The AB 32 Challenge:
Reducing California's Greenhouse Gas Emissions

Prepared for the
Southern California Leadership Council
Future Issues Committee

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LAEDC

Economic Vitality,
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Overview

AB 32

- California emitted 426.6 million metric tons (MMT) of greenhouse gases in 1990 and 479.8 MMT in 2004. The California Energy Commission (CEC) forecasts a further increase to 600 MMT by 2020 under a 'business as usual' scenario.
- AB 32 requires California to reduce greenhouse gas (GHG) emissions to 1990 levels by 2020, roughly 30% below the 600 MMT forecast.
- AB 32 requires a further 80% cut below the 1990 threshold by 2050.
- The California Air Resources Board (CARB) is formulating the state's GHG reduction strategy in a scoping process (already underway) that will conclude later this year.
- The scoping process is the best opportunity to influence the shape of GHG regulation in California. The regulations will take effect January 1, 2012, though certain early action measures will be enforceable starting January 1, 2010.

Challenge

- Meeting the AB 32 targets will be difficult because the state's population will have will have grown by 48%, from 29.7 million to 44.1 million residents, 1990-2020.
- Bringing the state's total GHG emissions to 1990 levels by 2020 will require a cut in per capita emissions of 3.9 metric tons (about 30%) to 9.7 metric tons per person.
- Reductions will not be easy, since the state's economy is already comparatively energy efficient. Californians used an average of 7,400 kilowatts per person in 2005, compared to national average per capita electricity consumption of almost 13,000 kilowatts. Similarly, the state consumes about 187 kilowatts per $1,000 of gross state product, compared to 347 kilowatts per $1,000 of GDP nationally.
- Globally, California would rank 18th in total emissions if it were a separate country. The state ranks near the top among the most efficient developed economies, alongside France and Italy, for the fewest GHG emissions per $1,000 GDP.

Economic Stakes

- Statewide, firms in sectors that are among the largest sources of GHG emissions employ 2.6 million workers and contribute $272.5 billion to the state's total economic output (valued at $1.46 trillion). In Southern California (which includes the counties of Los Angeles, Orange, Riverside, San Bernardino, San Diego, and Ventura), the direct GHG industries employ more than 1.3 million workers and account for $125.3 billion in economic output.

- Statewide, the direct and indirect firms in all GHG-related industries collectively employ almost 8.0 million workers, or 49% of California's total of 16.4 million employees. These industries produce a total of $624 billion in economic output, which is 43% of the statewide total. In Southern California, direct and indirect GHG-related firms employ a total of 3.65 million workers, representing 39% of total employment in that region. Their economic output of $291 billion accounts for 35% of the total regional output valued at $830 billion.

The Cost of GHG Reductions

- The LAEDC believes that reaching the state's GHG reduction targets will impose costs on the state in terms of lost jobs and reduced economic output. This will be particularly true for the more stringent 2050 target that requires a drop to 80 percent below 1990 emission levels, despite the addition of millions of new residents.
- Actual costs will depend on the mix of GHG reduction policies adopted; the extent to which other states and countries join in (reducing the potential handicap for firms operating in California); the scale of potential savings available from energy efficiency improvements; the pace of technological innovation (and its adoption); as well as the discovery (or not) of transformative new technologies.
- Studies suggesting GHG regulation will be "cost-free" are problematic in practice (understating costs and overstating benefits) and in principle (because they overlook the core market failure – polluting is free).
- Case studies suggest that even straightforward GHG regulations may have complex economic impacts.

Market-Based Reduction Strategies

- As a general rule, the LAEDC prefers the efficiency of market-based mechanisms that set the broad goals and then allow firms and individuals (rather than regulators) to decide upon their most cost-effective strategies to meet the goals.
- Global GHG emissions are rising too rapidly for cuts in California alone to make any difference. The state could be a catalyst for global action, however, if it can demonstrate sensible policies that reduce GHG emissions without harming the economy. Policymakers should resist the temptation to cut emissions too deeply too soon, because the cost of such cuts rises as the timeframe is shortened and as the targets are tightened. If action on climate change produces results that look like the state's botched attempt at electricity deregulation, the costs will be large indeed, both to the state economy, and to the global cause of GHG reduction.
- Market-based approaches to GHG regulation use a price signal to influence behavior. Since firms and individuals typically respond to rising prices by attempting to minimize their costs, price signals can be an efficient way to lower emissions.
- Cap-and-trade systems start by setting a limit on the total annual pollution from a designated source. Next, annual pollution allocations are divided up among the market participants. Firms covered by the cap must measure and report all

emissions. Participants can emit pollution up to the amount covered by their allotment. If a firm exceeds its allotment, it must pay fines. If the firm emits less than its allotment, the difference becomes a credit, which can be sold. Companies are free to buy and sell emission allowances to carry on their operations in the most profitable manner. Credits trade at variable prices depending on availability and demand. The resulting market for pollution credits allows firms to create custom-tailored emissions reduction strategies. Aggregate emissions level fall over time as the annual cap is lowered.

- The principal advantage of a cap-and-trade system is that it gives firms flexibility to achieve their emission targets in the most cost-effective way possible for them, while setting a strict overall limit on the total emission level. Government's role is limited to setting cap levels, issuing (assigning or auctioning) allowances, and monitoring emission levels.

Business Principles for Implementing AB 32

- Reduce global emissions and keep jobs in California
- Provide regulatory certainty
- Use sound scientific methods
- Impose only cost-effective and technologically feasible regulations
- Promote innovation and market-based strategies
- Minimize and fairly allocate compliance costs

SCLC Next Steps

- California's GHG reduction strategy is still taking shape, with many of the most important decisions scheduled to be finalized within the next twelve months.
- The Southern California Leadership Council should participate in CARB's scoping plan process. The importance of the scoping plan cannot be overstated. It will set the ground rules and select the primary strategies for emission reductions in the state. The plan will make recommendations on direct emission reduction measures, alternative compliance mechanisms, market-based mechanisms, and incentives. Once the plan has been finalized, it will be significantly more difficult to contest or alter the basic approach. The scoping plan, therefore, represents the best opportunity to successfully influence the shape of the state's response to GHG reductions.

Introduction

California has embarked on a bold effort to reduce the state's greenhouse gas emissions and its contribution to global climate change. Under AB 32, the state will attempt to lower its emissions of greenhouse gases to 1990 levels by 2020, and 80% below that threshold by 2050. California's growing population makes these ambitious targets, particularly the latter, which will likely require a reshaping of everyday life. How the state will proceed – whether the reductions will be achieved through command-and-control regulations or some sort of market-based mechanism – is still up in the air, but will be decided within the next twelve months.

This report, an introduction to the challenges posed by the AB 32 targets, was prepared for the Southern California Leadership Council's Future Issues Committee with the goal of helping the full council make an informed decision on whether to tackle the issue. The report does not dwell on the scientific links between climate change and greenhouse gases. Rather, the focus is on how the state will pursue greenhouse gas reductions and the likely consequences for the state economy.

The report consists of seven sections. The first provides background on greenhouse gases including major types and sources; California's policy response; and the AB 32 implementation schedule.

Section two describes the state's inventory of greenhouse gas emissions (by source and by type); compares the state's emissions with those from other countries; and explains the difficulty of reducing the state's total emissions when the population is increasing and its energy use is already comparatively efficient.

Section three looks at the industries that are major sources of greenhouse gases in California today, and estimates their direct and indirect contributions to statewide employment and GDP.

Section four considers the cost to the economy of pursuing emissions reductions, critiquing studies that claim the AB 32 targets will not impose an economic burden, and describing the complex interactions that can arise from even the most straightforward-seeming policies.

Section five examines the relative merits of market-based approaches to greenhouse gas reductions.

Section six introduces business principles for implementing AB 32 (developed by a statewide coalition), and considers their economic rationale.

Section seven concludes by recommending next steps for the SCLC.

I. Background

Greenhouse Gas Background

A greenhouse gas (GHG) is a chemical compound that absorbs and traps reflected heat in the atmosphere. The major greenhouse gases are water vapor, which causes about 36%-70% of the greenhouse effect on earth; carbon dioxide, which causes 9%-26%; methane, which causes 4%-9%, and ozone, which causes 3%-7%.

Most greenhouse gases are naturally occurring. Humans have been adding to the natural production of GHGs, notably through the carbon dioxide released by the combustion of fossil fuels. Some particularly powerful GHGs, such as fluorinated gases, are created and emitted exclusively as a byproduct of human activity. Table 1 describes the main greenhouse gases released by humans and the activities that produce them.

Table 1
Greenhouse Gases Produced By Human Activity

GHG	Major Sources	CO^2 e Factor
Carbon Dioxide (CO_2)	Fossil fuel combustion; burning solid waste and trees; industrial manufacturing	1
Methane (CH_4)	Landfills; production and transport of coal, natural gas and oil; enteric fermentation and other agricultural sources	21
Nitrous Oxide (N_2O)	Ammonia production; fertilizer manufacturing; other agricultural; burning transportation fuels	310
Hydrofluorocarbons (HFCs)	Refrigerants; substitution of ozone-depleting substances	150-11,500
Perfluorocarbons (PFCs)	Semiconductor manufacturing; aluminum production	6,500-9,200
Sulfur Hexafluoride (SF_6)	Electricity transmission and distribution; magnesium production	23,900

Sources: CARB

The warming effect of greenhouse gases is described in terms of carbon dioxide equivalents, also shown in Table 1. One molecule of methane has 21 times the warming effect of one molecule of carbon dioxide; sulfur hexafluoride has almost 24,000 times the warming effect. The CO_2e conversion factors allow all GHG emissions to be reported in million metric tons of carbon dioxide equivalents (MMT CO_2). This standard unit of measurement is even more unwieldy than an acre-foot (for water) or a TEU (for shipping containers). Once described, one can visualize an acre-foot (the amount of water needed to cover one acre to the depth of one foot) or a Twenty Foot Equivalent container (a 20-foot long rectangular metal box). A million metric tons of a colorless, odorless gas, on the other hand, is much harder to picture. The list below describes some activities that produce one million metric tons of carbon dioxide.

1 MMT of CO_2 is equivalent to[1]:

- The total emissions from a typical 1,000 megawatt coal-fired facility operating for 49 days
- The total emissions from a state-of-the-art 500 megawatt combined-cycle gas-fired power plant running for 18 months
- The total emissions from all of the passenger cars in California (about 14 million in 2005) operating for about 6 days (or 216,000 passenger cars operating for a year)
- The total emissions from all of the passenger cars and light trucks in California (about 21 million in 2005) operating for about 3 days (or 179,000 passenger cars and light trucks operating for a year)
- The average emissions from generating the electricity used by all California households (11.5 million in 2000) in about 6 days (or 193,000 average California households in a year)
- The emissions from generating electricity that would be saved in one year if every man, woman and child in Los Angeles County and Orange County each replaced one standard light bulb with a compact fluorescent bulb (about 3 per household)

Global Greenhouse Gas Emissions

Worldwide emissions of carbon dioxide and other greenhouse gases have been rising for decades, fueling concern that humans are contributing to global warming. The Carbon Dioxide Information Analysis Center (CDIAC) estimates that human activity released 267 billion metric tons of carbon dioxide, 1900-1999.[2] The United States was a major source of the emissions, accounting for 29 percent of the carbon dioxide released by human activity in the 20th Century. Europe and Russia were responsible for 39 percent of the total CO_2 emissions, while the rest of the developed world accounted for another 7 percent of the emissions.

Together, developed countries were responsible for three-quarters of overall carbon dioxide emissions last century. Over the next three decades, the developed world's share will fall to 52 percent (even if their actual emissions do not decline) because CO_2 emissions in the developing world are rising rapidly, particularly in China. Thus, the developed world will emit a smaller share of a much larger global total.

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[1] Coal-fired plant emissions based on data from a Citi report prepared by John Clapp & Lois Grobert, "Global Climate Change: Theory and Practice"; all other emissions estimates based on examples from CARB.
[2] Andrew C. Revkin, "A China Goes, So Goes Global Warming," *New York Times* (December 16, 2007).

In fact, worldwide, emissions are growing so quickly that it will take just 32 years, 2005-2036, to emit 270 billion metric tons of carbon dioxide, eclipsing in just three decades the total emissions generated during the 20th Century. Further, exceeding the previous 100 years' worth of emissions may not take even 32 years: the same model that was used for the forecast significantly underestimated actual global emissions, 2000-2004.

Policy Response[3]

Globally, the 1997 Kyoto Protocol of the UN Framework Convention on Climate Change is the most prominent response to rising greenhouse gas emissions. The Kyoto Protocol requires signatory developed nations to report and reduce their GHG emissions. Developing countries can participate through voluntary programs whereby developed countries offset their own emissions by paying for projects that reduce emissions elsewhere. The Kyoto Protocol does not require countries in the developing world to reduce their emissions on their own, an omission that President Bush has cited to justify his refusal to ratify the Kyoto Protocol.

More than 170 countries have ratified the Kyoto Protocol. In Europe, 25 countries participate in the European Union Emission Trading Scheme, a multi-national market for trading greenhouse gas emissions. Australia, long a holdout, has announced it will sign the protocol. Yet, progress on global GHG reduction will be severely constrained without the active participation of the two largest emitters, the United States and China.

The United States, the largest and richest emitter, has made little progress at the national level, despite a blizzard of proposed Senate and House bills in 2007 addressing GHG emissions. The bills covered cap-and-trade programs (Electric Utility Cap and Trade Act of 2007; Low Carbon Economy Act of 2007), carbon sequestration (National Carbon Dioxide Storage Capacity Assessment Act of 2007), security (National Energy and Environmental Security Act of 2007), innovation (Climate Stewardship and Innovation Act of 2007), and specific targets for emission reductions (Low Carbon Economy Act of 2007). At year end, only the modest efficiency improvements mandated in the Energy bill had passed.

At the state level, in contrast, 40 states are taking some form of action to reduce GHG emissions, including 19 states with established GHG reduction targets. New York, for example, plans to reduce the state's carbon emissions to 5 percent below 1990 levels by 2010 and to 10 percent below 1990 levels by 2020; Arizona seeks to reduce GHG to 2000 levels by 2020 and to 50 percent below 2000 levels by 2040; and Oregon plans to be 10 percent below 1990 levels by 2020 and 75 percent below by 2050. Thirty-four states and two Canadian provinces are participating in the national Climate Registry – an effort to standardize GHG reporting. States are also exploring ways to work together to reduce greenhouse gases, particularly through cap-and-trade programs. The Regional Greenhouse Gas Initiative, covering the Northeast and Mid-Atlantic states, and the Western Regional

[3] Based on materials distributed to participants at the conference "California's AB 32: Requirements, Challenges and Opportunities – One Year Later" organized by Jeffer Mangels Butler & Marmaro LLP (JMBM) and CantorCO2e, LP in San Diego (November 2, 2007).

Climate Action Initiative, covering California, New Mexico, Oregon, and Washington, are exploring the development of cap-and-trade programs.

In California, global warming appeared on the legislative agenda as early as 1988. Table 2 summarizes the state's policy response leading up to the adoption of AB 32.

