Improving Air Quality and Health by Reducing Global Warming Pollution in California

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Boosting the Benefits: Improving Air Quality and Health by Reducing Global Warming Pollution in California

The California Global Warming Solutions Act (AB 32) provides a significant opportunity to improve air quality and public health in the state. Our new analysis shows that many strategies for combating global warming will reduce air pollution, which lowers health risks. In fact, measures being considered for implementation under AB 32 could prevent more than 700 premature deaths and thousands of other negative health impacts annually, saving $3.2 to $5.0 billion in health costs in the year 2020 alone. New evidence of increased health impacts from exposure to particulate matter (PM) suggests that these health benefits and savings may be even greater than estimated here. California should adopt these measures to reduce global warming pollution and provide tremendous short- and long-term health “co-benefits” by improving air quality and combating global warming at the same time.

Global Warming Worsens Air Pollution
Global warming will continue to have enormous impacts on air quality as temperatures rise, weather patterns change, background pollutant levels increase, and wildfires become more common. Because every degree of warming is expected to lead to about a 3 percent increase in energy use per capita, hotter temperatures will also increase unhealthy emissions from power plants.

Research also shows that hotter temperatures will lead to higher emissions of smog- and soot-forming gases such as nitrogen oxides (NO\textsubscript{x}), while also accelerating the formation of ozone smog. Together, the increased emissions of precursors and stepped up formation of smog and soot create a feedback loop since both of these pollutants contribute significantly to further global warming (see sidebar on page 10: Addressing the Warming Impacts of Smog and Soot). In addition to the global warming pollution emitted in California itself, the ozone problem will be exacerbated by pollution that travels with air currents from Asia to the west coast of the United States. One estimate shows that ozone levels throughout California are expected to exceed the state standard by the end of this century due to pollution stemming from Asia alone.
Boosting the Benefits: Improving Air Quality and Health by Reducing Global Warming Pollution in California

Air Pollution Harms Californians’ Health

As home to five of the 10 smokiest cities in the United States, California is already suffering a staggering health toll from air pollution, including up to 24,000 premature deaths each year and tens of thousands of illnesses.6 Ozone precursors such as NOₓ, particulate matter (PM), and a variety of other pollutants are emitted primarily by fossil-fuel combustion from transportation, power plants, and other industries. These sources also emit greenhouse gases (GHGs), whose long-term effect is to increase global temperatures. Ground-level ozone and PM have been linked to respiratory hospital admissions and emergency room visits, decreased lung function, and increased mortality related to cardiovascular and respiratory illness.7

One recent study concluded that global warming pollution emissions from human activities may already be causing an additional 1,000 air pollution–related deaths and 20 to 30 additional cancers annually for each 1 degree Celsius rise in temperature in the United States; 300 of these deaths occur in California.8 Policies limiting emissions from fossil-fuel burning, therefore, offer the double benefit of reduced global warming pollution and improved air quality.

Immediate and Comprehensive Action Under AB 32 is Needed

The California Global Warming Solutions Act of 2006 (AB 32) calls for reduction of global warming emissions to 1990 levels by 2020, and the governor has set a target of 80 percent below 1990 levels by 2050. AB 32 also calls for regulation of the major sources of global warming pollution (see Figures 1 and 2). While the exact list of regulatory measures that will move forward under AB 32 is yet to be determined, the Climate Action Team (CAT)—an interagency working group tasked with crafting policies for helping California meet its global warming reduction targets—has vetted a package of promising measures that would achieve reductions in all of the major sectors contributing to global warming pollution in California.

With quick action, these regulatory measures can bring significant environmental and health benefits, including the prevention of emissions totaling 109 million metric tons of CO₂ equivalents (MMT CO₂e) by 2020—approximately two-thirds of the reductions needed to meet the 2020 limit. Projected reductions in fuel and energy consumption for these measures, as well as avoided NOₓ and PM emissions, are derived directly from the most recent update of the CAT report. The potential health impacts of these reductions were evaluated according to the health risk assessment methodology established by the California Air Resources Board (CARB) Goods Movement Emission Reduction Plan (GMERP); health costs were similarly estimated according to the CARB GMERP. For more information on the methodology used in this report, see Appendix A: Technical Notes and Methods.

