



THE ROAD TO CLEAN AIR

Public Health and Global Warming Benefits of Advanced Clean Car Standards



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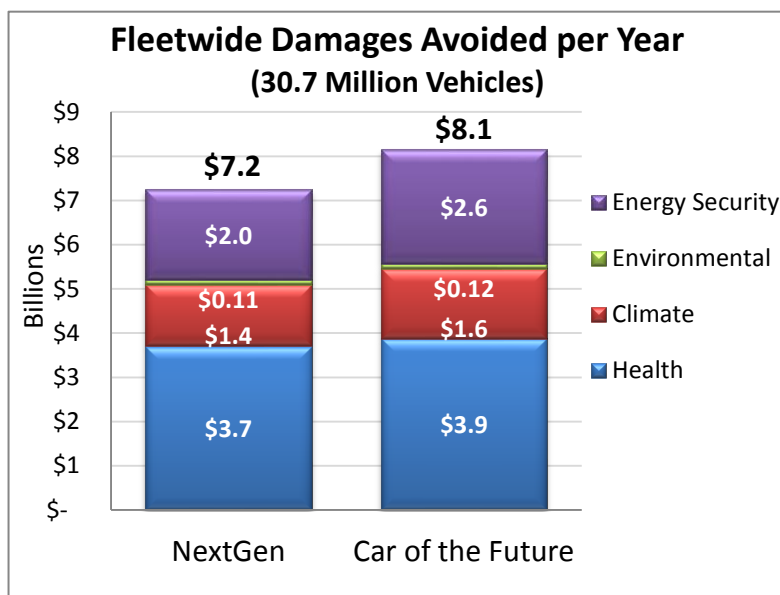
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I. Executive Summary

Despite decades of clean air leadership and a great deal of progress in reducing smog and soot, California remains home to some of the most polluted air in America. Over 90 percent of Californians live in areas that fail to meet federal health-protective air quality standards. A leading source of California’s struggle with air pollution is our transportation sector. California’s landmark motor vehicle and fuel standards have provided critical improvements in the state’s air pollution crisis over the last several decades, but there is still far more to do.

This report highlights the critical need for California to adopt the next generation of passenger vehicle standards that set our state on the path to meeting our clean air and climate goals. Motor vehicle emissions present both immediate and long lasting threats to public health. Smog and fine particle emissions generated by the combustion of petroleum fuels cause immediate and lifelong respiratory impacts while greenhouse gases emitted today will continue to threaten respiratory health for generations to come. Now that the California Air Resources Board is preparing the next round of vehicle standards, California must use this opportunity to ensure a rapid transition from our reliance on dirty fuels and a continuation of our state’s national and international leadership in clean air policy.



Included in this report is new data quantifying the public health, global warming and societal costs and impacts of vehicles meeting current state standards and comparing these vehicles to two future scenarios for advanced clean cars (“NextGen” and “Car of the Future”) that could be required by state regulation. Both future scenarios analyzed in this study rely on significant increases in zero emission vehicles, plug-in electric vehicles and cleaner, more efficient vehicles and both assume full fleet turn-over by 2025. CARB is set to adopt revised clean car standards later this year and to begin implementing

these standards in 2017. By quantifying the air quality, health and environmental impacts of these two scenarios, this study provides a clear comparison of California’s future with and without stronger clean car requirements.

Data analyzed in this study includes numbers of premature deaths, hospitalizations, asthma and other respiratory symptoms, numbers of lost work days and numbers of lost school days as well as public health costs related to these outcomes. Based on this analysis, vehicles meeting current tailpipe standards will cause \$14.5 billion in public health and societal costs annually, including 570 premature deaths, over 11,000 asthma attacks and lower respiratory symptoms and 610 respiratory and cardiac hospitalizations for each year on the road. Per gallon consumed, these vehicles will also contribute

\$1.19 in health and societal damages; in other words, each full 16.4 gallon tank brings nearly \$20 worth of health and other damages that don't show up on the gas pump.