Table 2
CA Initiatives To Reduce GHG Emissions

Name & Code	Year	Purpose of the Initiative
AB 4420	1988	Directed CEC & CARB to study how global warming trends may affect the state and recommend ways to reduce or avoid impacts
SB 1771	2000	Encouraged voluntary actions to increase energy efficiency & reduce GHG; CEC to inventory CA GHG; established voluntary registry, CA Climate Action Registry (CCAR)
SB 527	2001	Authorized administrative penalties for certain violations of air pollution laws and clarified SB 1771
SB 1170	2001	Required CEC, CARB, and the Department of General Services to adopt fuel-efficiency measures for the state's motor vehicle purchases
AB 1493	2002	Required CARB to develop regulations to achieve maximum feasible cost-effective GHG reductions from motor vehicles
SB 812	2002	Instructed CCAR to include forest management practices as a mechanism to reduce GHG emissions
SB 1078	2002	Required investor owned utilities to meet 20% of their resource needs with renewable power by 2017
SB 1389	2002	Required CEC to prepare an integrated energy policy report every two years
AB 857	2002	Instructed the Governor to prepare a "comprehensive State Environmental Goals and Policy Report"
AB 1007	2005	Ordered CEC, CARB and other state agencies to develop a state plan to increase use of alternative transportation fuels
Executive Order S-3-05	2005	Set GHG emission reduction targets for California: reduce GHG to 2000 levels by 2010, to 1990 levels by 2020, and 80% below 1990 level by 2050
SB 1368	2006	Required CEC to set global warming emissions standards for electricity used in CA regardless of the state of origin
AB 32	2006	CA Global Warming Solutions Act aims for real, quantifiable, and cost-effective GHG reductions; adopts the targets laid out in Exec. Order S-3-05.

Source: Malcom C. Weiss & Ian Michael Forrest, "Climate Change Legislation Summary," JMBM (Jeffer Mangels Butler & Marmaro LLP)

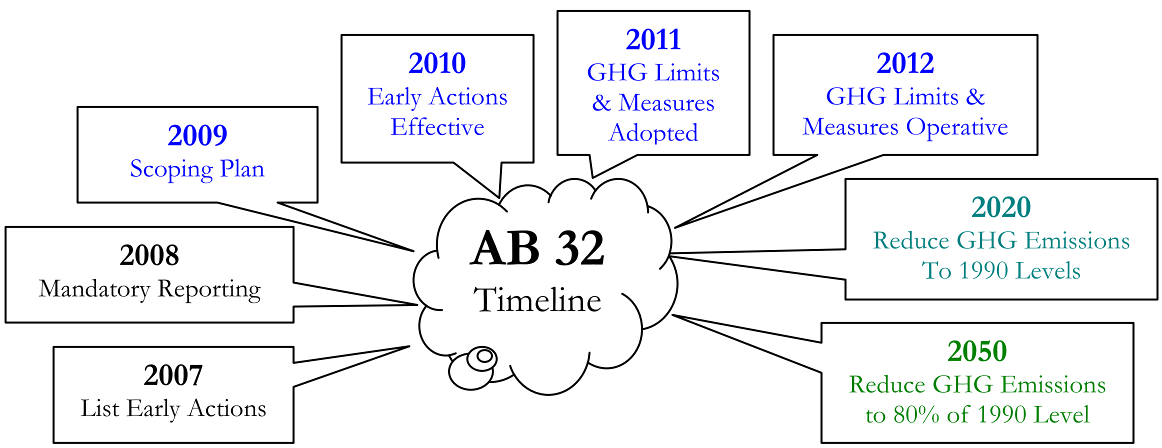
Since the passage of AB 32, Governor Schwarzenegger has signed several additional executive orders on the subject of GHG:

Executive Order S-20-6 (October 2006) designated the Secretary for Environmental Protection the statewide leader for California GHG programs, coordinating among the various state departments, agencies and boards working on the issue. The order directed the CARB, in conjunction with the Secretary for Environmental Protection and the Climate Action Team, to develop a comprehensive market-based compliance program that would permit trading with the European Union, the Regional Greenhouse Gas Initiative and other such programs.[4] CARB was also directed to conduct an economic analysis of efforts to reduce GHG emissions; the Secretary and the Climate Action Team were directed to develop a plan that will incentivize investment and compliance, enhance research, and develop and demonstrate GHG emission reduction technologies.

Executive Order S-01-07 ((January 2007) established a statewide goal to reduce the carbon intensity of California's transportation fuels by at least 10 percent by 2020.

Figure 1 below shows the timeline for the implementation of AB 32 California Global Warming Solutions Act of 2006.

Figure 1



Early Actions: The California Air Resources Board is required under AB 32 to develop a list of early action measures that can be implemented before the full emissions reduction measures take effect. CARB identified nine early action items: a low carbon fuel standard; landfill methane capture; restrictions on high global warming potential refrigerants; PFC reduction from semiconductor manufacturing; SF_6 reductions in the non-electric sector; reduction of high global warming potential GHGs in consumer products; a truck efficiency program; tire inflation program; and green ports (dockside electrification for ship plug-in).

[4] The Climate Action Team consists of the Secretary of the Business, Transportation and Housing Agency, Secretary of the Department of Food and Agriculture, Secretary of the Resources Agency, Chairperson of the Air Resources Board, Chairperson of the State Energy Resources and Conservation Development Commission and President of the Public Utilities Commission.

Emissions Reporting: CARB was required to determine by January 1, 2008 the statewide GHG emissions level in 1990, which will become the 2020 target. In response, CARB has determined that the 1990 level was 427 million metric tons of carbon dioxide equivalent. CARB also must adopt regulations to require reporting and verification of statewide GHG emissions and to monitor and enforce reporting compliance.

Scoping Plan: By January 1, 2009, CARB must prepare and approve a "scoping plan" to outlining the state's strategy for meeting the 2020 target. The scoping plan must determine the maximum technologically feasible and cost-effective GHG emissions reductions possible and make recommendations on direct emission reduction measures, alternative compliance mechanisms, market-based mechanisms, and incentives. These measures will be introduced in four workshops between November 30, 2007 and March 25, 2008. A draft scoping plan will be released in June, followed by more workshops in July. The plan will be presented for adoption in November, 2008.

Early Actions - Implementation: CARB must adopt regulations, enforceable by January 1, 2010, to implement the early action measures.

GHG Regulations: CARB will adopt comprehensive regulations to reduce GHG emissions by January 1, 2011, and the regulations will take effect on January 1, 2012.

II. Greenhouse Gas Inventory & Context

Introduction

This section consists of three parts. First, we place California's greenhouse gas emissions in a global context. We present comparison data from the World Resources Institute for the top 22 countries that contributed at least 1 percent of global greenhouse gas emission in 2000. This is the most recent data available covering all greenhouse gases (CO_2, CH_4, N_2O, PFCs, HFCs, and SF_6). We also present comparative data for selected countries and regions from the U.S. Energy Information Administration. The EIA data is less comprehensive – covering just the major component of greenhouse gas emissions (CO_2) – but it is more recent (2005).

In the second section, we focus on what is known about greenhouse gas emissions in California. Using California Air Resources Board data, we describe the state's inventory of emissions, 1990-2004; share of emissions by sector in 2004; and share by industry in 2004.

The third section describes the scope of the reductions required to meet the AB 32 targets. We present the raw cuts required based on current (2004) and business-as-usual projections (2020) to reach the target. Next, we present population and employment forecasts for the state, which underscore the magnitude of the task. The AB 32 challenge, we conclude, will be to reduce per capita emission in the state by almost 30 percent. The task will be harder in California than it might be elsewhere because the state is already comparatively efficient in its use of electricity.

Greenhouse Gas Emissions in Global Context

Global Emissions of All Greenhouse Gases, 2000: The World Resources Institute estimates California accounted for 442.4 million metric tons of greenhouse gas emissions in 2000, the most recent year for which there are comprehensive global estimates for emissions of carbon dioxide, methane, nitrous oxide, and fluorinated gases (hydrofluorcarbons, perfluorcarbons and sulfur hexafluoride). California's output of greenhouses gases represented 1.3 percent of the worldwide total of 33.7 billion metric tons in 2000.

Table 3 (on the next page) ranks 22 countries that each accounted for at least 1.05 percent of global emissions of greenhouse gases. The U.S. was the largest single source, emitting the equivalent of 6.9 billion metric tons of CO_2 equivalent representing one-fifth of the global total. China, at almost 5.0 billion metric tons, was the second largest source and accounted for 14.4 percent of worldwide emissions. Russia (5.7%), India (5.6%), and Japan (4.0%) round out the top five emitting countries.

Table 3 Total Greenhouse Gas Emissions, 2000 (CO_2, CH_4, N_2O, PFCs, HFCs, SF_6)					
Rank	Country	Millions of Metric Tons	% of World Total	Metric Tons of Emissions	
				Per Capita	Per $1,000 GDP
1	**United States**	**6,871.7**	**20.38%**	**24.3**	**0.7168**
2	China	4,963.1	14.42%	3.9	1.0006
--	EU (25)	4,741.9	14.07%	10.5	0.4569
3	Russia	1,915.7	5.68%	13.1	1.8453
4	India	1,889.1	5.60%	1.9	0.7700
5	Japan	1,351.5	4.01%	10.7	0.4063
6	Germany	1,013.3	3.01%	12.3	0.4837
7	Brazil	849.5	2.52%	4.9	0.6692
--	Texas	763.7	2.26%	36.5	1.0501
8	Canada	684.1	2.03%	22.2	0.8147
9	UK	658.8	1.95%	11.0	0.4188
10	Italy	532.2	1.58%	9.2	0.3691
11	Mexico	525.8	1.56%	5.4	0.5933
12	S. Korea	519.2	1.54%	11.0	0.6829
13	France	518.4	1.54%	8.8	0.3425
14	Indonesia	504.6	1.50%	2.4	0.8079
15	Australia	491.2	1.46%	25.6	1.0091
16	Ukraine	482.1	1.43%	9.8	2.3829
17	Iran	475.9	1.41%	7.5	1.2829
--	**California**	**442.4**	**1.31%**	**13.0**	**0.3437**
18	South Africa	417.6	1.24%	9.5	1.0076
19	Spain	381.9	1.13%	9.4	0.4332
20	Poland	372.8	1.11%	9.6	0.9274
21	Turkey	355.4	1.05%	5.3	0.8096
22	Saudi Arabia	353.8	1.05%	16.5	1.3309

Source: World Resources Institute, Climate Analysis Indicators Tool (CAIT), 2007

Considered together, the 25 members of the European Union accounted for the equivalent of 4.7 billion tons, accounting for 14.0 percent of the global total. California would have placed between Iran (1.4 percent; 17th) and South Africa (1.2 percent; 18th). Among U.S. states, only Texas – at 2.3 percent of the global total, it falls between Brazil (7th) and Canada (8th) – is a larger source of greenhouse gases. [Indonesia would have jumped to 3rd and Brazil to 4th if the rankings had taken deforestation into account.[5]]

Table 3 also reports the amount of greenhouse gases produced on a per capita basis, and per $1,000 of GDP in 2000.[6] These figures reveal that China and India, two of the largest overall emitters of greenhouses gases, are much further down the list when their large populations are taken into consideration. Indeed, India's 1.9 metric tons of emissions per person ranks lowest among the 22 countries that are the largest sources of greenhouse gases.

[5] "So hard to see the wood for the trees," *Economist* (December 22, 2007).
[6] Comparisons made using purchasing power parity US dollar exchange rates.

At the other end of the spectrum were Australia (25.6 metric tons per capita) and the United States (24.3 metric tons per capita). California (at 13.0 metric tons per person) was well below the U.S. average, though still higher than the European Union (at 10.5 metric tons per person). Texas (36.5 metric tons per person) was higher than the U.S. average and indeed higher than any other country.

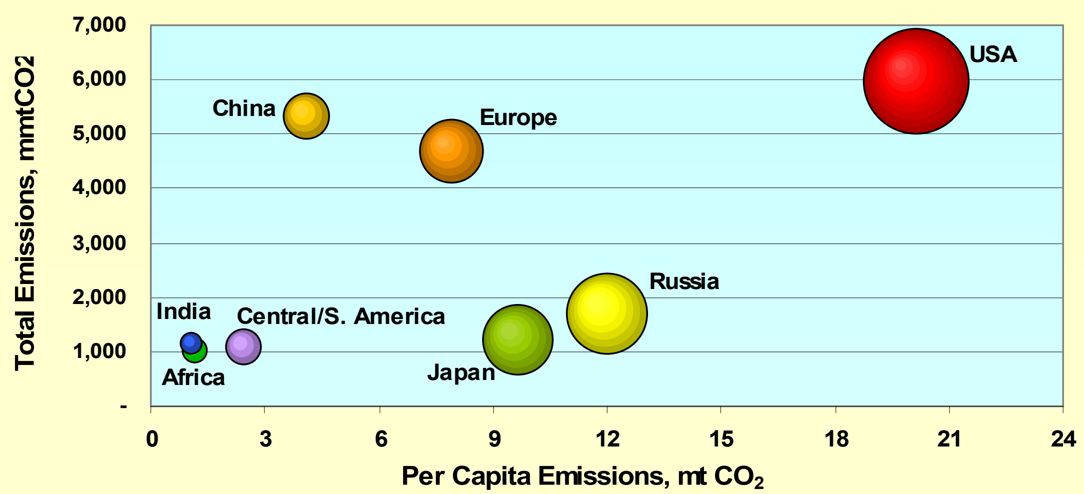
The range of values for greenhouse gases emitted per $1,000 of GDP reflects levels of industrialization; technological advancement; industry mix; and policy choices. France (0.34 metric tons) and Italy (0.37 metric tons) produce the fewest greenhouse gas emissions per $1,000 in GDP among the top 22 emitting countries. The Ukraine (2.38 metric tons) and Russia (1.85 metric tons) produce the most emissions per $1,000 in GDP. For every $1,000 in GDP, the United States produces 0.72 metric tons; California emits 0.34 metric tons; and Texas emits 1.05 metric tons. On this measure, California is among the best in the world.

Global Emissions of Carbon Dioxide, 2005: The U.S. Energy Information Administration data on world carbon dioxide emissions from the consumption and flaring of fossil fuels are not as comprehensive as the World Resources Institute data, but the information is more recent (2005). CO_2 emissions are the single largest component (70 to 80 percent) of global greenhouse gas emissions from human activity. In 2005, worldwide emissions of carbon dioxide were 28.2 billion metric tons.

Figure 2 compares U.S. CO_2 emissions to emissions of other selected countries and regions in 2005. The size of the bubbles corresponds to per capita emission. America (20.1 metric tons per person in 2005) has the largest bubble, and Russia (12.0 metric tons per capita) is 2nd. The height of the bubbles above the horizontal axis indicates total emissions. The bubble for the U.S., with just over 5.9 billion metric tons representing about 21% of the world total, is at the top of the chart. China's bubble, the 2nd highest, is considerably smaller, reflecting its high overall but relatively low per capita emissions. China's emissions were 5.3 billion metric tons, 19% of the world total.

Figure 2

Per Capita U.S. CO_2 Emissions in Global Context, 2005



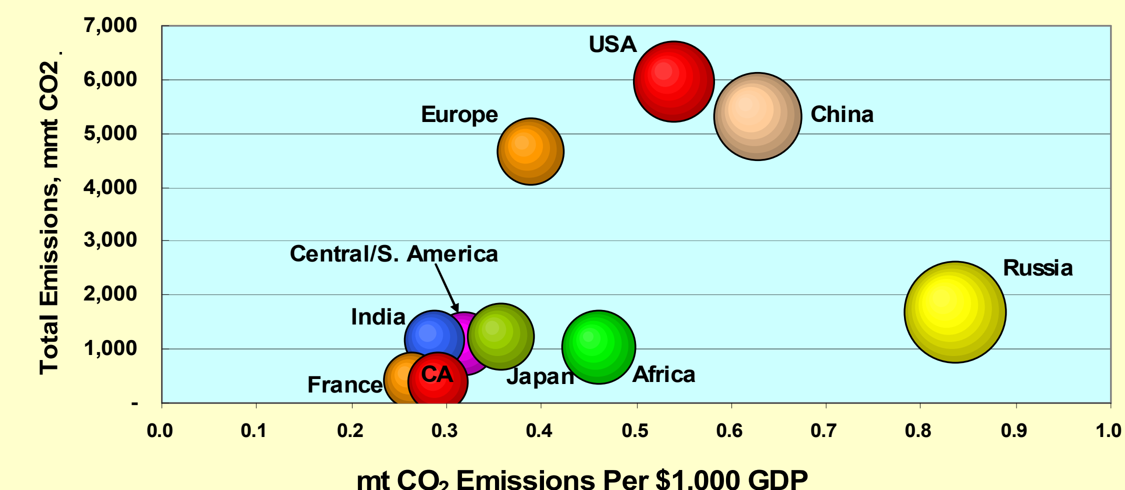
Source: Energy Information Administration

This compares with Europe (4.7 billion; 17%); Russia (1.7 billion; 6%); Japan (1.2 billion; 4%); India (1.2 billion; 4%); Central and South America (1.1 billion; 4%); and Africa (1.0 billion; 4%).