![Figure 1: Sources of Global Warming Pollution Emissions by Sector in California, 2004](image)

- Transportation 38%
- Natural Gas 14%
- Electricity 25%
- Industrial 15%
- Agriculture and Forestry 5%
- Other 4%

![Figure 2: Summary of Global Warming Pollution Emission Reductions Identified* to Contribute to AB 32’s 2020 Limit](image)

- Cleaner Cars and Trucks, 43 MMT, 25%
- Energy Efficiency, 33 MMT, 20%
- Smart Growth, 11 MMT, 9%
- Low-Carbon Fuel, 15 MMT, 9%
- Renewable Energy, 16 MMT, 9%
- Cleaner Power Plants, 9 MMT, 5%
- Water Efficiency, 5 MMT, 3%
- Forestry, 11 MMT, 7%
- Other, 24 MMT, 15%

*Emissions reductions as identified by the Climate Action Team, CARB, and NRDC.

Note: The first number listed in Figure 2 after each category of measures represents million metric tons (MMT) of CO₂-equivalent emission reductions, totaling 187 MMT CO₂e.

Reductions in Pollution Bring Health and Economic Co-Benefits

Our analysis shows that the measures that reduce the greatest amounts of global warming pollution—cleaner cars and trucks, energy efficiency, renewable energy, and smart growth—also contribute to significant reductions in the NOx and PM emissions that lead to health problems.\textsuperscript{10} In addition, these measures are likely to produce many other improvements to air quality and public health, including reductions in carcinogens that can be byproducts of burning fossil fuel.

This package of CAT measures is projected to reduce NOx emissions in 2020 by 86,000 tons. More than three-quarters of the NOx reduction is from the cleaner car and truck measures, which also reduce emissions in communities along transportation and goods-movement corridors where air quality is particularly poor. Energy efficiency is the single largest contributor to the 3,000 tons of PM reductions from this package, with smart growth, renewable energy, and cleaner cars and trucks providing additional major reductions. It is worth noting that smart growth measures also provide significant public health benefits in the form of enabling a more active lifestyle, which can curb obesity rates, leading to lowered risk of diabetes and heart disease.\textsuperscript{11}

In this analysis, energy efficiency and renewable energy measures contribute little to estimated reductions in NOx because of the conservative assumption that all displaced power generation would have been met with new natural gas combined-cycle plants. To the extent that energy efficiency and renewable energy displace existing power generation, we can expect further decreases in NOx and improvements in air quality than estimated in our analysis. It is expected that some dirty, natural gas power plants may come off-line or be utilized significantly less by 2020, and retiring or replacing these plants with new natural-gas plants could significantly decrease NOx. Since NOx is a precursor to smog and fine particulate matter, NOx reductions will improve regional and local air quality.

Reducing Other Health Threats from Global Warming

Existing levels of greenhouse gases are predicted to result in significant changes to California’s climate, which can negatively impact public health. Substantial reductions in global greenhouse gas emissions can slow or reduce the degree of warming experienced, thereby preventing or modulating the following health threats linked to global warming:

- **Heat Waves and Extreme Heat:** The frequency of heat wave days in some parts of California is projected to double by 2050, and heat-related deaths are expected to quadruple by 2100.
- **Extreme Precipitation Events:** Storms are expected to become more frequent, intense, longer, and larger, resulting in flooding, infrastructure damage, and population displacement.
- **Mosquito, Flea, and Tick-Borne Diseases:** Diseases spread by mosquitoes, ticks, and fleas (including malaria, West Nile virus, dengue fever, Lyme disease, and the plague) are expected to increase as the climate becomes more favorable for many of these insects.
- **Pollen and Allergy:** In a warmer environment with more carbon dioxide, ragweed produces significantly more pollen. Many weeds and allergenic plants will produce pollen earlier, for a longer time, and in more copious quantities, resulting in increased seasonal allergies and triggers for asthma sufferers.
- **Food and Water Supply:** Droughts are expected to afflict many regions of the world and threaten drinking water supplies. In addition, as the climate changes, agricultural pests already spreading into new areas will be harder to control.

