ozone, U.S. EPA set a new 8-hour ozone standard at 0.075 parts per million. States have less than one year (from March 27, 2008) to provide air quality information to U.S.EPA, which will be used to designate non-attainment areas by 2010. By 2011, states must submit SIPs demonstrating how they will attain the new, more stringent, standard.

Health Impacts of PM2.5 (Criteria Pollutant)

Particulate matter (PM) air pollution is also well studied. Particulate matter pollution is a complex mixture that consists of dry solid fragments, solid cores with liquid coatings, and small droplets of liquid. PM can be directly emitted into the air in forms such as dust and soot. It can also be formed in the atmosphere from the reaction of various gases. Inhalable particulate matter is less than 10 microns in diameter (a micron is one-millionth of a meter) and is called PM10. Even smaller particles, those 2.5 microns or less in diameter, are called "fine particles" or PM2.5. PM2.5 is a component of PM10. Diesel PM is particulate matter emitted from diesel-fueled combustion; diesel PM has been classified as a TAC by ARB.

Extensive research has shown that PM can be inhaled into the deep portions of the lungs. Some inhaled particles are exhaled again, but others deposit in the lungs, which can lead to inflammation in both the lungs and the circulatory system. Fine particulate matter may also pose an increased health risk as it can penetrate deeper into the lungs.

Population-based studies in hundreds of cities around the world have demonstrated a strong link between exposure to elevated particulate matter levels and premature death, especially in people

41 http://www.arb.ca.gov/planning/sip/2007sip/2007sip.htm

with pre-existing heart or lung disease. The two most relevant of these studies were performed in many cities in the United States, and have been ongoing for over 15 years. Both of these studies found a strong relationship between long-term PM exposure and premature death.

Scientists have observed higher rates of hospitalization, emergency room visits and doctor's visits for respiratory illnesses or heart disease during times of high PM concentrations. During these periods of high PM levels, scientists also observed the worsening of both asthma symptoms and acute and chronic bronchitis, and reductions in various measures of lung function.

The elderly and people with heart and/or lung diseases are particularly at risk of experiencing adverse effects from PM exposure. Studies have also shown that children may be particularly vulnerable to PM effects. There is evidence from the ongoing Children's Health Study, funded by the ARB for over ten years, that in communities with high levels of PM children's lungs develop more slowly and that at maturity they tend to have lower lung capacity than children who grow up in communities with lower levels of PM. Just as with ozone, children and infants may also be more at risk of experiencing adverse effects from PM because they inhale more air per pound of body weight than do adults, they breathe faster, and have smaller body sizes. In addition, there is some evidence that children's developing immune systems may cause them to be more susceptible to the effects of PM than adults.

Health Outcomes

ARB most recently updated its methodology for quantifying the health impacts of fine particulate matter during the development of the Goods Movement Emissions Reduction Plan (GMERP). This methodology has been peer-reviewed during the development of the GMERP. To develop quantitative health outcome estimates in the GMERP, ARB reviewed relevant scientific literature on health impacts associated with air pollution exposure and chose a subset of the studies based on strength of methodology and applicability to California residents or conditions. From these studies, concentration-response functions,[42] a measure of observed relative risk, and the associated error terms (95 percent confidence intervals) were obtained for the following health outcomes:

- **Premature death:** A death that occurs at a younger age than would be expected. Air pollution is not implicated as the *cause* of death, but rather a contributing factor in someone whose health is typically already compromised, thereby accelerating the time of death by about 14 years.
- **Hospital admissions for respiratory and cardiovascular causes:** Hospitalization admissions for conditions including pneumonia, chronic obstructive pulmonary disease (COPD), asthma, heart attack, stroke, congestive heart failure and cardiac arrhythmia.
- **Asthma and lower respiratory symptoms:** Symptoms such as cough, phlegm production, chest pain, or wheeze, associated with the lower respiratory tract (windpipe, lungs, and airways leading to/associated with the lungs).
- **Acute bronchitis:** Inflammation of the main airways to the lungs, resulting in symptoms such as hacking cough and phlegm production.
- **Work loss days:** Days of missed work for members of the population age 18 through 65.

[42] A concentration-response function relates changes in exposures to ambient concentrations of a pollutant to changes in an adverse health effect.

- **Minor restricted activity days:** Days when a person is not able to engage in their usual range of activities due to minor health conditions. This does not include work loss or bed confinement.

The methodology that ARB uses for quantifying premature death and other health outcomes from PM exposure is similar to a peer-reviewed methodology developed by the U.S. EPA[43] for their risk assessments. This methodology is regularly updated by ARB staff as new epidemiological studies and other related studies are published that are relevant to California's health impacts analysis.

Estimation/Quantification Process

For this analysis, ARB used a methodology similar the GMERP process, which is described in Attachment E.

Estimated Health Outcomes

For this initial version of the public health evaluation of the Draft Scoping Plan, ARB focused on the criteria pollutant reductions estimated for the recommended regulations in the transportation and electricity and natural gas sectors. The health outcomes estimated for these sectors are presented in Table 7.