Another way to express the intensity of carbon dioxide emissions is to compare emissions per $1,000 GDP (US dollars at purchasing power parity). Figure 3 compares U.S. CO_2 emissions per $1,000 of GDP to selected countries and regions in 2005. The larger the bubble, the more carbon dioxide generated for each increment of GDP.

Figure 3

U.S. & CA CO_2 Emissions Per $1,000 GDP in Global Context, 2005



Source: Energy Information Administration

The U.S. is still at the top of the chart (because it generated the highest total emissions of carbon dioxide) but it is closer to middle-of-the-pack in the amount of CO_2 emitted per $1,000 of GDP at 0.54 metric tons in 2005. Russia is located in the lower right corner of the chart because its total emissions of carbon dioxide were comparatively low, but its economic activity emitted the most CO_2 per $1,000 of GDP (0.84 metric tons). California and France, two of the best economic performers relative to their GHG emissions among developed countries, are in the bottom left of the chart. [France benefits from its heavy reliance on nuclear power; California benefits from decades of energy efficiency measures (on which see more below).] India is in the same neighborhood, but its emissions per $1,000 GDP reflect an economy dominated by services and agriculture.[7] In contrast, China's development strategy is export-oriented manufacturing which is more fuel intensive.

California's Greenhouse Gas Emissions

The California Air Resources Board (CARB) has been charged with producing a comprehensive inventory of greenhouse gas emissions in California. The inventory must

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[7] Services were 54.6% of GDP in India in 2005; agriculture was 17.5%; and industry was 27.9%. The comparable figures for China were services 11.7%; agriculture 11.7%; and industry 48.9%.

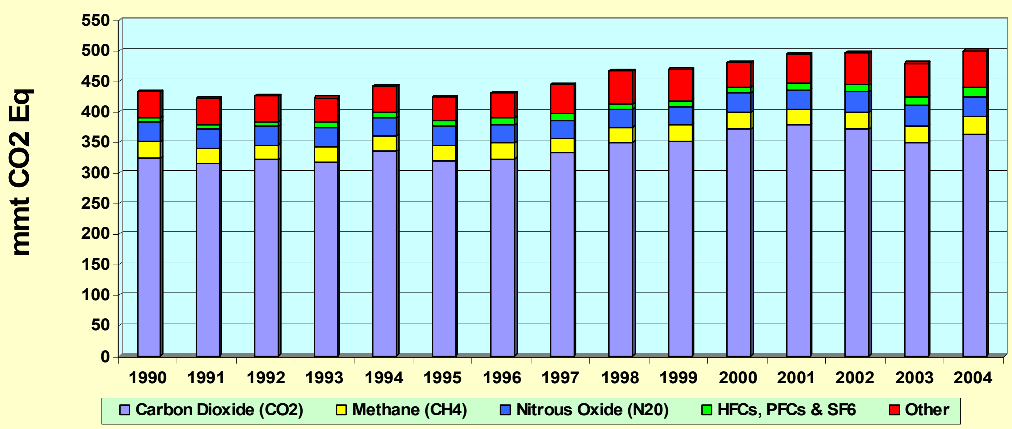
include all major greenhouse gases (CO_2, CH_4, N_2O, PFCs, HFCs, and SF_6); all major sources (fossil fuel combustion, industrial processes, agriculture, construction, waste); and cover both in-state *and* out-of-state emissions attributable to in-state activities (such as out-of-state electricity generation). The inventory also must take into consideration the effect of forestry and land use (which can create carbon sinks, reducing the net emissions of GHGs).

The CARB's greenhouse gas inventory has gone through multiple revisions, reflecting measurement difficulties. This is particularly true for the pre-2004 inventories, which have to be estimated retroactively. The historical inventory is critical: it determines the baseline 1990 level that will become the 2020 target, and defines the scope for future cuts.

The four figures below offer different perspectives on the greenhouse gas inventory in California. Figures 4 and 5 present historical data covering greenhouse gas emission by type of gas and by major (source) category for the years 1990 through 2004. Figures 6 & 7 focus on 2004, the most recent year for which there is data. Figure 6 reveals the percentage of statewide emissions for each major source category; Figure 7 further divides the categories into component industries.

Figure 4 shows five components of greenhouse gas emissions in California: carbon dioxide; methane; nitrous oxide; fluorinated gases and other. [The latter consists of all emissions from electricity generated out-of-state and consumed in California (which are not differentiated by type of gas). The data are the most recent available.]

Figure 4
California Greenhouse Gas Emissions, 1990-2004



Source: Climatechange.ca.gov/policies/greenhouse gas inventory (Revised in January 2007)

Figure 4 shows that carbon dioxide was the largest component of greenhouse gas emissions in California, 1990-2004, accounting for between 82.4 and 84.6 percent of gross in-state emissions (i.e. excluding out-of-state emissions associated with in-state uses).

- Almost all of the carbon dioxide emitted in-state (96 percent in 2004) comes from fossil fuel combustion.
- The remainder, in descending order, is associated with cement production; land use changes and forestry emissions; limestone and dolomite

consumption; soda ash consumption; carbon dioxide consumption; lime production; and waste combustion.

Methane comprised 6.0 to 6.7 percent of gross in-state emissions, 1990-2004.

- The top three in-state sources in 2004, accounting for 75% of methane emissions, were landfills, enteric fermentation (from cow digestion) and manure management.
- Other sources include: the petroleum and natural gas supply system; wastewater treatment; various stationary and mobile sources; and flooded rice fields.

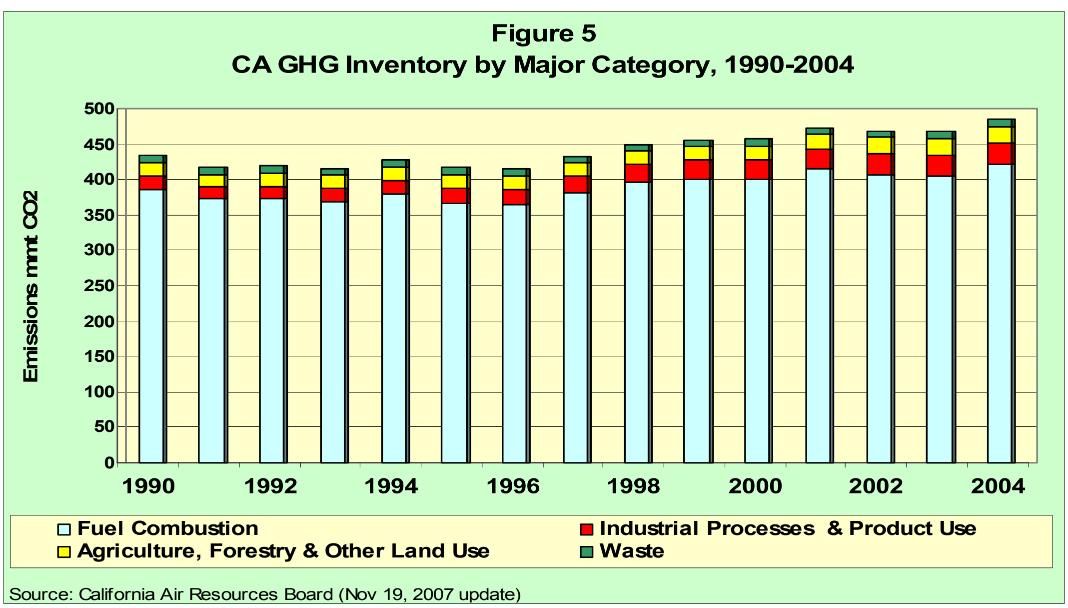
Nitrous oxide comprised 6.9 to 8.4 percent of gross in-state emissions, 1990-2004.

- Almost all of the nitrous oxide emitted in the state comes from two sources: agricultural soil management (58% in 2004) and mobile source combustion (35% in 2004).

Fluorinated gases accounted for 1.8 to 3.2 percent of gross in-state emissions, 1990-2004.

- The substitution of ozone-depleting substances accounted for 89% of fluorinated gases emitted in the state in 2004. This is noteworthy, since the emissions from such substitutes have increased 182%, 1990-2004, driving an overall 99% increase fluorinated gas emissions during the same period.
- The remaining fluorinated gas emissions are from electricity transmission and distribution, and semiconductor manufacturing.

Figure 5 below describes GHGs by source, breaking out California emissions of greenhouse gases by major emitting source (fuel combustion; industrial processes and product use; agriculture, forestry and other land use; and waste) for the years 1990-2004.[8]

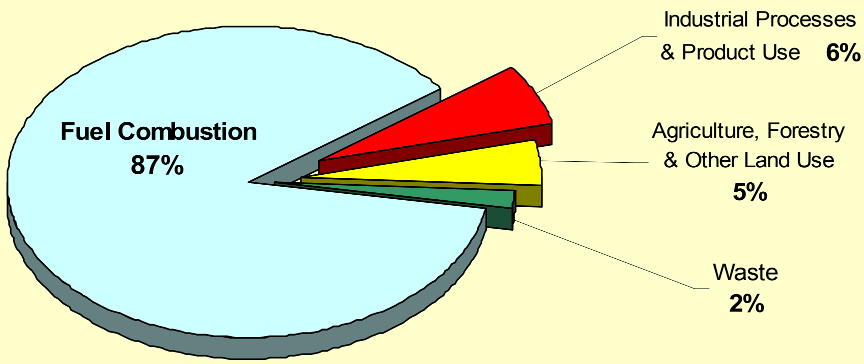


[8] The totals in Figures 4 & 5 do not match exactly because Figure 5 is based on November 2007 revisions issued by CARB. New data for Figure 4 have not been released since January 2007.

Gross California emissions of greenhouse gases (including both in-state emissions and out-of-state emissions for in-state uses) have ranged between 415.6 and 484.4 million metric tons of carbon dioxide equivalent, 1990-2004. Fuel combustion consumption has been the largest source of these emissions, accounting for between 86.6 and 89.2 percent of the total emitted, 1990-2004.

Figure 6 shows the percentage share, by category, for emissions in 2004.

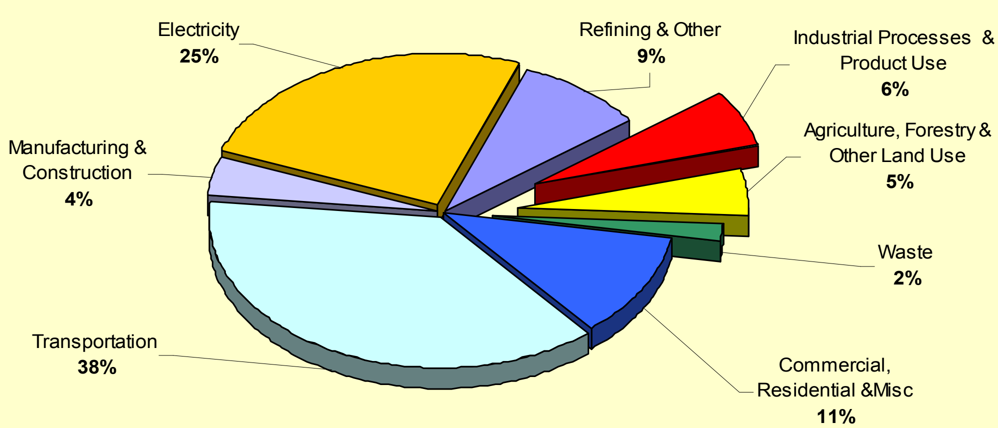
Figure 6
CA GHG Inventory by Major Category, 2004
(mmt CO_2e)



Source: California Air Resources Board (Nov 19, 2007 update)

Fuel combustion accounted for 86.9 percent of gross state greenhouse gas emissions in 2004. The rest of the emissions were from industrial processes and product use (6.4 percent); agriculture, forestry and other land use (4.8 percent); and waste (1.9 percent).

Figure 7
CA GHG Inventory by Major Sector (mmt CO_2e), 2004



Source: California Air Resources Board (Nov 19, 2007 update)

Figure 7 provides further detail, breaking out the greenhouse gases emitted from fuel combustion into major sectors of the economy during 2004.

CARB tracks greenhouse gases produced by fuel combustion in five major sectors. Fuel combustion (which includes fugitive emissions from fuel use) in California (in-state and out-of-state, whenever the ultimate consumption was in-state) generated 420.9 million metric tons of carbon dioxide equivalent in 2004.

- Transportation uses emitted 182.0 million metric tons of CO_2 equivalent, 37.6 percent of the gross state total in 2004.
- Electricity generation (in-state and out-of-state) accounted for emissions of 123.2 million metric tons of CO_2 equivalent, 25.4 percent of the total.
- Commercial, residential and miscellaneous uses added 53.1 million metric tons of greenhouse gas emissions, 11.0 percent of the total.
- Refining accounted for 43.3 million metric tons of emissions, 8.9 percent of the total.
- Manufacturing and construction added 19.5 million metric tons of emissions, 4.0 percent of the total.

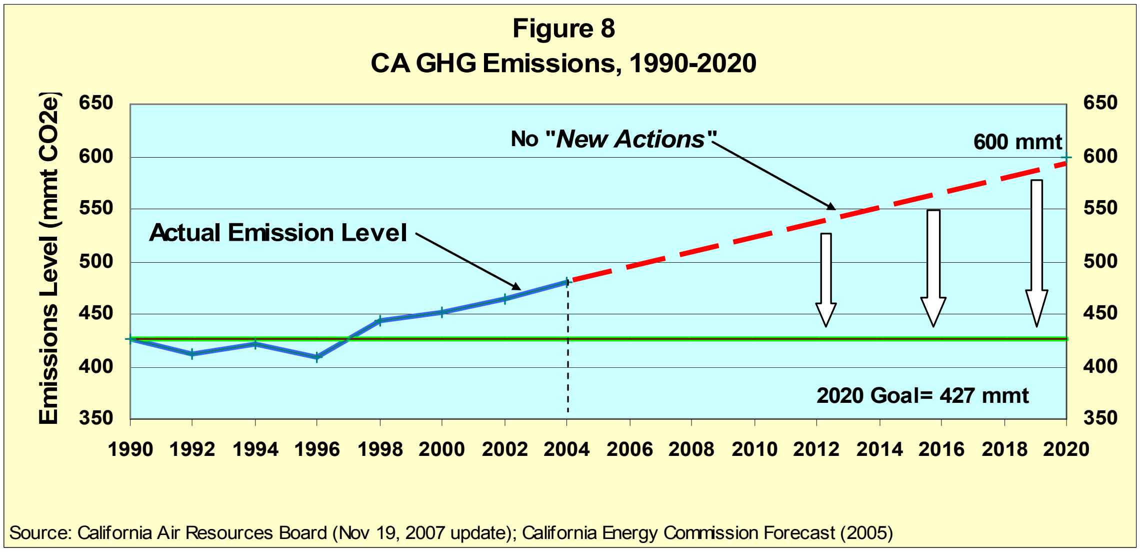
Industrial processes and product use contributed 30.8 million metric tons of greenhouse gas emissions (6.4 percent of the 2004 total). Almost half of these emissions came from products used as substitutes for ozone-depleting substances. The rest came from, in descending order, the mineral industry (cement and lime production); other (unspecified); other product use; non-energy products made from fuels; the chemical industry; and the electronics industry.