The reductions in PM and NO\textsubscript{x} from the CAT measures are estimated to prevent more than 300 premature deaths associated with air pollution and thousands of additional hospitalizations and illnesses. And the benefits quantified here would save a total of $1.4 to $2.3 billion in avoided health costs in 2020. These projections are likely to underestimate the total health benefits of this climate package, since many viable global warming pollution measures were not included and many benefits to public health, such as reduced cancer risk, were not quantified.\textsuperscript{12}

**Additional Global Warming Measures and Proposals**
CARB’s implementation plan for AB 32 will also include the Early Action Measures (EAMs) and 35 other measures adopted in October 2007, estimated to produce reductions of an additional 35 million metric tons of carbon dioxide equivalents (MMT CO\textsubscript{2}e).\textsuperscript{13} Further measures proposed to CARB for consideration during the scoping plan process for AB 32 could contribute reductions of up to 39 MMT CO\textsubscript{2}e more.\textsuperscript{14} The EAMs that are not part of the Climate Action Team report, together with the additional proposed measures, if adopted, would avoid more than 52,000 tons of NO\textsubscript{x} and PM pollution, would avert roughly 250 additional premature deaths and thousands of cases of asthma and respiratory symptoms, and would save $1.1 to $1.8 billion in health costs in 2020. The NO\textsubscript{x} and PM reductions from all of the potential types of AB 32 measures (CAT, EAM, and additional measures) are shown in Figures 3 and 4. The specific air quality benefits and health benefits rankings of each individual measure within the CAT package, EAMs, and additional proposed measures are summarized in Table 1.

![Figure 3: NO\textsubscript{x} Reductions from AB 32 Climate Action Team Measures, 135,000 Tons in 2020](image1)

![Figure 4: PM Reductions from Potential AB 32 Measures, 6,000 Tons in 2020](image2)