Table 7: Estimates of Statewide Health Benefits in 2020*
(number of cases)

Health Endpoint	**Health Benefits of Existing Measures and 2007 SIP** *mean*	**Health Benefits of Recommended Draft Scoping Plan Measures (Transportation and Electricity and Natural Gas Sectors)** *mean*
Avoided Premature death	3,700	320
Avoided Hospital admissions for respiratory causes	770	67
Avoided Hospital admissions for cardiovascular causes	1,400	120
Avoided Asthma and lower respiratory symptoms	110,000	8,800
Avoided Acute bronchitis	8,700	730
Avoided Work loss days	620,000	53,000
Avoided Minor restricted activity days	3,600,000	310,000

* Uncertainty intervals for each estimated benefit range within 20-70 percent of the mean benefit (presented in this table). For example, the number of premature deaths avoided due to the scoping plan could be between 88 to 550.

[43] U.S. Environmental Protection Agency, *Regulatory impact analysis for the final Clean Air Interstate Rule*, Office of Air and Radiation, EPA-452/R-05-002, 2005.

B. OTHER POTENTIAL PUBLIC HEALTH AND SAFETY ISSUES

Electric, Hydrogen, and Hybrid Vehicles: High voltage wiring within electric-drive vehicles must be handled appropriately in the case of an accident. Emergency response personnel are trained to identify high voltage wiring to avoid electric shock in the case of an extraction. Hydrogen appears to be as safe as gasoline as a vehicle fuel. Hydrogen is extremely light and buoyant, so it dissipates into the open air very quickly, making any flammable concentration of hydrogen unlikely.

High Speed Rail: The High Speed Rail PEIR/EIS evaluated the potential for public safety issues related to electromagnetic frequency exposures due to the wireless communication system associated with the project. The evaluation concludes that the potential adverse effects could be avoided or mitigated to a less-than-significant level.

Regional GHG Targets: Various studies suggest that community design has an impact on public health. A greater mix of land uses in a neighborhood can produce a number of public health benefits. A more diverse neighborhood can reduce trips and therefore facilitate walking, biking, and use of transit. Studies show that more compact development is correlated with increased walking and transit trips. Additionally, public health research has shown that there is a direct connection between compact development and lower boy mass indices, lower levels of obesity and decreased instances of hypertension. Although there are limitations with the studies, the findings suggest that low impact development may improve quality of life in many ways. The following co-benefits represent just a few of the many improvements in quality of life.[44]

Social capital has various components. It is generally described as the sense of belonging and civic participation experienced in a community. It is a series of social networks that provide trust and reciprocity and promote cultural and political life. Studies indicate that social capital may increase as people spend less time alone in their vehicles due to improved transportation planning and conducive land uses.[45] Improved social capital has been linked with improved mental health, prolonged life and better overall health.[46] More pedestrian- and cyclist-friendly development and amenities may also help to increase public safety, furthermore strengthening community ties.

There are also many potential health benefits, such as increased access to health care via public transit for people without access to vehicles, and decreased violence and pedestrian injuries and fatalities due to more pedestrian- and cyclist-friendly development. As open spaces and desirable locations (such as shopping, entertainment, schools, etc) become more plentiful, proximate and accessible to pedestrians and cyclists, residents are likely to increase their levels of physical activity. Moderate physical activity reduces many serious health risks, including coronary heart disease, diabetes mellitus, hypertension, anxiety and depression, and obesity.

[44] Many of these benefits are taken from the CCAP report "CCAP Transportation Emissions Guidebook" (http://www.ccap.org/safe/guidebook/guide_complete.html) and "Understanding the Relationship Between Public Health and the Built Environment" report prepared for the LEED-ND Core Committee.
[45] Sullivan and Kuo 1996, Community & Environment Design, 2006.
[46] Ibid.

Access to green space has also been shown to lessen the impacts of mental fatigue and improve cognitive functioning in children.[47]

Decreased commute times and traffic congestion lessen driver-induced stress and the amount of traffic injuries and fatalities. Less vehicle use translates into improved air quality and reductions in adverse health impacts, such as death, cancer and exacerbation of asthma, which are most realized in particularly vulnerable populations, the elderly, the young and the health-impaired.

In order to bring about positive change, as well as avoid situations where attempts to solve one problem exacerbate another, it is essential that all levels of government continue to consider other societal, economic and environmental priorities in their decision-making processes related to land use, transportation, and local government operations. For example, some compact development may increase proximity to large sources of pollution, such as high traffic arterials, distribution centers, and industrial facilities, which increases exposure to vehicle air pollution and other toxics and particulates. Communities should be designed to ensure that sensitive land uses such as residences and schools are an adequate distance from these sources. In addition community design should decrease vehicle use, through increasing transit service and walkability, and include buildings with indoor air quality mitigation to further reduce exposure. Agencies should also consider housing supply and affordability needs so that long term housing affordability is not compromised. To maximize benefits and minimize unintended consequences, agencies will need to continually balance multiple priorities through an integrated planning approach.

Agencies should also consider housing supply and affordability needs so that long term housing affordability is not compromised. To maximize benefits and minimize unintended consequences, agencies will need to continually balance multiple priorities through an integrated planning approach.

[47] NACCHO 2008.

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