Agriculture, forestry and other land use generated 23.3 million metric tons of emissions in 2004 (4.8 percent of the state's total greenhouse gas emissions). Solid waste disposal and wastewater treatment accounted for the remaining 9.4 million metrics tons (1.9 percent) of the state's greenhouse gas emissions.

Meeting the AB 32 Challenge

The California Air Resources Board estimates that the state emitted 433.3 million metric tons of carbon dioxide equivalent (gross) in 1990. (November 19, 2007 update) Allowing for sinks and sequestrations, the state's net emissions were 426.6 million metric tons. Under AB 32, the state must return to this level by 2020.

Figure 8 shows that in 2004, net emissions of greenhouse gases were 479.8 million metric tons, 53.2 million metric tons above the 1990 target. Meeting the AB 32 target in 2004 would have required reducing emissions by 11 percent.

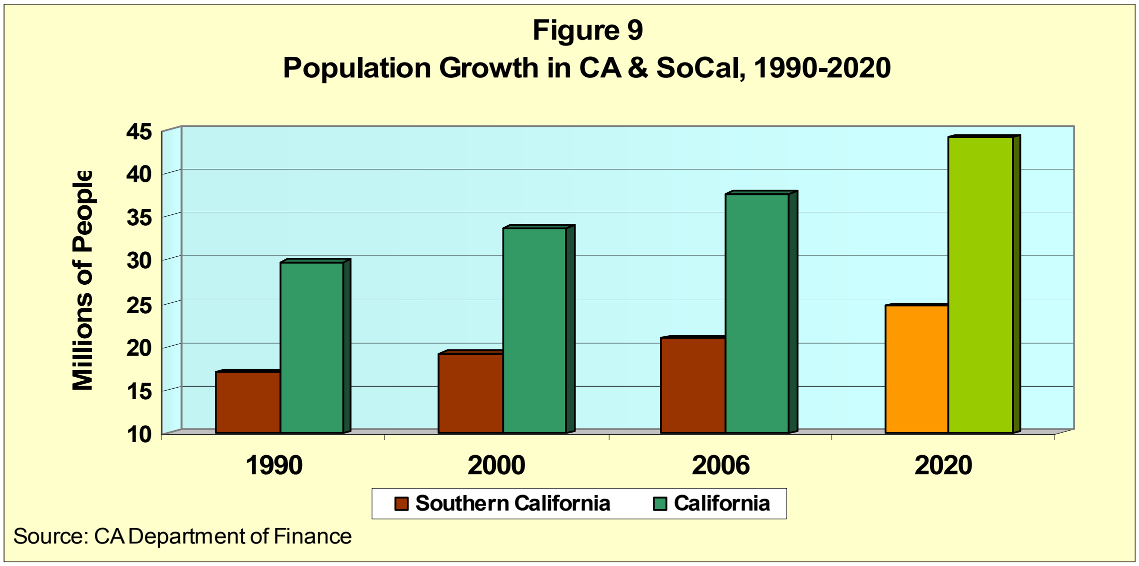


CARB forecasts an increase in the state's net emissions of greenhouse gases to 600 million metric tons of carbon dioxide equivalent by 2020 under a 'business as usual' scenario. This means that on its current course, the state would need to cut emissions by about 30 percent to reach the AB 32 target.

Greenhouse gas emissions are rising because the state's population and its economy are growing. More people means the state will see more electricity consumption, more vehicle miles traveled, and more business activity, all of which translate (at current rates) to more greenhouse gas emissions.

Returning to 1990 levels of emissions will require offsetting the increased demand for electricity to power uses that are more prevalent today than they were 18 years ago, like air conditioners (in fast-growing inland areas and throughout the state) and for electronics such as large screen televisions. The more daunting challenge, however, will be reducing the state's carbon footprint while adding millions of new residents.

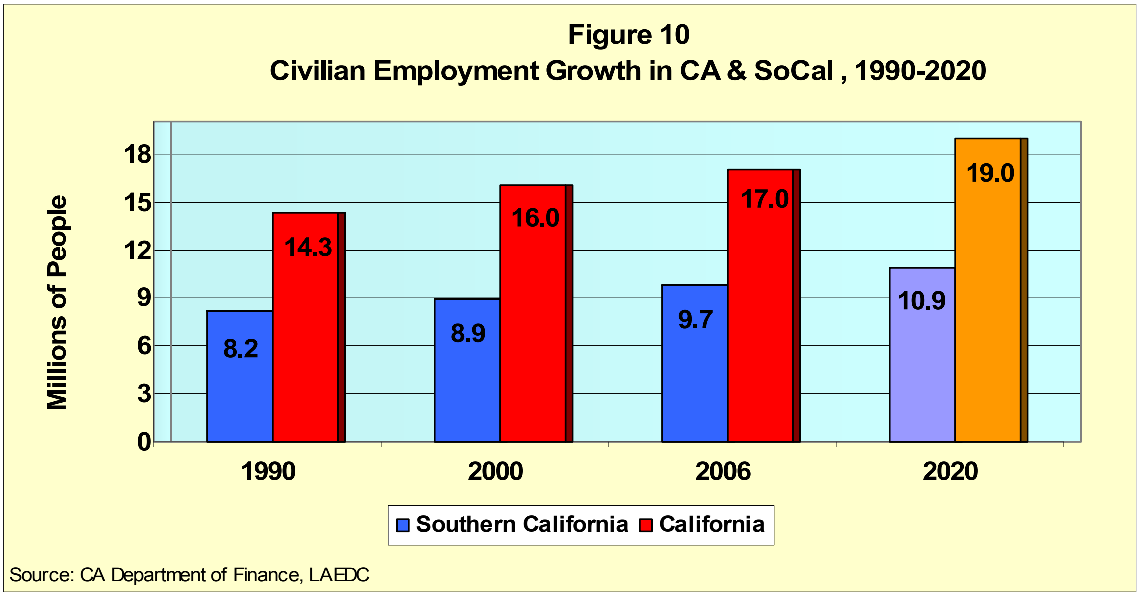
As Figure 9 shows, California's population has grown 27 percent, 1990-2006, rising from 29.7 million to 37.7 million people. During the same period, the population of the six counties of Southern California (Los Angeles, Orange, Riverside, San Bernardino, San Diego and Ventura counties) increased 23 percent, from 17 million to 21 million people.



Going forward, California is expected to add 6.4 million additional residents by 2020, a 17 percent increase to 44.1 million residents. Southern California will be home to 3.7 million of these new residents, bringing the regional population to 24.7 million and accounting for 58 percent of the statewide increase, 2006-2020.

Thus, in just 30 years, California's population will have grown by 48 percent, from 29.7 million to 44.1 million residents: 14.4 million more people will call the Golden State home in 2020 than in 1990. [For comparison, Illinois, the 5th most populous state in the nation, had 12.8 million residents in 2006.] Even though per capita greenhouse gas emissions in California are low by U.S. standards, just slightly more than half the national average, 14 million-plus people will add considerably to the state's total emissions inventory. The state would have to make considerable changes to return to 1990 levels of greenhouse gas emissions even if the new residents were to collectively produce zero net new emissions (which is impossible). Factoring in the new residents makes meeting the 2020 target that much harder.

California will have to add jobs for its growing population. Figure 10 shows that total civilian employment in the state increased 19 percent, 1990-2006, from 14.3 million to 17.0 million. During the same period, total civilian employment in Southern California (Los Angeles, Orange, Riverside, San Bernardino, San Diego and Ventura counties) also increased 19 percent, from 8.2 million to 9.7 million jobs.



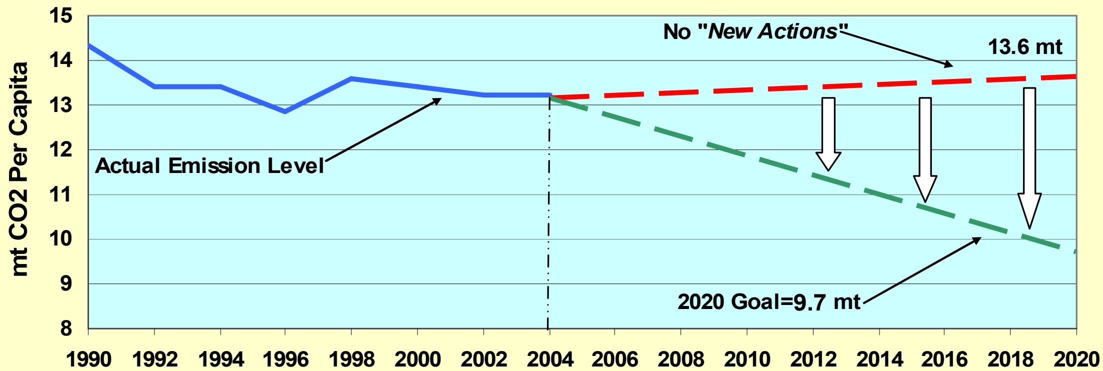
Total civilian employment will increase, 2006-2020, by up to 2 million jobs, bringing statewide civilian employment to about 19 million jobs. [This LAEDC forecast assumes the employment to population ratio in the state will decline slightly as the baby boomer generation enters retirement.] During the same timeframe, Southern California will add about one million jobs, bringing the regional total to almost 11 million jobs.

Thus, total civilian employment in California will grow by up to 33 percent, 1990-2020. The additional economic activity associated with nearly 5 million additional jobs – particularly the energy used for transportation and electricity – only adds to the difficulty of returning California to 1990 GHG emission levels.

In the context of actual (1990-2006) and anticipated (2007-2020) population and employment growth, the only way California will reach the AB 32 goal of returning to 1990 emissions levels will be to sharply reduce emissions per capita.

Figure 11 shows per capita emissions of greenhouse gases in California, 1990-2004, as the blue line. Net per capita emissions (including sinks and sequestrations) fell from 14.3 metric tons per person in 1990 to 13.2 metric tons per person in 2004. Without new measures to curb greenhouse gases, per capita emissions are expected to continue at the current level, shown by the dotted red line.

Figure 11
GHG Emissions Per Capita, 1990-2020

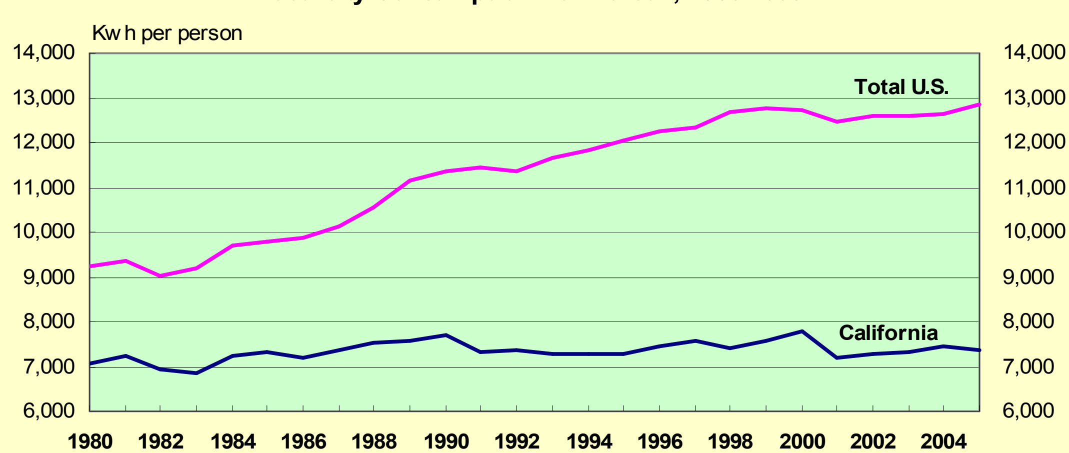


Source: California Air Resources Board (Nov 19, 2007 update), CA Department of Finance

To bring the state's total emissions of greenhouse gases down to the 1990 level of 426.6 million metric tons by 2020, per capita emissions will have to fall by 3.9 metric tons (almost 30 percent) to 9.7 metric tons per person (represented by the dotted green line on the chart).

As if the growing population and economy weren't enough, California also will be challenged by the progress the state has already made in energy conservation and efficiency. For example, Californians use considerably less electricity than the U.S. average and the gap is widening, as shown in Figure 12.

Figure 12
Electricity Consumption Per Person, 1980-2005

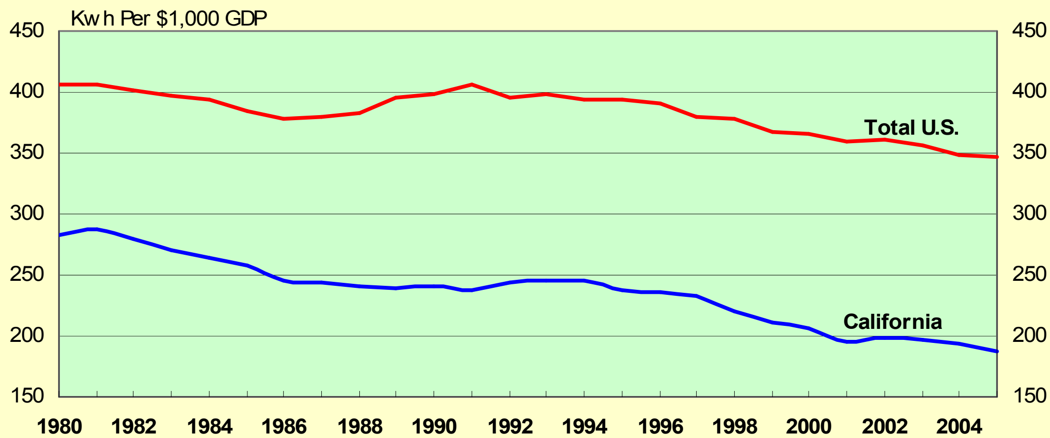


Source: EIA, U.S. Census Bureau

In 1980, Californians used an average of 7,000 kilowatts per person, while the national average was more than 9,000 kilowatts. In the years since 1980, per capita consumption in the state has been fairly steady, rising by just 4.5 percent to 7,400 kilowatts per person in 2005. Nationwide, per capita annual electricity consumption has grown more than 40 percent to almost 13,000 kilowatts – nearly 5,500 kilowatts more than in California.

The electricity intensity of the state economy performed even better, as shown in Figure 13.

Figure 13
Electricity Consumption per $1,000 Real GDP, 1980-2005



Source: EIA, BEA, CA Department of Finance

Electricity consumption in the state was 283 kilowatts per $1,000 of gross state product in 1980, about 30 percent below the national average. By 2005, the state and national economies had both become more efficient in their use of electricity, but California improved more. The state's electricity efficiency improved by about one third, consuming about 187 kilowatts per $1,000 of gross state product. The U.S. economy's efficiency also improved, by nearly 15 percent, to 347 kilowatts per $1,000 of GDP.

Four factors favor lower electricity consumption in California relative to the nation as a whole.

First, the state has a favorable climate, which helps keep down the demand for electricity for heating and air conditioning.

Second, the state has a high rate of import penetration. In this context, an import is any good produced outside the state economy, so both U.S. and foreign goods are included. This is important because it means that the electricity used to produce the imported items was consumed elsewhere, and is not reflected in the state's consumption figures.

Third, while there is a lot of manufacturing activity in California – L.A. County has more manufacturing jobs than any county in the country – the concentration of the most electricity-intensive heavy industries is quite small.

And fourth, California firms and households have been forced to increase their efficiency in response to decades of air quality regulations and comparatively high electricity prices. Indeed, the combination of regulatory requirements and expensive power contributed to the state's low concentration of electricity-intensive industries.

To re-emphasize this point, the comparatively low and efficient use of electricity in California will make meaningful reductions in greenhouse gas emissions through energy efficiency improvements that much more difficult.