### Table 1: Co-Benefits of Climate Action Team, Early Action Measures and Additional Proposals

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>TYPE</th>
<th>INDIVIDUAL MEASURES</th>
<th>Emission Reductions in 2020 (tons)</th>
<th>Health Benefits Ranking</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>NOX</td>
<td>PM</td>
</tr>
<tr>
<td>EAM</td>
<td></td>
<td>Diesel Truck Fleet Clean-up</td>
<td>35,405</td>
<td>1,898</td>
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<tr>
<td>CAT</td>
<td>Cleaner Cars and Trucks</td>
<td>Hybrid and Efficient Diesel Trucks</td>
<td>46,915</td>
<td>73</td>
</tr>
<tr>
<td>CAT</td>
<td>Limited Diesel Idling</td>
<td></td>
<td>18,615</td>
<td>33</td>
</tr>
<tr>
<td>CAT</td>
<td>Cleaner Cars and Trucks (Pavley)</td>
<td></td>
<td>74</td>
<td>136</td>
</tr>
<tr>
<td>EAM</td>
<td>Marine Vessel Speed Reduction</td>
<td></td>
<td>667</td>
<td>18</td>
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<tr>
<td>CAT</td>
<td>Cleaner Cars and Trucks – New Improvements</td>
<td></td>
<td>14</td>
<td>27</td>
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<tr>
<td>CAT/EAM</td>
<td>Fuel Efficient and Inflated Tires</td>
<td></td>
<td>1</td>
<td>1</td>
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<tr>
<td>CAT</td>
<td>Cleaner Power</td>
<td>Municipal Utility Program, Emissions Performance Standard</td>
<td>268</td>
<td>256</td>
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<tr>
<td>Proposed</td>
<td></td>
<td>Updates to Building and Appliance Standards (Titles 24 and 20)</td>
<td>3,358</td>
<td>256</td>
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<td>CAT</td>
<td>Energy Efficiency</td>
<td>Municipal Utility Program</td>
<td>321</td>
<td>307</td>
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<td>CAT</td>
<td>Investor-Owned Utility, Additional Programs</td>
<td></td>
<td>292</td>
<td>279</td>
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<tr>
<td>CAT</td>
<td>Appliance Standards (In Place)</td>
<td></td>
<td>251</td>
<td>239</td>
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<td>CAT</td>
<td>Investor-Owned Utility Programs</td>
<td></td>
<td>196</td>
<td>187</td>
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<tr>
<td>Proposed</td>
<td></td>
<td>Standards for Buildings at Time-of-sale</td>
<td>1,389</td>
<td>106</td>
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<tr>
<td>CAT</td>
<td></td>
<td>Building Standards (In Place)</td>
<td>104</td>
<td>99</td>
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<td>CAT</td>
<td></td>
<td>Green Buildings Initiative</td>
<td>89</td>
<td>85</td>
</tr>
<tr>
<td>CAT</td>
<td></td>
<td>Stationary Refrigeration and A/C Sources</td>
<td>36</td>
<td>34</td>
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<tr>
<td>CAT</td>
<td>Forestry</td>
<td>Urban Forestry</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Proposed</td>
<td>Low Carbon Fuel</td>
<td>Freight Transportation Measures</td>
<td>5,790</td>
<td>196</td>
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<tr>
<td>CAT</td>
<td>Shore Electrical Power for Marine Vessels</td>
<td></td>
<td>4,700</td>
<td>85</td>
</tr>
<tr>
<td>EAM</td>
<td>Electrify Large Irrigation Pumps</td>
<td></td>
<td>1,251</td>
<td>89</td>
</tr>
<tr>
<td>EAM</td>
<td>Truck Stop Electrification</td>
<td></td>
<td>896</td>
<td>39</td>
</tr>
<tr>
<td>CAT</td>
<td>Other Renewable Energy</td>
<td>Accelerate Renewable Portfolio Standard to 33%</td>
<td>532</td>
<td>508</td>
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<tr>
<td>CAT</td>
<td>Solar Initiative</td>
<td>California Solar Initiative</td>
<td>58</td>
<td>56</td>
</tr>
<tr>
<td>CAT</td>
<td>Smart Growth</td>
<td>Measures to Improve Transport Energy Efficiency, Smart Land Use, and Intelligent Transportation</td>
<td>7,960</td>
<td>476</td>
</tr>
<tr>
<td>Proposed</td>
<td>Water Efficiency</td>
<td>Water Efficiency, Additional</td>
<td>273</td>
<td>261</td>
</tr>
<tr>
<td>CAT</td>
<td>Water Use Efficiency</td>
<td>Water Use Efficiency</td>
<td>32</td>
<td>31</td>
</tr>
</tbody>
</table>

**Note:** Measures lacking quantified fuel or energy savings were excluded from this analysis.

**Source:** Updated Macroeconomic Analysis of Climate Strategies Presented in the March 2006 CAT Report, Final Report; CARB, Expanded list of EAMs, October 2007; NRDC and other Recommendations for Policies to Reduce Global Warming Pollution for the AB 32 Scoping Plan, October 1, 2007. Health Benefits rankings were determined using the health impacts assessment methodology from the CARB Goods Movement Emissions Reduction Plan, April 2006, as described above.
Setting Air Quality and Health Goals for Other High-Polluting Industries
Some important measures for reducing greenhouse gases to achieve AB 32 goals have yet to be fully defined. For example, potential for greenhouse gas reduction and co-benefits for the petroleum refining, oil and gas extraction, and agriculture sectors have yet to be determined. Also, upgrading highly polluting power plants holds potential for tremendous co-benefits. For example, in 2005, just five old (pre-1980) power plants in California contributed to more than one quarter of the total NO\textsubscript{x} emissions from all power plants in the state.\textsuperscript{15} These same five plants (which have an average age of 50 years) are also quite carbon-intensive, releasing 1.5 to 3.5 times more CO\textsubscript{2} per megawatt-hour of production than a new natural-gas combined-cycle plant, amounting to roughly 5 percent of the total CO\textsubscript{2} emitted from California power plants in 2007.\textsuperscript{16} Repowering or replacing dirtier plants with cleaner technologies, as is currently planned for some of these older plants, can improve air quality and reduce greenhouse gas emissions at the same time.