These costs and health outcomes can be substantially reduced under the next round of clean car standards. According to this analysis, when fully implemented, the advanced clean car standards could achieve the following reductions:

- reduce vehicle greenhouse gas emissions by 45 – 52%
- reduce vehicle smog-forming emissions by 75 – 85%
- reduce petroleum consumption by 38 - 49%
- reduce premature deaths and illnesses by 65 - 75%
- reduce public health, global warming and societal costs by 50 - 56%

When fully implemented across the fleet, California advanced clean car standards could avoid the following illnesses and deaths annually:

- 400 - 420 premature deaths avoided
- 420 - 440 respiratory ER visits and cardiac/respiratory hospitalizations avoided
- 8,075 - 8,440 asthma attacks and lower respiratory symptoms avoided
- 181,000 – 190,000 acute and upper respiratory symptoms avoided
- 5,100 – 5,300 cases of acute and chronic bronchitis avoided
- 390 - 405 heart attacks avoided
- 28,100 - 29,300 work loss days avoided
- 8,800 - 9,500 missed school days avoided
- \$7.2 - \$8.1 billion in costs of health, global warming and societal damages avoided

In addition to avoided illnesses and public health costs, achieving advanced clean car standards also saves consumers money. A vehicle meeting current standards consumes almost 4,000 gallons of gasoline over its lifetime, or over 120 billion gallons fleetwide in California. By contrast, an average vehicle in the strongest regulatory scenario in our study, the “Car of the Future,” will consume 1,927 fewer gallons of gasoline, or over 59 billion gallons less fleetwide than the current standard fleet. This amounts to an annual cost savings of \$780 per vehicle or \$24 billion in annual savings across an entire “Car of the Future” fleet (based on AAA’s April 1, 2011 California Daily Fuel Gauge Report price of \$4.05 per gallon, which is conservative compared to gas prices that have spiked to \$4.25 as of May 1).

The American Lung Association in California strongly supports adoption this year of advanced clean car standards that respond to the urgent need to improve our air quality, meet federal targets for ozone and particle pollution reduction, reduce the devastating lung health impacts of our transportation choices and reduce our dependence on petroleum. This report also shows that zero emission vehicles produce the greatest public health, global warming and societal benefits and are critical to achieving California’s federal air quality targets. The data in this report support the following key recommendations for the next generation of CARB vehicle standards:

California should adopt a clean car package that couples strong smog and particle pollution controls and greenhouse gas emission standards with an aggressive zero emission vehicle requirement that achieves at least a 45 percent reduction in vehicle greenhouse gases (onboard and tailpipe) in the new motor vehicle fleet by 2025 compared to levels achieved under current standards, including:

- Tailpipe pollution standards that cut smog forming emissions by 75 percent and place stringent controls on particle pollution.
- Greenhouse gas tailpipe emission standards that achieve a minimum 6 percent annual reduction in greenhouse gases between 2017 and 2025. To achieve the greatest health and global warming benefits, California should pursue even stronger requirements that will result in a 7.8 percent annual reduction in greenhouse gases and promote higher levels of zero emission vehicles and plug-in hybrid-electric vehicles.
- A requirement that at least 20 percent of new vehicles are zero emission vehicles by 2025.

The American Lung Association in California

saves lives and improves the health of Californians and their lungs. Through research, education and advocacy, we fight to reduce smoking, keep the air we breathe clean, prevent and treat lung diseases such as asthma and COPD, and eliminate lung cancer.

II. Background: Transportation and California’s Air Quality Challenge

Despite significant progress in reducing motor vehicle emissions in California over the past several decades, our dependence on dirty transportation technologies and fuels continues to harm the health and welfare of Californians. Largely due to transportation emissions, California remains home to some of the most polluted regions in the United States. Most urbanized areas in California remain in violation of federal air quality standards for ozone and particle pollution, requiring costly investments and additional control measures to bring California within reach of clean air. In fact, over 90 percent of Californians live in areas with serious air quality problems, largely due to our transportation sector. The American Lung Association’s 2011 *State of the Air Report* found that eight of the nation’s ten most ozone-polluted cities were in California, including all of the top seven. For particulate pollution, six California cities made the most-polluted list, including the top two. Measures to clean up vehicles, including the advanced clean car regulations and the zero-emission vehicle regulation are at the top of the list of measures that make a difference in meeting California’s federal obligations.

We know that California’s public health toll from air pollution is already very high, and results in billions of dollars in health costs every year from premature deaths and medical interventions. The California Air Resources Board (CARB) currently estimates that exposure to unhealthy levels of particulate matter causes 9,200 premature deaths in California each year. Ozone pollution, or smog, also contributes to premature deaths, triggers asthma attacks that send families rushing to emergency rooms and causes millions of lost school and work days, burdening our state with billions of dollars in health costs and lost productivity every year. In some parts of California, residents face over four months worth of unhealthy air each year.