III. ECONOMIC STAKES IN GHG REDUCTION

Measures to reduce GHG emission in California will likely impose costs on large swaths of the economy. This will be particularly true post-2020, since meeting the 2050 target – 80 percent below 1990 emission levels – will require dramatic changes in the way we live and conduct business in California. The industries that will be most directly affected are those responsible for the most GHG emissions today. Firms in these industries will face higher production costs in-state, which will make it tougher to compete with out-of-state businesses not subject to the same regulations. (Alternatively, out-of-state firms may be able to raise the prices they charge in California to match the lowest California suppliers.) In this section, we survey the current economic contribution of the sectors that produce the most emissions. We also estimate the indirect economic activity supported by these industries.

Implementation of AB 32 will impact a large segment of the California economy, as shown in Table 4. Direct GHG industries are those listed in the GHG inventory. Statewide, firms in these industries employ 2.6 million workers and contribute $272.5 billion to the state's total economic output (valued at $1.46 trillion). In Southern California (which includes the counties of Los Angeles, Orange, Riverside, San Bernardino, San Diego, and Ventura), the direct GHG industries employ more than 1.3 million workers and account for $125.3 billion in economic output.

Table 4
Size of Greenhouse Gas Industries in California and Southern California

	California		Southern California	
	Employment (# of jobs)	Contributions to CA GDP ($ millions)	Employment (# of jobs)	Contributions to CA GDP ($ millions)
All Industries	16,403,521	1,457,090	9,253,203	830,134
GHG Industries (Direct)	2,609,489	272,461	1,321,369	125,287
GHG Industries (Direct & Indirect)	7,998,748	624,042	3,647,497	291,027
GHG Share	**49%**	**43%**	**39%**	**35%**

Source: Economic Census 2002; CA LMID, QCEW (ES 202); BEA, U.S. Department of Commerce

However, the impact of AB 32 will extend well beyond the direct GHG industries. The direct GHG industries are "high multiplier" activities because their actions affect a multitude of California-based firms in other—indirect—industries. Firms in the indirect industries supply raw materials, component parts, equipment, legal and accounting services to firms in the direct industries. Thus, the indirect firms will feel the effect if direct firms change their production and purchasing behavior because of new AB 32 requirements.

Statewide, the direct and indirect firms in all GHG-related industries collectively employ almost 8.0 million workers, or 49% of California's total of 16.4 million employees. These industries produce a total of $624 billion in economic output, which is 43% of the statewide total. In Southern California, direct and indirect GHG-related firms employ a total of 3.65

million workers, representing 39% of total employment in that region. Their economic output of $291 billion accounts for 35% of the total regional output valued at $830 billion.

Table 5 breaks the GHG-industry totals into seven major sectors. Statewide, the largest sector is construction, with almost 930,000 direct (more than 2.2 million total) GHG-related workers and total economic output of $201 billion. Construction accounts for 36% of the all GHG direct jobs and 29% of economic output in direct GHG sectors. The second largest sector is manufacturing, which employs almost 630,000 direct workers and contributes about $62.7 billion in direct economic output. [Details for individual industries in the manufacturing sector are presented in Table 6.] Transportation is the third largest sector, accounting for about 420,000 direct workers and $40.3 billion in economic output.

Table 5
Greenhouse Gas Industries by Major Sector

Industries	CA Direct		CA Direct and Indirect		SoCal Share	
	Jobs	CA GDP ($ millions)	Jobs	CA GDP ($ millions)	% of Jobs	% of GDP
Major Sector Total	**2,609,489**	**272,461**	**7,998,748**	**624,042**	**46%**	**47%**
Construction	929,950	79,264	2,224,998	201,124	52%	51%
Manufacturing	629,654	62,653	2,746,111	137,062	45%	51%
Transportation	420,163	40,338	1,035,828	98,666	59%	53%
Ag., Forestry & Land Use	378,942	23,722	865,162	50,331	13%	15%
Chemical/Petrochemical	155,212	36,719	771,544	77,428	53%	47%
Utilities	56,400	25,939	253,044	50,399	41%	39%
Waste	39,168	3,826	102,060	9,031	41%	51%

Source: Economic Census 2002; CA LMID, QCEW (ES 202); BEA, U.S. Department of Commerce

The fourth sector is agriculture, forestry and land use. Firms in this sector employ almost 380,000 direct workers and produce $23.7 billion in economic output. chemicals/petrochemicals. Chemical and petrochemical firms employ 155,000 direct workers statewide, and contribute $36.7 billion in GDP. [Additional details on this sector are presented in Table 7.] Firms in the utilities and waste sectors account for about 2% each of direct employment in among GHG industries in California. Utilities, however, contribute 10% ($25.9 billion) of GDP among GHG industries; firms in the waste sector account for 1% ($3.8 billion).

Southern California's shares of total (direct and indirect) employment vary across the different sectors. Firms in the 6-county region make up 46% of total California (direct and indirect) employment and 47% of total statewide economic output in the GHG-related industries. The region's most significant shares are in transportation, at 59% of total statewide employment and 53% of total statewide GDP. The next highest shares for

Southern California are in the chemical and petrochemical sector, where the region accounts for 53% of total employment and 47% of total GHG-related GDP. The region has a 52% share of statewide GHG-related employment in the construction sector. Southern California firms account for 45% of the state's manufacturing employees and 51% of manufacturing-sector GDP. Regional utilities generate 41% of total statewide direct and indirect employment and 39% of total statewide GDP. Agriculture, forestry and land use is the only sector where the region's share of statewide GHG-related employment (13%) is less than 41%.

Table 6 focuses on the manufacturing sector. Statewide the largest industry in this sector by far is computer & electronic products manufacturing (aka "high tech") with more than 1.65 million total (direct and indirect) GHG-related workers and $77.1 billion of total economic output. Transportation equipment manufacturing is the sector's second largest industry with almost 292,000 employees and $20.2 billion of industry GDP. High tech accounts for 60% of total employment and 56% of total sector GDP. Transportation equipment firms employ almost 18% of the sector's workers and produce 15% of its GDP.

Table 6
Greenhouse Gas Industries in the Manufacturing Sector

Industries	CA Direct		CA Direct and Indirect		SoCal Share	
	Jobs	CA GDP ($millions)	Jobs	CA GDP ($millions)	% of Jobs	% of GDP
Manufacturing Sector Total	**629,654**	**62,653**	**2,746,111**	**137,062**	**45%**	**51%**
Computer/Electronic Product Mfg	318,214	66,925	1,653,344	77,132	33%	39%
Transportation Equipment Mfg	127,431	10,172	491,947	20,241	69%	81%
Machinery Mfg	79,843	7,513	271,849	16,417	54%	54%
Nonmetallic Mineral Product Mfg	47,186	5,002	139,869	10,710	49%	51%
Electrical Equip. & Appliance Mfg	31,737	3,278	106,036	7,110	64%	71%
Primary Metal Mfg	25,243	2,763	83,065	5,452	67%	66%

Source: Economic Census 2002; CA LMID, QCEW (ES 202); BEA, U.S. Department of Commerce

Southern California's shares of total (direct and indirect) employment vary across the different industries in the manufacturing sector. Not surprisingly, the region's most significant shares are in transportation equipment manufacturing, at 69% of total statewide employment and 81% of total statewide GDP. The next highest regional shares are in the electrical equipment and appliance manufacturing industry, where SoCal accounts for 64% of total California employment and 71% of total statewide GDP. The region is also important in primary metal manufacturing, where the region generates 67% of total statewide direct and indirect employment and 66% of total statewide GDP.

Table 7 focuses on the chemical/petrochemical sector. Statewide the largest industry is chemical manufacturing (which includes drugs, paints, cleaning solutions and cosmetics as well as traditional chemical products), with almost 504,000 total (direct and indirect) GHG-related workers and $39.8 billion of economic output. Petroleum and coal products manufacturing is the sector's second largest industry, with over 134,000 employees and $28.2 billion of industry GDP. Chemicals accounts for 65.3% of total employment and 51% of total sector GDP. Petroleum & coal products firms employ 17.4% of the sector's workers and produce 36% of its GDP.

Table 7
Greenhouse Gas Industries in the Chemical/Petrochemical Sector

Industries	CA Direct		CA Direct and Indirect		SoCal Share	
	Jobs	CA GDP ($millions)	Jobs	CA GDP ($millions)	% of Jobs	% of GDP
Petrochemical Sector Total	**155,212**	**36,719**	**771,544**	**77,428**	**53%**	**47%**
Chemical Manufacturing	84,366	18,430	503,792	39,822	54%	53%
Petroleum and Coal Products	15,091	13,614	134,364	28,161	18%	26%
Plastics & Rubber Products	55,755	4,675	133,388	9,445	84%	80%

Source: Economic Census 2002; CA LMID, QCEW (ES 202); BEA, U.S. Department of Commerce

Southern California's shares of total (direct and indirect) employment vary across the different industries in the chemicals/petrochemicals sector. The region's most significant shares are in plastics and rubber manufacturing, at 84% of total statewide employment and 80% of total statewide GDP. The next highest shares for Southern California are in the chemical manufacturing industry, where the region accounts for 54% of total California employment and 53% of total statewide GDP. The region's share of petroleum manufacturing lags well behind, generating just 18% of total statewide direct and indirect employment and 26% of total statewide GDP.

IV. The Cost of GHG Reductions

Introduction

This section explores the vexing issue of the economic consequences associated with implementing California's GHG regulations. The LAEDC believes that reaching the state's GHG reduction targets will impose costs on the state in terms of lost jobs and reduced economic output. This will be particularly true for the more stringent 2050 target that requires a drop to 80 percent below 1990 emission levels, despite the addition of millions of new residents. The actual cost will depend on the mix of GHG reduction policies adopted; the extent to which other states and countries join in (reducing the potential handicap for firms operating in California); the scale of potential savings available from energy efficiency improvements; the pace of technological innovation (and its adoption); as well as the discovery (or not) of transformative new technologies.

With many of the most important elements of the AB 32 framework yet to be decided, it is still too early to establish a definitive cost estimate for GHG regulations in California. In this section, we start with a preliminary study of cost estimates developed by CRA International for the Electric Power Research Institute. This study in particular is useful because of its comparison of costs associated with different regulatory approaches.

Next, we examine three influential studies that suggest there will be no cost or even a net economic boost from GHG regulations. Starting with the assumption that GHG regulation will create jobs and save consumers money leads to considerably different policy choices than starting with the assumption that restrictions on emissions will cost money. We explain why the studies suggesting GHG regulation will be "cost-free" are problematic in practice and principle.

Then, we turn to a series of case studies that focus on particular GHG reduction strategies or projects. We use these cases to illustrate the difficulty of predicting the economic impacts of GHG reduction and to draw attention to some of the key issues that policymakers will need to consider in developing the AB 32 implementation strategies.

We conclude with a cost comparison of various methods of reducing GHG emissions from the Swedish utility Vattenfall.

EPRI Study

The study prepared by CRA International for EPRI modeled 20 different strategies to limit GHG emissions.[9] For each strategy, the study estimated the potential reduction in emissions, examined the cost to implement it, and then projected the impact on gross state product, investment, and consumption. All forms of GHG limitation policies entailed economic costs relative to business as usual. While all estimates should be considered preliminary and

[9] Program on Technology Innovation: Economic Analysis of California Climate Initiatives: An Integrated Approach, Volume 1: Summary for Policymakers. Electric Power Research Institute, Palo Alto, CA: 2007.

order-of-magnitude, one of the lower-cost scenarios suggested a reduction in statewide consumption of 1.26% in 2020, a cost of $1,170 per household.

In most sectors, significant GHG emission reductions will raise costs. Higher costs will make California producers less competitive versus their out-of-state competitors. Making a sector less competitive will depress real wages, either directly or by raising prices. The net effect will be a reduction in consumer spending. Some types of policies entail more costs than others and thus have greater negative impacts.

- There is a surprising amount of variability in the economic impact, depending on the policy chosen. The most cost-effective programs cost the state economy one-third as much as the least cost-effective ones.
- Policies that rely on market-oriented abatement incentives appear more cost-effective than command-and-control sector-specific regulations.
- Policies that combine market-oriented approaches with (time for) technological innovation were the most effective.
- Even for market-oriented polices, the incremental cost of abatement (the cost to reduce the next MMT of CO_2) increases as the reduction targets become more stringent.
- Economic impacts will be more severe for industries that are more energy intensive. Three different scenarios showed losses in industrial output across sectors, but the losses were worst in transportation (-5% to -30%) and oil refining (-15% to -30%).

The details of GHG reduction policies matter. One of the key cost factors involves the treatment of imported electricity and the potential for "contract shuffling," whereby power generators in other states sell their cleanest power to California and their dirtier power to everyone else. This shuffling makes it easier for California to meet the target, but without real reductions in global GHG emissions. Regulators could avoid shuffling by requiring contracts only with new generation facilities, but this will increase the cost.

"No-cost" GHG Reduction Studies

A trio of studies from respected sources suggests California can meet the AB 32 targets in 2020 at little or no net cost to the state economy. Indeed, the studies by the California Climate Action Team (CAT), the Center for Clean Air Policy (CCAP), and David Roland-Holst at UC Berkeley argue that policies to reduce global warming emissions will boost the gross state product and create jobs.[10]

[10] The state Climate Action Team prepared the "2006 Climate Action Team Report to the Governor and Legislature." The Center for Clean Air Policy, a think tank whose mission is "to significantly advance cost-effective and pragmatic air quality and climate policy through analysis, dialogue and education" produced the report "Cost Effective GHG Mitigation Measures for California." David Roland-Holst of UC Berkeley wrote a paper titled "Economic Assessment of some California Greenhouse Gas Control Policies: Applications of the BEAR Model."

The LAEDC finds these studies to be overly optimistic. Some policies will surely generate more in savings than they will cost in implementation, but overall, greenhouse gas reduction is likely to be a burden on the California economy. The price may be worth paying, but designing good policy must start with the pragmatic acknowledgement that meeting the AB 32 targets will create winners and losers. In this section, we argue that studies suggesting GHG reduction measures can be implemented without substantial cost are problematic in practice because they underestimate costs and overstate benefits, and problematic in principle, because they overlook the key market failure at the heart of the greenhouse gas issue.

Problematic in Practice

Counting benefits but not counting costs

Roland-Holst assesses the economic impact of some GHG control policies with a sophisticated economic model. He is correct to argue that "many policies under active consideration in California actually *save money* and *increase employment* overall because the indirect effects are so important…energy savings allow consumers to increase other spending, largely on in-state goods and services, and this stimulates California growth and employment…Policies that reduce energy dependence thus yield an economic dividend in the form of savings that can be reallocated to other expenditure." Yet, the opposite is also true: if California residents have to pay more for energy from greener sources, for example, they will have to decrease their spending on goods and services. The ripple effect from the decrease in spending will reduce California growth and employment, just as surely as redeploying savings boost them.

The Roland-Holst study essentially adds up only the positive side of the equation and then, only part-way complete, declares that GHG reduction policies will be a net benefit to the economy. Roland-Holst finds that reducing the state's emissions by 96 MMT CO_2 (56% of the cut necessary to meet the 2020 target) adds $55.5 billion to the state economy. He has not demonstrated that meeting the target will be a net benefit, however, only the far less controversial point that some of the changes will produce benefits (in the form of savings), and that redeploying savings will create jobs.

The challenge in California is the scale of the changes required to reach the 2020 goal. The Roland-Holst study finds that the savings grow but then peak and begin to fall about halfway to the target. Getting the rest of the way will require changes that are more expensive. Instead of a net savings from efficiency gains, there may be a net cost. Imported electric power from coal-fired power plants, for example, is cheaper than power from combined-cycle gas power plants and much cheaper than solar and wind power. Paying more for electricity will necessarily reduce the money available to consumers for purchases of other goods and services produced in the California economy. [This phenomenon is visible in the section on HFC reduction, which shows that HFC reduction strategies can reduce CO_2 by 7.7 MMT in 2020 at a cost to the state economy of $4.6 billion and 6,800 jobs.]