We estimate that additional global warming pollution control measures in these sectors could yield significant co-benefits, potentially reducing NO\textsubscript{x} and PM pollution by 10 percent by 2020, including 3,000 fewer tons of NO\textsubscript{x} pollution and 2,000 fewer tons of PM. These reductions would in turn yield significant additional public health benefits, by preventing almost 140 premature deaths and thousands of cases of asthma and respiratory illness. These reductions would also save up to $1 billion in health costs in 2020. Taken together, these comprehensive reductions—along with the CAT package, early action measures, and scoping plan proposals—would provide enormous public health benefits in 2020 (see Table 2). Note that measures are categorized in order of the highest certainty of implementation and data availability (CAT measures) to the least certain (potential additional measures).

<table>
<thead>
<tr>
<th>Avoided Health Impacts in the Year 2020</th>
<th>Climate Action Team Measures</th>
<th>Additional Early Action and Proposed Measures</th>
<th>Potential Additional Measures</th>
<th>Total</th>
<th>Value (in millions of dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Premature Death</td>
<td>330</td>
<td>250</td>
<td>140</td>
<td>710</td>
<td>$3,200 – 5,000</td>
</tr>
<tr>
<td>Hospitalization (respiratory)</td>
<td>70</td>
<td>50</td>
<td>30</td>
<td>140</td>
<td>$2.7 – 4.2</td>
</tr>
<tr>
<td>Hospitalization (cardiovascular)</td>
<td>120</td>
<td>94</td>
<td>50</td>
<td>270</td>
<td>$6.0 – 9.5</td>
</tr>
<tr>
<td>Asthma and other Lower Respiratory Symptoms</td>
<td>8,300</td>
<td>6,400</td>
<td>3,500</td>
<td>18,000</td>
<td>$0.2 – 0.3</td>
</tr>
<tr>
<td>Acute Bronchitis</td>
<td>690</td>
<td>540</td>
<td>290</td>
<td>1,500</td>
<td>$0.3 – 0.5</td>
</tr>
<tr>
<td>Work Loss Days</td>
<td>50,000</td>
<td>39,000</td>
<td>21,000</td>
<td>110,000</td>
<td>$12 – 18</td>
</tr>
<tr>
<td>Minor Restricted Activity Days</td>
<td>290,000</td>
<td>220,000</td>
<td>120,000</td>
<td>630,000</td>
<td>$18 - 29</td>
</tr>
</tbody>
</table>

Source: Updated Macroeconomic Analysis of Climate Strategies Presented in the March 2006 CAT Report, Final Report; CARB, Expanded list of EAMs, October 2007; and from NRDC and other Recommendations for Policies to Reduce Global Warming Pollution for the AB 32 Scoping Plan, October 1, 2007. Health impacts and values were estimated using the health impacts assessment methodology from the CARB Goods Movement Emissions Reduction Plan, April 2006, as described above.
The Local Impacts of Large Sources of Carbon, Soot, and Smog-forming Pollutants
Our analysis shows the potential for significant health benefits from measures to reduce global warming pollutants. However, the location of these benefits is just as important as the magnitude of the benefits, especially given that many of California’s communities of color and low-income communities have been and continue to be disproportionately impacted by pollution. Health benefits from cleaner car and truck measures will be most pronounced near freeways, freight facilities and high traffic corridors. Communities near stationary sources, such as power plants, would be expected to benefit from reduced emissions from these sources.