California’s history of strong leadership in adopting cutting-edge motor vehicle standards has achieved tremendous success in reducing emissions and related health impacts. However, California has not established strong enough requirements to shift from oil to cleaner, more sustainable sources of transportation fuel. The California Air Resources Board’s current standards have significantly cut tailpipe smog and soot pollution (LEV II) and are on track to reduce new vehicle greenhouse gases by roughly 30 percent by 2016 (Pavley I). Even when fully implemented, these standards will largely be accomplished through conventional gasoline technologies.

Californians must demand that the next generation of clean vehicle standards puts California on the pathway to a true shift to zero and near-zero emission technologies, and achieves an overall 45 percent reduction in greenhouse gases and a 75 percent reduction in smog forming gases by 2025. This pathway is critical to meeting our ambitious climate and air quality goals, while also avoiding significant health, environmental and societal costs.

American Lung Association State of the Air 2011 Most Polluted Cities in America	
Ozone (CA Cities: 8 of the Top 10)	
#1	Los Angeles
#2	Bakersfield
#3	Visalia
#4	Fresno
#5	Sacramento
#6	Hanford
#7	San Diego
#9	Merced
Short-Term Particle Pollution (CA Cities: 6 of the Top 10)	
#1	Bakersfield
#2	Fresno
#4	Los Angeles
#7	Visalia
#9	Hanford (tie)
#9	Sacramento (tie)

III. Project Description

As proven by California's history of leadership, adopting aggressive standards is critical to spurring advances in lower emission and zero emission vehicle technologies that reduce smog and soot pollution and improve public health. Through 2009, California's Zero Emission Vehicle program has already resulted in over 300,000 hybrids and other advanced technology vehicles on California roadways, with more hybrids and zero emission vehicles hitting the roads every day. The American Lung Association in California contracted with an engineering consulting firm, TIAX LLC (TIAX), to demonstrate the health, climate and other benefits of moving forward with the next generation of California vehicle standards that dramatically increase the numbers of cleaner and zero-emitting vehicles on the road. The study includes a technical analysis comparing the impacts of existing and possible future vehicle standards.

The TIAX analysis compares vehicles meeting currently adopted CARB standards to vehicles meeting two future scenarios for the next round of vehicle standards. California has adopted motor vehicle standards that will reduce vehicle emissions as far out as model year 2016. The California Air Resources Board is currently developing their staff proposal for the next round of standards that will run through 2025. To evaluate the pollution and health impacts associated with vehicle emissions under each set of standards (current standards versus possible 2025 standards), TIAX developed a comparison of a future fleet of passenger vehicles (at 2025 vehicle population estimates of 30.7 million) achieving either current or future standards to illustrate the damages caused by today's fleet versus the benefits achievable through more advanced standards. TIAX based this evaluation in a vehicle to vehicle comparison for the average mid-sized vehicle that achieves the current standards that are fully implemented by 2016 as well as the average vehicle that would achieve two different scenarios for more stringent standards fully implemented in 2025. The numbers generated for each vehicle type were then used to develop fleet mix scenarios. The benefits of the fleets meeting the more stringent standards are presented in terms of reductions in emissions of criteria pollutants (*e.g.* PM_{2.5}, NO_x, VOCs), greenhouse gases, petroleum consumption as well as the health costs and damages avoided, including:

- Premature deaths
- Asthma attacks and other respiratory symptoms
- Heart attacks
- Hospitalizations and Emergency Room visits
- School and work days lost

The primary scenarios created through this modeling effort are described as "Current Standard," "NextGen" and "Car of the Future," and were created with the following regulatory assumptions:

- **Current Standard:** Follows existing criteria emission reduction requirements of the California Air Resources Board (LEV II), as well as the existing Clean Cars program (Pavley I Standards).
- **"NextGen":** Assumes full fleet turnover to reflect both: CARB's proposed criteria emission reductions in 2025 (LEV III) as well a vehicle mix needed to achieve a greenhouse gas emission reduction path of 6 percent per year from 2017 to 2025 (Pavley II or "LEV III – GHG"). A growing market share for zero emission vehicles (ZEV) is required to meet this pathway.

- **“Car of the Future”**: Assumes full fleet turnover to reflect both: CARB’s proposed (LEV III) criteria emissions reductions in 2025 and the fleet mix needed to achieve annual greenhouse gas reductions of 7.8 percent. The fleet mix assumed contains a greater share of zero emission vehicles needed to align vehicle standards with California’s goal for an 80 percent reduction in greenhouse gases by 2050.