Treating offsetting gains as additive

The CAT and CCAP studies were compiled one sector at a time, an approach that overestimates the potential reduction in green house gas emissions by ignoring the interaction between proposed regulatory actions. Measures to improve fuel efficiency will reduce GHG emissions and so will smart growth strategies that reduce travel demand. But some of the successes of these programs will be offsetting.

Persuading people to choose cars that get 40 mpg instead of 14 mpg for their 50-mile commute to work will reduce GHG emissions. Changing urban land use patterns so that people commute 5 miles to work instead of 50 also will reduce emissions. The results of these two policies, however, are not necessarily additive, since switching from a vehicle that gets 14 mpg to one that gets 40 mpg will have much less impact if one is traveling 5 miles to work instead of 50. Overestimation of the reduction in GHG emissions is important because it suggests that further (potentially costly) cuts beyond those considered by the studies will be required to reach the 2020 target.

Counting savings from impractical or unrealistic options

The CCAP study contends there are cost-free savings to be had by shifting 10 percent of the state's truck traffic to rail, based on a national study by the American Association of State and Highway and Transportation Officials (AASHTO). Moreover, the study argues there will be fuel cost savings of $713 million, and increased rail infrastructure costs will be offset by reduced highway costs and user cost savings. The AASHTO study is plausible in an interstate context, but its findings are probably not applicable to intrastate freight movement.

Within California, it is unclear whether 10 percent of truck traffic could in fact be shifted to rail. First, much of the freight that travels within the state by truck today is not suitable for shipment by rail. In-state traffic tends to be between two (or more) points that are not connected by rail. Even if shipment by rail were convenient, it is not likely to be cost-effective. Trucks have the price advantage for journeys under 500 miles; rail has the advantage for trips over 1,000 miles; and the tipping point from one to the other is somewhere in between. Second, the volume of freight shipped on rail lines in the state is already growing rapidly, straining the existing infrastructure. International cargo moving by rail to and from the San Pedro Bay ports in particular already threatens to outpace intermodal lift and rail capacity. Shifting an additional 10 percent of the state's truck traffic to rail seems a dubious proposition given the ongoing challenges posed by the long-term trend of increasing rail traffic.

Overestimating Savings

An analysis by the AEI-Brookings Joint Center for Regulatory Studies (Joint Center) contends that the CAT study overestimates the savings from GHG reduction policies by billions of dollars.[11] Two overestimation errors, related to the conflation of private and social cost savings, stand out.

First, the CAT study overestimates the potential savings from energy efficiency measures by about $2 billion because it computes the savings using retail rather than wholesale electricity rates. The CAT study estimates a reduction of 51 million megawatt hours by 2020, valued at $5.6 billion based on a retail price of 11 cents per kWh. The retail price, however, includes fixed costs such transmission, distribution and administrative overhead in addition to the generating costs. Reducing electricity demand through efficiency measures only reduces generating costs. The Joint Center paper cites a 2003 study by the California Energy Commission that found the average cost of electricity generation that can be avoided through demand reduction is 7 cents per kWh. This means the savings from energy efficiency measures are likely to be nearly 40 percent lower than estimated by the CAT study.

Second, the CAT study makes a similar subtle mistake in estimating the savings potential from the adoption of more fuel-efficient vehicles. The substantial estimated savings are based on the retail price of gasoline, which includes federal and state taxes excise taxes, plus state sales tax. The adoption of more fuel efficient vehicles will extend the long-term trend of declining tax revenue per vehicle mile traveled. Eventually, the shortfall in government revenue will have to be made up, either by increasing the fuel taxes or by raising other taxes or fees. The mild assumption that the state and federal government will not permanently let their tax revenue collections slide suggests that the actual savings will be less than portrayed in the CAT study.

Uncounted Costs

The CAT report and the others frequently ignore or understate the private costs that will be associated with many of the proposed GHG reduction programs. Roland-Holst, for example, avers that "most of the GHG policies considered can enlist significant private agency at a public cost that is a small fraction of the potential benefit." Private costs, which are excluded from his model due to lack of data, are still costs! More to the point, any private funds that are channeled into GHG reduction programs will necessarily reduce the spending available for purchases of other goods and services produced in the California economy.

Part of the Roland-Holst study also glides over the scope of potential consumer expenditures, explaining, for example, that "savings in vehicle operating expenses far outweigh the initial cost of more efficient vehicles, with payback periods averaging less than three years." Such a statement may be valid if a consumer is trading a Chevy Tahoe for a Toyota Prius, but it is demonstrably false when trading a regular gasoline-powered vehicle for a hybrid version of the same model.

[11] Stavins et al, "Too Good to Be True? An Examination of Three Economic Assessments of California Climate Change Policy," American Enterprise Institute-Brookings Institute Joint Center for Regulatory Studies. The Joint Center is notable for its collaboration between conservative (AEI) and liberal (Brookings) economists.

The Joint Center study points to several other areas where the costs of GHG reduction programs are ignored or uncounted:

- The studies consider the programmatic costs of some energy efficiency programs but not the cost to consumers and businesses. In estimating the cost of Demand Side Management (DSM) programs to curtail electricity use, for example, the cost to the utilities to offer incentives and run public education campaigns is considered. The additional cost to consumers, however, is not. The consumer cost is probably higher than the utilities' costs (which are themselves passed on to the ratepayers), since taking advantage of a rebate on a newer, more efficient refrigerator, for example, would still require the outlay of hundreds of dollars.

- Some of the programs will cost an as-yet-unknown amount to implement and administer. All of the studies, for example, propose the use of forestry programs to sequester carbon. The expense of designing a standard methodology for measuring the carbon-dioxide-equivalent sequestered and then routinely applying such a methodology may be trivial.

- Some GHG reduction programs will require a trade-off in quality of goods, the cost of which is not considered. The CAT report, for example, assumes consumers will trade performance for fuel efficiency in vehicles and place no value on the foregone power. Similarly, the CCAP study counts the emissions and production savings from switching to limestone cement blends without considering any additional expense that might be required to offset the reduced structural integrity of limestone blends.

Problematic in Principle

While there are certainly some programs that will offer California firms and consumers substantial savings, policymakers should be wary of promises that GHG reduction programs can be implemented without substantial cost to the economy. The first response to any alleged savings driven by energy efficiency improvements should be to wonder *why a government program or mandate is needed to enforce their adoption if the savings are so substantial.* For the savings to be substantial, yet not realizable without government intervention, implies a market failure.

The Joint Center study addresses this point directly, and is worth quoting at length:

> Many improvements in energy efficiency may be socially costly for one of two reasons. First, energy efficiency improvements may be impeded by market barriers that represent real economic costs, rather than market failures. Second, even where market failures are present, the cost of policies to address them may exceed resulting savings.
>
> [Therefore, we should ask of a study that claims to find savings:] Has the study truly identified a market failure that provides an opportunity to

> improve economic efficiency through policy intervention? Or, has the study instead incorrectly estimated the economic costs of the examined measures? Put simply, if opportunities truly exist to reduce costs while reducing emissions, why would potential beneficiaries of these opportunities not undertake them voluntarily? Also, if a market failure is present, can policies address that failure without imposing costs that exceed resulting savings?"

The real issue is not that firms and consumers face barriers to adopting practices and technology that will save them money. Rather, the problem is that polluting is free. Today, firms and consumers do not have to pay anything toward the long-term costs that will be imposed by the GHG emissions associated with their actions. To quote the Joint Center study again,

> The core market failure leading to excessive GHG emissions is the failure of emitters to internalize the social cost of their emissions, and thereby the social benefit of emission reductions…
>
> The fact that the core market failure leading to excessive emissions is the failure of individuals and firms to internalize the cost of their emissions suggests that a market-based policy, such as a cap-and-trade system, should be the core policy instrument employed. By creating a price signal that reflects the social cost of emissions, market-based policies can address this core market failure far more cost-effectively than can standards or other policy approaches...the possibility that there may be some no-cost emission reduction opportunities suggests that *additional,* carefully targeted policies should be considered. Such policies should serve as *complements,* rather than alternatives, to market-based policy because they address fundamentally different market failures.

Measuring the Cost of GHG Reduction: Selected Case Studies

Reducing greenhouse gases will require measures that put a price on emissions (directly) or compel people to act as if there were a price for emissions (indirectly through government programs).

Paying to reduce carbon emissions will, of necessity, impose some costs on the economy. In a closed economic system, imposing a price on GHG emissions (by compelling their reduction) would mostly involve a reallocation of resources within the economy plus any frictional costs from administering the program. The danger for a comparatively small jurisdiction within an open economy, such as California, is that the resource reallocation may spill across the state's borders and may ultimately cost the economy. The results will depend on how much activity leaves the state, and on the overall balance as spending on goods and services shifts in response to the greenhouse gas regulations. We attempt to illustrate this and other policy challenges in the following case studies.

CASE STUDY: Proposed Early Action Strategy – Reduce hydrocarbon emissions from pleasure craft

One of the proposed early action strategies seeks to reduce hydrocarbon emissions from pleasure craft (including inboard, outboard, sterndrive, and personal watercraft) by requiring the inclusion of an evaporative control system. Hydrocarbons are ozone precursors and ozone is a greenhouse gas, so reducing hydrocarbon emissions would contribute to meeting the AB 32 targets.

On the surface, this proposal is attractive. The evaporative control systems – low permeation fuel lines and tanks, carbon canisters and fuel injection – are proven technology. They have been used in on-road vehicles for decades; have been required in some off-road vehicles; and a trial study demonstrated their feasibility in marine applications. The equipment is expected to increase the price of a boat to consumers by $350, less than 10 percent of the price of a new personal watercraft, and a tiny fraction of the price of most boats. And the rule would apply only to new pleasure craft, starting in 2012, so there would be no retrofits of existing boats.

Predicting the impact of such a seemingly simple rule on the California economy is complicated. The easy part is the aggregate cost: at $350 per boat, the cumulative cost to consumers is projected to be $310 million by 2020, rising to $1.13 billion by 2035. The $350 spent on the control system, however, has neither appeared from a vacuum nor disappeared into one.

On the plus side, the $350 for the control equipment will be directed to the boatbuilding and engine equipment manufacturing industries, where it will create additional employment, boosting wages and state taxes.

On the downside, boat buyers will have $350 less to spend on other items than they would without the regulation. To the extent that they spend less on other purchases – such as lattes, clothes or movie tickets – it will reduce employment (and the associated wages and state taxes) at coffee shops, apparel stores and theaters.

Whether the shift in economic activity precipitated by the regulation will be a net benefit to the state economy depends on the California content of the goods and services being purchased. In general, substituting goods and services produced in-state for goods produced out-of-state will raise employment in California and boost the economy. The reverse is also true.

In the case of the control equipment for pleasure craft, what matters is that California is a net importer of boats. The 2002 Economic Census reported that the state's boat dealers earned 8.0 percent of the industry's $12.4 billion in sales nationwide, while California boat builders earned 3.9 percent of the industry's national revenues of $8.5 billion. This suggests that increasing spending on the boat building industry will create some jobs in California, but much of the money (and jobs) will be directed to out-of-state firms.

The overall impact of this rule on the state economy, therefore, depends on whether the $350 increase in the price paid by boat purchasers would have otherwise been spent on goods and services with greater or lesser California content. If the spending is pulled from predominantly imported goods, the rule could actually help the state economy. If price increase translates into fewer purchases of California-made goods and services, it will hurt the economy.

Note: this is not one of the adopted early items because the science related to the warming impact of hydrocarbon emissions is still being worked out. The air quality improvements are clear, however, an advantage that would have to be added to the benefit side of any cost-benefit analysis for this strategy.

CASE STUDY: Nellis Air Force Base Solar Project

Nellis Air Force Base in southern Nevada is the site of the largest solar plant in North America, a new 15-megawatt plant consisting of 70,000 solar panels on 140 acres on the base. The project is a public-private joint venture between the Nellis AFB, MMA Renewable Ventures, and Sun Power Corp.

Nellis AFB leased the land free of charge to MMA. In return, the AFB has a 25-year contract to purchase power for 2.2 cents per kilowatt hour. This is a substantial savings (expected to be about $1 million per year) on the 9 cents per kWh it pays for energy from Nevada Power.

MMA invested $100 million in the 15-megawatt plant, which was built and is operated by SunPower Corp. After SunPower Corp is paid, MMA earns an investment return from its sale of power to the AFB and from its sale of energy credits to Nevada Power. The energy credits are equivalent to the 24,000 tons of CO_2 that would have been created if the base had been served instead by a 15-megawatt coal plant. Nevada Power purchases the credits because it is required by state law to produce renewable power or buy renewable energy credits.

Despite its location next door in Nevada, this case is relevant to understanding California GHG regulations because of the economics involved. The new facility avoids 24,000 tons per year of CO_2 emissions. Despite free use of the land on which it is sited, the power plant cost $100 million to build. The power is sold at a discount to the AFB, but even if the base agreed to continue paying the same rate it paid before (9 cents per kWh), the plant would be uneconomical. No one in the private sector invests $100 million with the expectation of earning a return of $1,350,000 (1.35%) per year. The key to the deal, therefore, is the credits being purchased by Nevada Power.

This means that customers of Nevada Power are effectively paying for the solar power plant (and the reduction in emissions) through their rates. The rate increase necessary to purchase the credits is probably imperceptible to individual ratepayers in Nevada. In aggregate, however, several million dollars per year that might otherwise have been spent on goods and services in Nevada will be used to purchase the credits.

The sale of the credits, meanwhile, benefits San Jose, California-based SunPower Corp. and MWA Renewable Ventures LLC of San Francisco. Determining whether a regulation leads to a net gain or a net cost to a state economy will depend on the balance of transactions of this sort and whether they take place across or within state lines.

CASE STUDY: Early Action Strategy – Tire pressure program

The CARB staff recommendation for the tire pressure program describes it as follows:

> Maintaining a vehicle's tire pressure to the manufacturer's recommended specifications is a practical strategy to achieving early greenhouse gas (GHG) emission reductions. Current Federal law requires auto manufacturers to install tire pressure monitoring systems in all new vehicles beginning September 1, 2007. Staff recommends that the ARB investigate strategies to ensure that the tire pressures in older vehicles are also monitored, as well as requiring the tires to be checked and inflated at regular service intervals. One potential strategy would be to require all vehicle service facilities, such as dealerships, maintenance garages, and smog check stations, to check and inflate tires.

CARB estimates that a program to correct tire pressure would save Californians a minimum of .54 MMT of CO_2 emissions in 2010 (the first year of implementation) and 0.20 MMT of CO_2 emissions in 2020. The estimates are based on three assumptions:

- Gas mileage drops about 0.4 percent for every one pound per square inch (PSI) drop in tire pressure.
- The National Highway Traffic Safety Administration (NHTSA) estimates that 74 percent of all vehicles have at least one significantly under-inflated tire.
- The 2010 estimate is based on 27 percent of vehicles having at least one tire severely under-inflated (by 25 percent or more of the manufacturer's recommended pressure); 47 percent having tires under-inflated by 1 PSI; and 26 percent having the correct pressure.

This is an interesting illustration of the cost/benefit issue. The savings are large in the aggregate – 61 million gallons of fuel saved in 2010, worth $213.5 million @ $3.50 per gallon – yet the individual benefit for the majority of Californians will be indistinguishable from zero.

For 73 percent of drivers, the savings from this program could be zero or trivial. A vehicle that gets 14 mpg, with a 20-gallon tank, and one tire under-inflated by 1 PSI, would save about $0.28 per tank, or less than the typical impact of routine price variation between service stations. Vehicles with better gas mileage would save even less.

For the 27 percent of drivers with a tire under-inflated by 25 percent (8 PSI), savings will be noticeable, but still modest. The same vehicle in the example above, this time with a tire under-inflated by 8 PSI would save $2.24 per tank. Again, the savings from inflating tires properly would be lower for vehicles with better baseline mileage per gallon.