The maps in Figures 5 through 7 show the locations of certain facilities in industrial sectors that are known to emit significant quantities of global warming pollution, as well as emitting significant air pollution with the potential to greatly impact local communities: Power plants, cement plants, and petroleum refineries. Although these maps exclude all other sources, including other industries and all mobile sources, they provide a powerful illustration of the areas of the state which would benefit from reduced pollution from these specific facilities. The sectors represented on the maps account for roughly 20 percent of the total global warming pollution emitted in California.

The symbol for each facility on these maps shows the magnitude of CO₂ emissions (by symbol size) and the health risk by color. The health risk “index” represents the relative potential health impacts among the facilities mapped, based on a methodology similar to that used to estimate health co-benefits and based on NOₓ and PM emissions. See Appendix A for a description of the methodology and Appendix B for a listing of all facilities included in the maps.

The maps indicate that although there are polluting facilities scattered throughout the state, the Los Angeles area in the southern part of the state and the Carquinez and Richmond areas of the San Francisco Bay Area bear the brunt of pollution-related health impacts from these sources relative to other areas. In addition, the health risks associated with the power plants in Southern California are higher on average than elsewhere in the state due to high levels of air pollutant emissions, large populations living nearby, and poor regional air quality.

Impacts of Power Plant Siting on Local Air Quality
While new power plants are expected to be vastly cleaner than many existing facilities, those utilizing fossil fuel combustion will emit some level of harmful particulates that could have serious impacts at the local level. As a result, from a local perspective, the benefit from reducing particulates depends on where those reductions occur. There is the risk that new natural gas combined-cycle plants will be sited in urbanized areas, especially in communities already burdened with higher-than-average levels of pollution. In those instances, the increases in particulate emissions can have serious public health consequences. For example, the South Coast Air Quality Management District found very significant health impacts from a proposed new natural gas power plant in Vernon, CA, including a potential increase in annual premature mortality of up to four to 12 people.

Therefore, while strategically sited new natural gas combined-cycle plants have the potential to provide valuable co-benefits on a regional level, preventing inadvertent injustices at the local level requires prudent siting and planning.

Figure 5: Carbon Dioxide (CO₂) Emissions and Co-pollutant Health Impacts from Selected Industrial Facilities in California

Only three sectors are included on these maps, accounting for roughly 20 percent of total global warming pollution in California in 2004, according to the California Air Resources Board (CARB).

Of the nearly 1,000 power generating facilities registered with the California Energy Commission, we selected a subset here representing all 105 natural gas plants > 50 MW; all remaining coal-fired plants; and all other plants that were within the top 20 polluters of Nitrogen Oxides (NOx), Particulate Matter (PM), or CO₂ according to the CARB and CARMA databases respectively.

Health Risks were estimated based on 2005 data for NOx and PM, from CARB.

Emissions of CO₂ from CARMA.org, in "US" or "Short" tons.
...there's elevated asthma. Smoke from wildfires is laden with particulates, causing respiratory illnesses, eye irritation, and exacerbated asthma. A study of health impacts on children during the 2003 wildfires in California that burned 750,000 acres found that the risk of respiratory and other symptoms, including worsened asthma, increased up to 500 percent from more than six smoky days in a row. Wildfires in California are expected to increase in frequency by 11 percent to 55 percent because of global warming over the course of this century. A 5 percent increase in wildfires in 2020 could increase PM emissions by almost 4,000 tons, leading to more than 6,000 cases of asthma and respiratory symptoms.

Mercury is a heavy metal and neurotoxin that is emitted into the air mostly from cement plants and refineries in California. Mercury settles out of the air into water, where it builds up in fish that are consumed by people. It is estimated that only a teaspoonful of mercury can make the fish in a lake unsafe to eat. Even in low doses, mercury may affect a child’s development, delaying walking and talking, shortening attention span and causing learning disabilities.