Additionally, TIAX modeled scenarios wherein the entire new vehicle fleet consists solely of a single vehicle type, such as conventional gasoline, plug-in hybrid or battery electric vehicle. This vehicle-to-vehicle comparison allows clearer views of the benefits of shifting from gasoline to cleaner, advanced engine types. Appendix B provides a case study in the benefits of an entire new vehicle fleet of zero emission vehicles. Results are provided on an annual, fleetwide basis throughout the report to demonstrate the levels of harmful pollutants and negative health and climate impacts that could be avoided through these more stringent standards. In both monetary and human terms, this study presents a clear case for standards that require a petroleum off-ramp.

It is important to note that while this study modeled a battery electric vehicle to represent a gasoline-free vehicle, the development of hydrogen fuel cells and a wide range of clean fuels and zero emission technologies and platforms is critical to meeting our clean air and climate goals.

A more detailed description of the TIAX methodology and a reference list are provided in Appendix D. Additional methodology resources available online at: www.lungusa.org/california.

IV. Findings and Policy Recommendations:

This American Lung Association in California’s analysis of the health and environmental impacts of the new car fleet has clearly demonstrated that California’s dependence on petroleum-fuel vehicles is resulting in substantial costs to public health and the environment. Even when the current standards are fully implemented, the vehicle fleet meeting today’s standards will emit approximately 272 tons per day of smog forming pollutants along with 18 tons of fine particle emissions, leading to over \$5 billion in health damages annually, or over \$1,700 per vehicle over its lifetime. Fleetwide, these vehicle emissions will contribute to 570 premature deaths and 11,400 asthma attacks and lower respiratory symptoms each year they are on the road. This data clearly supports the need for more aggressive vehicle standards to cut criteria and greenhouse gas emissions from vehicles and promote vehicles that run on cleaner fuels, such as battery electric and hydrogen fuel cell vehicles.

These findings point to the following key conclusions:

California should adopt a clean car package that couples strong smog and particle pollution controls and greenhouse gas emission standards with an aggressive zero emission vehicle requirement that achieves at least 45 percent reduction in greenhouse gases in the new motor vehicle fleet by 2025 compared to levels achieved under current standards, including:

- Criteria pollution regulations that require the most stringent smog-forming emissions standard today (Super Ultra Low Emission Vehicle, or SULEV) to become the standard for all new vehicles in the next decade. CARB must also reduce particle emissions to 1 milligram per mile by 2025 or sooner.
- A strong greenhouse gas standard (Pavley II) that requires at least a 6 percent annual reduction for new vehicles between 2017 and 2025. (This equates to approximately 64 mpg average across the new vehicle fleet.)
- California would achieve a higher level of public health and environmental benefits by adopting a stronger greenhouse gas standard (Pavley II standard) requiring at least a 7.8 percent annual reduction in global warming gases for new vehicles from 2017 to 2025. This standard is also consistent with the level of GHG reduction estimated by the California Air Resources Board needed to stay on course with the 2050 goal established by Executive Order S-3-05 to reduce greenhouse gases to 80 percent below 1990 levels by 2050. (This equates to approximately 74 mpg average across the new vehicle fleet.)



Clean Car Policy Package

By 2025, the new passenger vehicle fleet must:

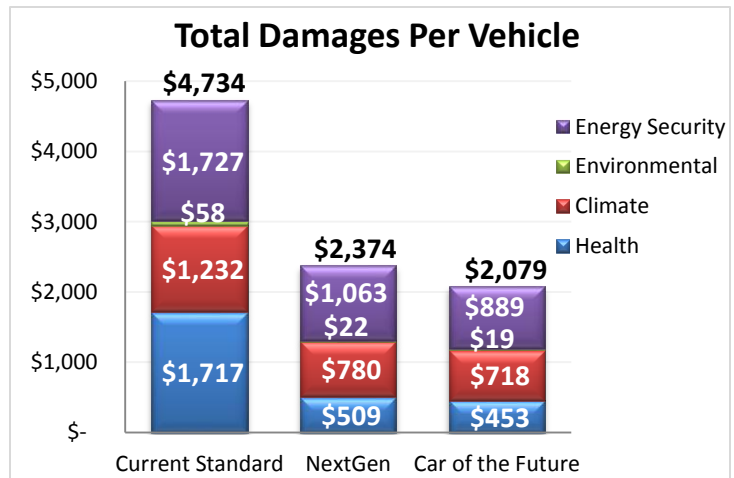
- Achieve 75% reduction in smog at the tailpipe and capture a 90% reduction in fine particulate standards.
- Achieve a minimum overall 45% reduction in greenhouse gas emissions from 2017-2025.
- Achieve a minimum 6% annual reduction in greenhouse gas emissions from 2017 to 2025.
- Achieve a minimum 20% zero emission technology vehicle mix by 2025.