With such paltry financial incentives, drivers are unlikely ever to undertake the proposed action based solely on the expected risk/return. Thus, this type of action is only going to happen via regulation (such as requiring the tire check and inflation at each servicing). Whether the costs will outweigh the benefits depends on the cost of tire inspection and inflation program. CARB cites a study suggesting the cost in labor would be $3.75 per vehicle. There were 21 million cars and light trucks in California. Suppose all but 10 million have automatic monitoring systems and are exempt. If the cost is $3.75 per vehicle, motorists who are covered by the regulations will pay $150 million in 2010, assuming 4 visits per year. One quarter of the motorists – those with the severely under-inflated tires – will recoup the cost of a visit on their second tank full; for the rest, the cost is a complete loss with little or no prospect of offsetting savings.

CASE STUDY: Early Action Strategy – Green Ports

The San Pedro Bay ports have adopted comprehensive clean air strategies covering all harbor-related activity, including cargo ships, harbor craft, dockside equipment (cranes and yard hostlers), plus trucks bringing containers to and from the port. The early action strategy focuses on one aspect of the comprehensive plan, providing electricity from shore to ships at berth.

Until recently, all ships docked in the harbor continued to run auxiliary engines to meet onboard electrical demand. Cargo ships burn especially dirty fuel, and are a significant source of nitrogen oxides (NO_x) and diesel particulate matter (PM) emissions in California. The goal of 'cold ironing' programs is to allow ships to plug into the local electric grid so that they can turn off their auxiliary engines. Health concerns prompted the program, which is expected to reduce NO_x and PM emissions by more than 90 percent. Shore-based power can be generated from less carbon-intensive sources, so the program doubles as a GHG reduction strategy.

The ports are an obvious place to look for GHG reductions. The San Pedro Bay ports and related activity, for example, are among the largest sources of NO_x, SO_x and diesel particulate matter emissions in the state. Cleaner, more efficient port-related activity therefore has the potential for a twofold advantage: reduce "standard" air pollutants and lower carbon dioxide emissions.

CARB estimates the program will reduce NO_x emissions by 19,000 tons per year; PM by 500 tons per year; and CO_2 emissions by 0.5 million metric tons. The program will be expensive, with an estimated cost of more than $1.2 billion. Port and terminal improvements account for one-third of the cost, modifications to new and existing ships will account for the rest. In addition, ports will also have additional annual capital and operating expenses of about $325 million by 2020.

The plan is technically feasible but faces serious challenges including the availability of electricity; standardization of electrical hookups and plug-ins; and sufficient visits of designated ships to California to make this action plan cost-effective and economically sound.

Making the ports cleaner will be expensive: the green ports early action item will cost more than $1 billion and it is just one element in a much larger initiative.

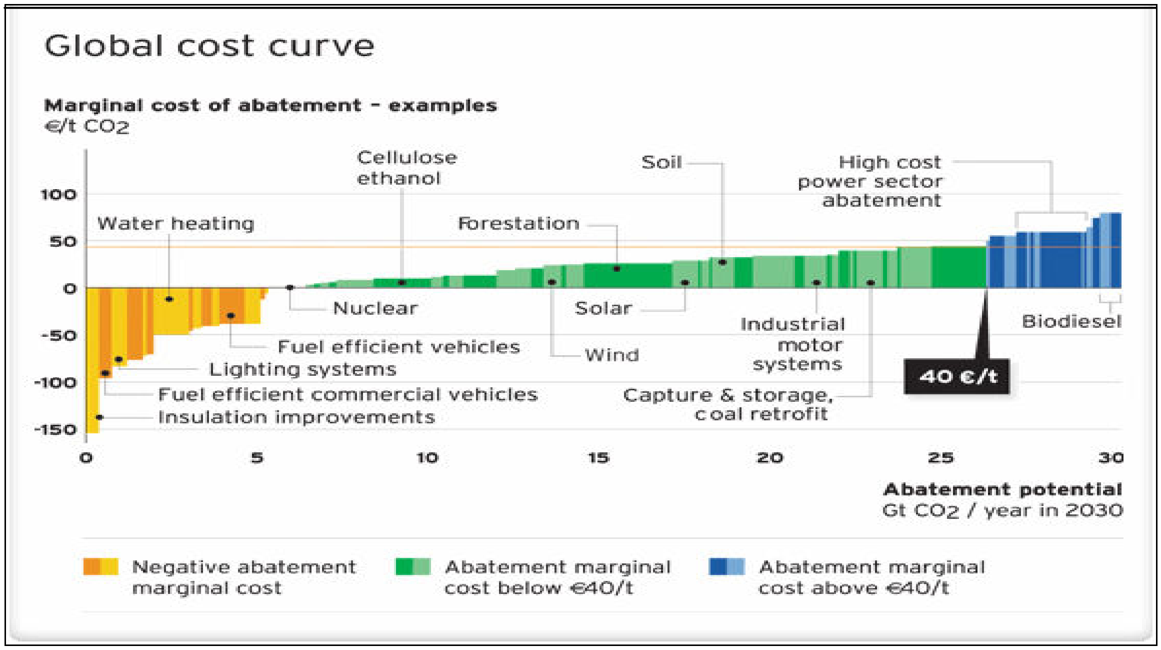
The ultimate cost of newer, more efficient equipment and strategies at the state's ports will be borne by the customers who purchase the goods being transported by ship. The added cost of the container fees required to pay for the (larger) green ports initiative will add only a small percentage to the total cost of the affected goods. Californians will pay slightly more for imported goods (and to export goods), with a related reduction in spending on other goods and services. Much of the cost, however, will be paid by people living elsewhere in the U.S. California ports are the country's gateway to the Pacific Rim, and at least half of the goods moving through them are destined for other states. The San Pedro Bay Ports alone handle 40 percent of the nation's container traffic. Consumers in Kansas, for example, enjoy lower prices for imported goods due in part to the traffic moving through the ports. It seems only fair that they should help bear the costs of cleaning up the pollution caused by their purchases.

On balance, this is one GHG reduction strategy where California is ultimately pulling in money from out-of-state consumers to spend on improvements whose economic benefits will largely be enjoyed by workers and firms in the state. This logic will hold as long as the fees are not so high as to place the state's ports at a competitive disadvantage to potential alternatives.

GHG Reduction Cost Comparison – A European Perspective

The cost of carbon dioxide reduction strategies varies substantially. Some strategies are relatively cost-effective, allowing those who implement them to recoup the abatement-related costs within a short period. At the other end of the spectrum are strategies that may reduce CO_2, but only after incurring substantial cost. A Swedish utility company, Vattenfall, has invested considerable time and effort in researching GHG reduction strategies. Vattenfall has prepared a comprehensive global mapping of GHG abatement opportunities through 2030, including "deep dive" assessments of the forestry, transport, agriculture & waste, power, buildings, and industry sectors. One of the more interesting products of their effort is the global cost curve reproduced in Figure 14 on the next page. The figure shows Vattenfall's estimate of the marginal cost of selected CO_2 emission reduction strategies, in €/t CO_2 (Euro per ton of CO_2).

Figure 14
The Marginal Cost of Carbon Dioxide (CO_2) Abatement by 2030



Vattenfall divides the strategies into three groups. Strategies that pay for themselves through efficiency savings, such as insulation improvements and improved lighting systems, are in yellow and orange. Strategies that cost less than €40/t CO_2, such as solar and wind power, are in green. And strategies that cost more than €40/t CO_2, such as the adoption of biodiesel, are in blue. The height of the bars above (or below) indicates the cost; the width of the bars suggests the scale of the opportunity (how much CO_2 could reduced globally). From a California perspective, the absolute cost matters less than the relative cost comparisons.

V. Strategies for Implementing AB 32

Introduction

AB 32 sets clear goals – reduce the state's GHG emissions to 1990 levels by 2020 and to 80 percent below 1990 levels by 2050. But the law leaves it up to state agencies to decide upon the best approach to reach them. Thus far, the debate has centered on the relative merits of market-based mechanisms and command-and-control regulations and the appropriate mix of each. As a general rule, the LAEDC prefers the efficiency of market-based mechanisms that set the broad parameters and then allow firms and individuals (rather than regulators) to decide upon their most cost-effective alternatives. In this section, we describe the general theory underpinning market-based approaches; discuss their strengths and weaknesses; and consider the performance of such systems to date. Before diving into the details of how to meet the state's goals, we pause to consider which goals the state is trying to achieve.

AB 32 is a piece of legislation that leaves considerable leeway between the letter of the law and the spirit of the law. Policymakers who focus too narrowly on meeting the AB 32 targets (the letter of the law) risk at least two potential pitfalls: in one, California reduces its own emissions at the expense of rising emissions in neighboring states; in the other, the state meets its targets but at the expense of its economy.

In the first scenario, the California policymakers ignore the consequences of firms' (and energy markets') reactions to changes in state policy. California's electricity sector, for example, could meet 1990 emissions levels simply by rearranging their power contracts. A study from the Center for the Study of Energy Markets (CSEM) argues that there is enough existing low-carbon electricity in the West to meet all of the state's projected demand in 2020, provided producers sell their low-carbon power to California and shift their dirtier power to other purchasers.[12] In this case, California might well meet its own AB 32 targets while leaving overall GHG emissions unchanged.

In the second scenario, policymakers focus on lowering emissions and ignore the potential economic costs. The CSEM study argues that a command-and-control policy like renewable portfolio standards (RPS) may be the most effective approach to reducing emissions from the electricity industry because the standards cannot be met from pre-existing sources of renewable power, as very little renewable capacity exists. (This makes the standards binding.) Yet, "RPS may be one of the less efficient means of achieving GHG emissions reduction. Unlike a more flexible carbon cap, it does not reward generation from non-renewable sources of low carbon power, and rewards energy conservation only very weakly."

The LAEDC is doubly concerned about the RPS approach. Renewable energy tends to be considerably more costly than more carbon-intensive alternatives, which means that California's ratepayers will have to pay more for power. This will reduce spending on other

[12] James Bushnell, Carla Peterman, Catherine Wolfram, "California's Greenhouse Gas Policies: Local Solutions to a Global Problem?" (April 2007) The Center for the Study of Energy Markets is a program of the University of California Energy Institute, a multi-campus research unit of the University of California located on the Berkeley campus.

goods and services in the state economy. Moreover, if higher energy costs and stricter emissions controls prompt an exodus of industrial users from California, it could punish the state's economy. Policymakers *must not let this happen*, not least because it will discourage other states and countries from following California's lead.

It's important to acknowledge that making tangible progress on climate change (the spirit of the law) of necessity requires cooperation from other states and other countries. Global GHG emissions are rising too rapidly for cuts in California alone to make any difference. The state could be a catalyst for global action, however, if it can demonstrate sensible policies that reduce GHG emissions without harming the economy. Policymakers should resist the temptation to cut emissions too deeply too soon, because the cost of such cuts rises as the timeframe is shortened and as the targets are tightened. If action on climate change produces results that look like the state's botched attempt at electricity deregulation, the costs will be large indeed, both to the state economy, and to the global cause of GHG reduction.

Developing countries, in particular, may decide that if one of the richest economies in the world cannot get GHG regulations right, then the price is too high for them to chance it. The priority for policymakers should be to adjust the timeframe and the targets as necessary to produce the smoothest possible transition to a low-carbon economy. Whether California's GHG reduction efforts make the state a visionary leader or a mad Spaniard tilting at windmills will depend on how painlessly we can make the needed cuts. Ironically, policies that generate the deepest cuts in the state's emissions soonest may be less in keeping with the spirit of AB 32 than more modest measures which, by encouraging replication elsewhere, nonetheless lead to the greatest net reduction of GHG emissions, regardless of origin.

Market based approaches

Market-based approaches to GHG regulation use a price signal to influence behavior. Since firms and individuals typically respond to rising prices by attempting to minimize their costs, price signals can be an efficient way to lower emissions. GHG emissions represent a market failure because emitters do not have to pay anything towards the long-term costs associated with their contribution to climate change. Forcing emitters to pay some of these costs – to put a price on polluting – creates a powerful incentive to reduce emissions. This approach shifts the information burden from regulators to firms and individuals, who know more about their own circumstances and thus are better positioned to determine their most cost-effective course of action.

Placing a tax on products and activities that generate GHG emissions would be the most straightforward way to raise the cost of being an emitter and to create an incentive to reduce emissions. Such a tax would create a clearer link between prices and emissions than generally higher price levels brought about by firms' compliance with regulatory directives. Taxes are blunt instruments, however, when it comes to controlling the level of activity being regulated. Firms and individuals might decide it was more cost-effective (or easier) to pay the tax and accept the higher cost than to change their behavior or make an investment that lowered emissions. (Presumably, the proceeds of the tax could be used to fund emissions-lowering investment, but this negates the underlying rational for the tax in the first place, namely that firms and individuals will make more efficient decisions than a regulator would.)

A cap-and-trade approach that establishes a market for carbon dioxide emissions is another way to create a financial incentive to lower GHG emissions. Cap-and-trade systems start by setting a limit on the total annual pollution from a designated source, which can be defined in several ways, such as all emitters within a geographic area, or all firms in a particular industry. Next, annual pollution allocations are divided up among the market participants. Allocations may be simply assigned to market participants: existing polluters receive an allotment based on some standard or metric such as historic emission levels or the emissions produced by a particular technology. Alternatively, allocations may be auctioned, in which case firms place bids for the number of credits needed to match their expected emissions.

Firms covered by the cap must measure and report all emissions. Participants can emit pollution up to the amount covered by their allotment. If a firm exceeds its allotment, it must pay fines. If the firm emits less than its allotment, the difference becomes a credit, which can be sold. Companies are free to buy and sell emission allowances to maintain their operations in the most profitable manner. Credits trade at variable prices depending on availability and demand. The resulting market for pollution credits allows firms to create custom-tailored emissions reduction strategies. Aggregate emissions level fall over time as the annual cap is lowered.

Advantages

The principal advantage of a cap-and-trade system is that firms choose between the sale and purchase of allowances, making technological improvements, and implementing new emission controls. Those companies that can reduce emissions at lower cost sell their extra allowances to those facing much higher costs (or retain the credits for future use). Thus, the cap-and-trade approach gives companies flexibility to achieve their emission targets in the most cost-effective way possible *for them*, while setting a strict overall limit on the total emission level. Government's role is limited to setting cap levels, issuing (assigning or auctioning) allowances, and monitoring emission levels.

The limited government role and the market-driven price for emissions reduction can make a cap-and-trade approach particularly attractive when there is broad disagreement about the potential cost of cutting emissions. A safety valve provision – wherein the regulator agrees to sell an unlimited number of emissions allowances whenever the market price for credits exceeds a certain threshold – could help eliminate some of the uncertainty surrounding the cost of GHG reductions. The Joint Center study suggests that it may be easier to agree on the threshold above which the costs of reductions would constitute too high a price for California firms: "While firms would still undertake all emission reductions necessary to meet the cap that are less costly than the safety valve's 'trigger price,' the safety valve ensures that allowance prices – and thereby the costs incurred to reduce emissions – will never rise above this trigger price."

Successful programs

The U.S. government has successfully used a market-based cap-and-trade approach to address acid rain in the Northeast and Mid-Atlantic regions. Acid deposition or acid rain occurs when emissions of sulfur dioxide (SO_2) react in the atmosphere, creating acidic compounds that fall to earth in either wet form (rain, snow, and fog) or dry form (gases or particles). The acidic compounds damage the environment, harming (or killing) plants and wildlife, and creating health problems for humans. The largest source of SO_2 pollution is coal-fired electric power plants.

The first phase of the acid rain reduction program started in 1995 with an annual cap of 11.9 million tons, which compares with annual emissions in 1980 of 17.3 million tons. The second phase reduced the annual emissions cap to 9.5 million tons per year starting in 2000. The cap will be further reduced to 8.95 million tons per year starting in 2010.