The California Air Resources Board has the opportunity to simultaneously reduce global warming and mercury pollution from cement plants. Our analysis suggests that the requirement of process changes at cement plants will also reduce mercury emissions by an estimated 35 to 55 percent, avoiding the release of almost 200 pounds of mercury each year from these plants, which currently account for approximately 90 percent of the airborne mercury pollution in California.

Instead of allowing the impacts of global warming to contribute to declining air quality, California must continue to pursue an ambitious set of policies designed to improve air quality and public health while also combating global warming. In order to best realize the full potential environmental and health co-benefits of reducing emissions of global warming pollutants, we recommend the following for California:

- Study, quantify, and maximize the co-benefits provided by the package of policies used to meet the AB 32 global warming emissions limit.
- Identify measures to reduce global warming pollution and provide air quality and health co-benefits in highly polluting sectors for which there are currently few specific measures, such as petroleum refining, oil and gas extraction, and agriculture.
- Make information about co-benefits available to the public to clarify how the state’s efforts to reduce global warming pollution will also reduce air pollution and benefit public health.
- Take into account the global warming benefits of reducing ozone smog and soot when adopting global warming pollutant, air quality, and toxic reduction regulations.
Endnotes

1 In 2007 dollars, based on a discount rate ranging from 3 percent to 7 percent; note that the primary component of health cost savings in the Value of a Statistical Life assigned to each premature death avoided. Uncertainty surrounding health impacts ranges from roughly 15 percent to 75 percent for most health endpoints, according to CARB, Technical Support Documents for the In-Use On-Road Diesel-Fueled Heavy-duty Drayage Trucks at Ports and Intermodal Rail Yard Facilities Regulation, Appendix E, December 2007. Available at: http://www.arb.ca.gov/regact/2007/drayage07/drayage07.htm.


4 California Climate Change Center, 2006. Degrees refer to degrees Fahrenheit.


10 We focused on NOx and PM emission reductions because these two pollutants contribute heavily to adverse health impacts from air pollution. While we were unable to quantify all known health impacts from NOx and PM, major impacts include onset of asthma, low birth weight, pre-term birth, and reduced lung function growth in children. For more information, see: CARB, Goods Movement Emission Reduction Program, March 21, 2006, Appendix A.


12 These measures are likely to reduce many other pollutants, including carcinogens such as benzene and formaldehyde; developmental toxicants such as lead and toluene; and neurotoxicants such as mercury and acrolein. However, we were unable to quantify reduced cancer risks or public health benefits from other co-pollutant reductions.


14 The analysis is based on proposals from NRDC. All scoping plan proposals submitted to ARB are posted at http://www.arb.ca.gov/cc/scopingplan/submittals/submittals.htm.

15 This is based on 2005 emissions inventory data from CARB, http://www.arb.ca.gov/app/emisinv/facinfo/facinfo.php. Note that the facility with the highest NOx emissions is likely to be repowered soon (http://www.energy.ca.gov/sitingcases/humboldt/documents/index.html). The next top five plants with the highest NOx emissions in 2005 contributed more than one-fifth of NOx emissions that year from the remaining power plants. Other plants may also be in the process of being repowered.

16 This is based on 2005 power plant data from CEC and 2007 CARMA data on CO2 emissions from power plants. (http://www.arb.ca.gov/app/emisinv/facinfo/facinfo.php http://www.energy.ca.gov/database/POWER_PLANTS.XLS www.CARMA.org) The emission rate for a new natural gas power plant was taken from the CAT report, referenced above. The five dirtiest power plants include one of the few coal-fired power plants in California, which produce significantly more global warming (accounting for the high end of the range) and NOx pollution per unit of production than natural gas-fired power plants.

17 Percent mercury reduction is calculated based on USEPA estimate that 30 to 45 percent of mercury emissions are due to coal combustion. Note that coal is the primary fuel used at California cement kilns.