The program has already demonstrated significant positive results. In 2002, SO_2 emissions from electric power plants were 7 million tons lower than they were in 1980, a 41 percent decrease, and 5.4 million tons lower than 1990. The lower emissions have substantially reduced the chances of residents in the region getting chronic bronchitis, asthma, and other respiratory diseases, yielding health benefits estimated to be in excess of $70 billion annually. The cost of the program has been lower than expected. The European Union used the U.S. sulfur dioxide cap-and-trade program as the model for its Emission Allowance Trading Scheme as part of its GHG reduction strategy.

Disadvantages

The "cap and trade" approach may not be very efficient or beneficial when polluters have identical or similar costs for reducing pollution. When all companies have the same burden of reducing emission levels, there is no incentive to trade allowances.

Cap-and-trade programs create markets for emissions, and markets can be volatile. The EPRI study points out that prices in the federal sulfur dioxide emissions reduction market described above "skyrocketed in 2005 from about $500/(short) ton to over $1500/(short) ton. One year later, prices for the same allowances had fallen again, dipping below $400/(short) ton, with no change in underlying regulatory requirements or technology." Prices in the European Union's Emission Trading Scheme have been similarly erratic. [EPRI notes that price spikes, such as those caused by extreme weather or shifting energy markets, might be alleviated with a safety valve provision, though doing so may cause the cap to be exceeded.]

Designing a cap-and-trade system can be difficult. The first hurdle is setting up the market to cover an appropriate geographic area. The challenge is to strike the right balance: the area must be small enough for the reductions to have the desired effect yet large enough to sustain an efficient market. The CSEM study illustrates this problem with reference to two NO_x emissions markets: the RECLAIM program in Southern California and the much larger program in the eastern US.

RECLAIM did not include the San Francisco Bay Area because reductions there would not help relieve smog conditions in Los Angeles. Smaller markets, however, have fewer participants and are less liquid. They are also "more likely to be dominated by one or two large polluters who may enjoy market power either in the product they produce or in the pollution credits. It appears that the RECLAIM was plagued by both of these problems." The NO_x emissions market in the eastern U.S., in contrast, covers 19 states. Most of the reductions to date have been concentrated in southern states, though the harm is concentrated in Midwest and Northeast. The LAEDC observes that this could mean the market is working. The least expensive reductions (in the south) have been made first. Additional cuts in the Northeast will likely follow as the overall cap is lowered, and once the 'low-hanging fruit' in the South is gone.

The second hurdle in designing this type of system involves setting the cap. If the initial cap is too low, then the price of the credits will be too high and will be a serious financial burden for the covered firms. If the initial cap is too high, then the credits will be too inexpensive (or simply unnecessary) and firms will have little incentive to make cuts even at low cost. There is general agreement that the initial limits for the European trading market for greenhouse gas emissions were too high. This initial error on the side of caution is probably preferable, as it can be easily corrected in the second phase when the limits are expected to be tightened considerably.

Specific California Challenges

Designing a cap-and-trade program for GHG reductions in California will certainly be challenging. The CSEM study, in particular, finds that a cap-and-trade market that covers just California could be "gamed" by shuffling contracts for imported power. Expanding the market to include Arizona, New Mexico, Oregon and Washington, they argue, would reduce but not entirely eliminate this problem. Perhaps adding still more states would help?

Expanding the geographic reach of the California market is generally regarded as a positive move, and the Governor's Executive Order directs state agencies to explore linkages between the European emission market and the proposed regional market in the Northeast. EPRI sounds a cautionary note on these plans, explaining that the EU is likely to be a net purchaser of permits (and therefore not a source of cheaper credits for California firms). Trading with the Northeast may require federal legislation. More importantly, such trades could have some perverse unintended consequences (by driving up carbon emission credit prices in the Northeast and making California a de facto purchaser of coal-fired power from Midwest, for example) unless both systems were carefully designed.

Given the challenges of creating a successful cap-and-trade program, why avoid command-and-control polices, especially when command-and-control looks so much easier? The command-and-control approach, however, could be more expensive than necessary. This raises the cost of compliance, which translates into lower output, reduced spending (on other goods and services) and lost jobs. Since California will only make a meaningful difference on global climate change by taking a leadership role in demonstrating that emission reductions can coexist with a strong economy, the market-based approach seems the better choice.

VI. BUSINESS PRINCIPLES FOR IMPLEMENTING AB 32

Implementation of AB 32 means changing the way Californians live and do business, perhaps dramatically. The process of adapting to AB 32 will occur over a period of years. Change of this magnitude increases uncertainty and will impose costs and other burdens on those [firms and individuals] charged with implementing the new rules and regulations. Thoughtful design of the goals and processes is needed to turn the AB 32 targets into reality. They also can help to reduce uncertainty and costs.

The AB 32 Implementation Group, a coalition of businesses throughout California, developed the following set of business principles to guide regulators and other interested stakeholders as we move the initial regulatory design process. The principles reflect a certain point of view. Given the targets set by AB 32, (1) how can California achieve the targets for reducing emissions at the lowest cost? Simultaneously, (2) how can we maintain our strong California economy and avoid potential harm? Finally, (3) are there ways for California business firms to grow and profit by reducing greenhouse gas emissions?

1. Reduce global emissions *and* keep jobs in California

- In designing the implementation plan for AB 32, California must give equal emphasis to retaining jobs and reducing emissions, since focusing exclusively on one will almost certainly cost it the other. [Favoring job retention suggests policies that do little to reduce emissions; blindly reducing emissions could cause firms (and jobs) to leave the state.]
- In the worst case, a company leaves California, moving the associated jobs and emissions to another state or country with a less intrusive regulatory regime. The state loses jobs without any net global reduction in emissions. Net emissions may even increase if the new jurisdiction is less stringent than California.
- What types of businesses might leave the state? Firms in "export" industries sell goods and services to out-of-state customers. Key export industries in California include: high technology, direct international trade (goods moving through the ports and carried out-of-state by rail and truck), tourism, defense/aerospace, agriculture/food processing, motion pictures, and higher education. Many of these firms (except for tourism and education) can serve their customers from locations in or out of California. Thus, they are the most likely candidates to leave if the AB 32 regulations prove unduly burdensome.
- Developing a strategy to mitigate the risk of employment losses to other locations is a good idea. At minimum, California needs to sign up other states and countries to play by the same rules we do. This will be crucial as a matter of program effectiveness, i.e., actually reducing global emissions. Also as a matter of fairness: California firms want to compete with firms in other regions based on economic factors, not their willingness to tolerate pollution.

2. **Provide regulatory certainty**

- By its very nature, the process of developing from scratch an AB 32 implementation plan raises concerns about the types of changes business firms will have to make—to their plants, their equipment, and their operating methods—and the costs of making such adjustments.
- Unfortunately, the risk of undertaking any investment rises with the level of uncertainty. An uncertain regulatory structure can create a riskier investment climate, which translates into lower capital expenditures and potentially lower economic growth.
- Put simply, firms will be reluctant to make expensive (even billion-dollar) investment decisions if they fear some or all of the activity will be penalized or disallowed *after* the new equipment is in place.
- This issue is particularly important for firms in the capital-intensive energy industries, which will likely be required to spend enormous amounts to bring their emissions into compliance with the new regulations.
- Beyond that, all California firms face the added uncertainty and burden that come with operating in a 'first-mover' regulatory environment. Europe has introduced a cap & trade market for greenhouse gas emissions, but that program is still working the kinks out. In any event, California will be first-in-the-U.S.

3. **Use sound scientific methods**

- The whole field of GHG involves serious scientific issues. Both the science and the measurements it requires are new. Rigorously-established, "cold, hard facts" are in particularly short supply. As an important example, the GHG inventory, the analytic foundation of the AB 32 rulemaking process, was until recently a work in process. The 1990 baseline GHG level (the target mandated by AB32) has changed at least four times since 1997, with estimates ranging from 425 MMT CO_2 to 468 MMT CO_2.
- In this situation, the state needs to take care in setting new emission standards, rules, and policies. Caution is required to avoid unintended consequences. Again, business firms' biggest fear would be wasting large amounts of time, effort and money on new equipment that doesn't meet the target.
- The state is in an uncomfortable position, having to establish new emission reduction strategies to reach targets—not yet well measured—from a starting position that is only a little better understood. Any rules developed during the initial round will of necessity be no better than "first, best guesses."
- It is important not to run ahead of the science, developing rules that are unsupported by the facts. The scientific method, based on sound research

and proper testing of hypotheses, offers the most powerful tool for evaluating proposed policies and emissions standards.

- All of these considerations suggest a concerted program of basic and applied research and development should be undertaken, funded jointly by the state and the private sector as appropriate. Knowledgeable scientists in the private sector and the state's universities both should participate. The research could be followed by small-scale demonstration projects to test (and measure!) the effectiveness of various proposed new emissions reduction strategies.

4. Impose only cost-effective and technologically feasible regulations

- Everyone agrees reducing global greenhouse gas emissions will be expensive. There are ways, however, to minimize needless expense and the cost burdens borne by California's residents and businesses.
- Cost-benefit analysis must be the standard for evaluating proposed regulations. The appropriate metric is: How much carbon will we keep out of the atmosphere for each million dollars in costs? Use of this or a similar metric will focus efforts first on the lowest hanging fruit, and then on the next-lowest-cost solutions, etc.
- Minimizing total program costs in this way will minimize the overall burden on Californians and is critical to keeping jobs in California. Otherwise, we will be penalizing firms for locating here.
- A separate but related issue concerns technological feasibility. New technology may be required to meet the goals of AB 32. If so, it makes sense to address the unknowns first through systematic research and development, and then develop testable strategies to resolve questions of cost-effectiveness.

5. Promote innovation and market-based strategies

- The advantage of market-based solutions is that they allow the state to set targets and then let individual businesses figure out what are their most cost-effective GHG reduction strategies. This general approach helps to minimize the program's administrative burden on the state and simultaneously allows businesses to minimize their compliance burdens.
- As an example, consider a firm with a fleet of buses or trucks. The company must decide how best to replace its old equipment. Assuming some form of market for carbon, the company could choose a) to buy the same buses as before and purchase carbon offsets; b) to buy cleaner vehicles that allow the fleet to meet (barely) the GHG emission standards; or c) to buy zero- or ultra-low emission vehicles that allow the fleet to exceed its reduction target and then sell the resulting credits/offsets. Note that reducing CO_2 emissions has become an important factor in vehicle purchasing decisions, but the decision of how to pursue the reductions remains with the company. Note further that the purchasing decision might

change from one year to the next depending on the prices of the different types of vehicles and carbon credits/offsets. The extra flexibility provided by reliance on the price/market system reduces the inherent risks of the GHG reduction program to the firm.

- Why should the AB 32 program promote innovation? First, because California- based firms may generate new lower-cost methods to reduce GHG emissions. Also, given the state's first mover position, these firms can "export" to other states and nations the new products they develop. And finally, because growing businesses generate more jobs.
- There are a number of ways the AB 32 program can promote innovation. As stated above, the state can fund R&D research into GHG reduction strategies. It can sponsor contests to generate new ideas. [A DARPA program to develop driverless vehicles (driven by computer) found it cost-effective—and improved results—to switch from R&D contracts to offering prizes for the winners of annual competitions.]
- Currently, there is considerable venture capital money available for "green-technology" projects. The state might consider supporting some of these private-sector efforts with grants and perhaps testing facilities.

6. Minimize and fairly allocate compliance costs

- Adherence to the first five business principles should result in minimization of the costs of the AB 32 program.
- The different costs associated with developing and reaching the AB 32 targets include: 1) the costs of devising and administering the GHG reduction program, which will be borne by the state and its taxpayers. 2) the costs of complying with the new rules and regulations, which will be borne largely by the private sector. And possibly, 3) the costs of GHG-related research and development programs, which would be borne by both public and private sectors.
- The benefits of the greenhouse gas reduction program will be distributed across the state. It's only fair to distribute the costs as widely as possible. Public costs fit that prescription, as they are borne by taxpayers in general.
- However, the composition of the carbon inventory in California necessarily means the initial burdens of compliance will fall more heavily on some sectors than on others unless explicit strategies are developed to shift some of the compliance burdens elsewhere.
- Designing an appropriately broad distribution of compliance cost burdens will be difficult, but the task is important for reasons of equity and to support the California-based industries involved. One strategy for the regulated industries would be to spread the compliance costs over all customers—commercial, industrial, and residential. Strategies for the independent energy and other industrial sectors will require some creative thought but, for example, could involve GHG surcharges on certain activities to fund some private-sector compliance costs.

VII. Next Steps: A Role for the SCLC

California's GHG reduction strategy is still taking shape, with many of the most important decisions scheduled to be finalized within the next twelve months. AB 32 is "framework" legislation, which lays out emissions reduction targets and directs state agencies to develop policies to meet the targets. CARB is taking the lead in developing a scoping plan through a series of workshops between November 30, 2007 and March 25, 2008. A draft plan will be released in June, followed by more workshops in July. The plan will be presented for adoption in November, 2008.

The Southern California Leadership Council should participate in CARB's scoping plan process. The importance of the scoping plan cannot be overstated. It will set the ground rules and select the primary strategies for emission reductions in the state. The plan will make recommendations on direct emission reduction measures, alternative compliance mechanisms, market-based mechanisms, and incentives. Once the plan has been finalized, it will be significantly more difficult to contest or alter the basic approach. The scoping plan, therefore, represents the best opportunity to successfully influence the shape of the state's response to GHG reductions.

The debate is still at the point of first principles, leaving some of the core questions yet to be settled. Because of the enormous impact GHG regulation will have on the state economy, the Leadership Council take an active role in finding answers to questions such as:

General Approach

- Will GHG regulations be developed piecemeal, sector by sector, or will the same set of rules apply across industries?
- What mix of market-based and command-and-control approaches will the state use?

Markets

- If a cap-and-trade system is adopted, how will the initial allowances be distributed? Will they be assigned based on historic emission levels or auctioned?
- Will California firms be able to get credit for GHG reduction projects in other states and other countries?
- Will California credits be tradable across other cap-and-trade systems?
- Will there be a safety-valve mechanism (to help prevent price spikes and to ensure the cost of the reductions is not crippling if they turn out to be higher than expected)?
- Which early actions will qualify for credit? What form will the credit (if any) take?

Targets

- What happens if the "maximum technologically feasible and cost-effective" reductions required by AB 32 are insufficient to meet the state's long-term targets, particularly for 2050?
- At what threshold, if any, will targets be relaxed to alleviate short-term economic hardship?

CEQA

- How will GHG regulations interact with CEQA? Will GHG compliance become part of the CEQA process?
- Who will take the lead in developing standards? Is this something best left to the Attorney General and the courts?

At a more fundamental level, policymakers (with SCLC input) need to wrestle with the ultimate purpose of California's GHG regulations. Climate change is a pressing global challenge, but California's changes alone will not make a whit of difference.[13] The state could have an important impact, however if demonstrating cost-effective GHG reduction measures galvanizes (or shames) other states and countries to join in. The decision whether to focus only on reducing California's emissions or on encouraging broader participation has far-reaching policy implications.

Some of these questions are inter-related. As the CSEM study explains, if the goal is to achieve maximum local reductions, a command and control regulatory framework is likely to be more effective. A market-based strategy applied just to California may end up being overwhelmed by leakage issues and readily available circumvention strategies. On the other hand, if the goal is to encourage others to join in (and thus maximize total long-term reductions), the state may be better served by adopting an economically efficient market-driven solution that can be scaled up to then national level, where it will be more effective.

[13] The CSEM study points out that California's targets, if reached, will eliminate less than 200 MMT CO_2 annually, while annual emissions in China are expected to rise by at least 15 times that amount by 2015.