- California's Zero Emission Vehicle (ZEV) program is a critical piece of the current advanced clean cars package going forward to the CARB Board. CARB should adopt requirements to ensure that at least 20 percent of the new vehicle fleet in 2025 must be zero emission vehicles.

These regulations will result in substantial future savings in reduced public health and global warming damages. Fleetwide, savings in health and other societal costs could be as high as \$7.2 - \$8.1 billion annually.

V. Summary: Analysis of Health, Global Warming and Societal Damages Of Vehicle Use

While significantly cleaner and more efficient, vehicles that achieve California’s current emission standards will still contribute to significant health, environmental and societal damages due to continued reliance on petroleum fuel. When fully implemented, California’s next generation of advanced vehicle standards could significantly reduce our petroleum consumption and cut the health damage caused by at least two-thirds compared to today’s standards.



Current Standards: Much Room for Improvement

Annually, vehicles meeting California’s current standards will cause the following damages (assuming a fleet of 30.7 million vehicles):

- consume 12.2 billion gallons of gasoline per year
 - cause \$1.19 in damages per gallon of gasoline used
 - cause \$19.52 in damages with each full tank
- emit 18 tons per day of fine particulates (PM_{2.5})
- emit 272 tons per day of smog-forming VOCs (142 tons/day) and NO_x (130 tons/day)
- emit 332,861 tons per day of greenhouse gases
- cause \$14.5 billion in health and other societal damages each year, including:
 - \$9.2 billion in health, climate and environmental damages
 - \$5.3 billion in energy security costs

Without more stringent standards, the emissions from a passenger vehicle fleet meeting current standards will annually cause:

- 570 premature deaths
- 11,400 asthma attacks and other respiratory symptoms
- 550 heart attacks
- 610 cardiac/respiratory ER visits and hospitalizations
- 715 cases of chronic and acute bronchitis
- 39,700 days of work lost
- 13,700 days of school lost

Advanced Clean Car Standards: Benefits to Public Health and the Environment

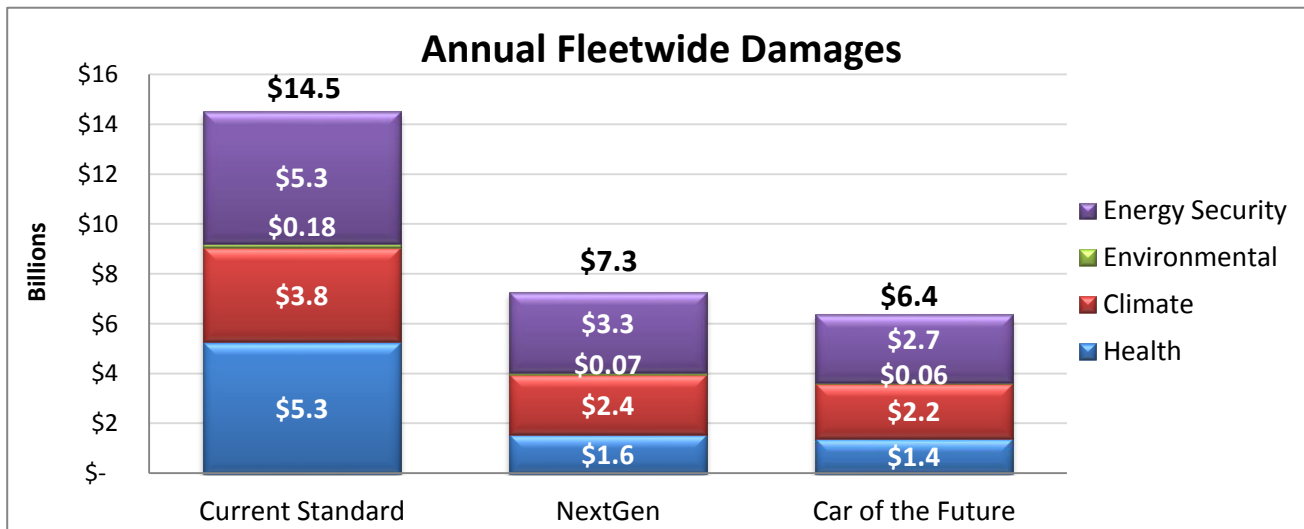
When fully implemented, advanced clean car standards that track with the American Lung Association in California recommendations for reducing criteria pollutants and greenhouse gases by 2025 will:

- reduce greenhouse gas emissions by 45-52%
- reduce smog-forming emissions by 75-85%
- reduce petroleum consumption by 38-49%
- reduce premature deaths and illnesses by 65-75%
- reduce public health, global warming and societal costs by 50-56%

When fully implemented across the fleet, advanced clean car standards could avoid the following illnesses and deaths annually:

- 400 - 420 premature deaths avoided
- 420 - 440 respiratory ER visits and cardiac/respiratory hospitalizations avoided
- 8,075 - 8,440 asthma attacks and lower respiratory symptoms avoided
- 181,000 – 190,000 acute and upper respiratory symptoms
- 5,100 – 5,300 cases of chronic and acute bronchitis
- 390 - 405 heart attacks avoided
- 28,100 - 29,300 work loss days avoided
- 8,800 - 9,500 missed school days avoided
- \$7.2 - \$8.1 billion in costs of health, global warming and societal damages avoided

Adopting a package of statewide standards for 2025 that significantly reduces criteria pollutants, diverges from the current pathway of oil dependence, requires a minimum 6 percent annual reduction in greenhouse gas emissions (45 percent total reduction from 2017 to 2025), and steps up requirements for zero emission technologies will provide significant benefits to public health, air quality and the environment. An even more progressive standard for the “Car of the Future” that tracks with CARB’s scenario for reaching California’s 2050 goals for 80 percent reduction in greenhouse gases would provide even greater public health and societal benefits. Illnesses and premature deaths linked to the fleet of vehicles meeting these more advanced standards could be cut by 65 to 75 percent. On a fleetwide basis, California could cut the \$14.5 billion in annual health and societal damages caused by a fleet meeting current standards by 50-56 percent, with remaining annual health and societal costs estimated at \$6.4 - \$7.3 billion (See chart below).

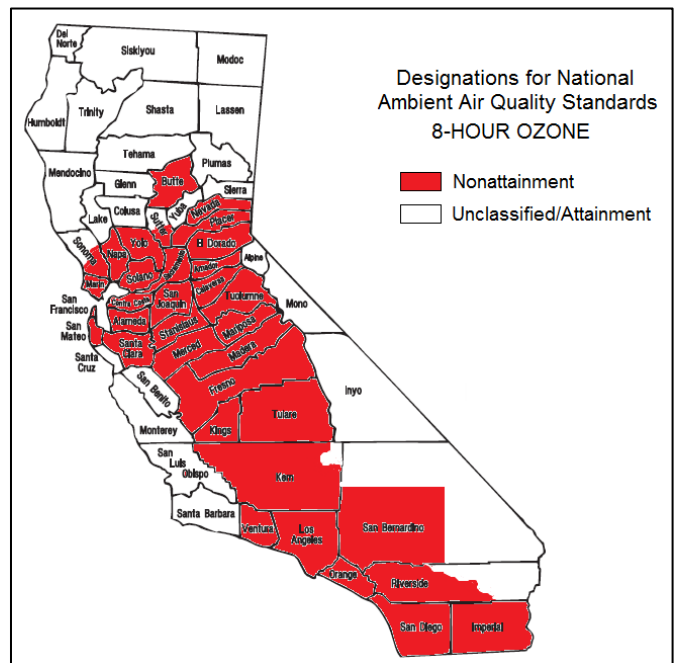


All told, the health and societal damages caused by petroleum-fueled vehicles can -and must- be reduced dramatically to improve public health, air quality and ensure that California provides the example for setting and pursuing ambitious greenhouse gas reduction targets.

VI. Advanced Clean Car Regulations: A Solution For California’s Air Quality Challenges

Across the state, both ozone and fine particle levels exceed health protective clean air standards set by the federal Environmental Protection Agency under the Clean Air Act. In fact, particle pollution levels in the Los Angeles and San Joaquin Valley regions of California can reach levels as high as two times the federal standard. California has risen to the challenge posed by the severe and persistent air pollution problem by adopting some of the most innovative and cutting edge control measures in the country. While much progress has been made to cut pollution levels, continued hard work by federal, state and local air quality agencies is needed to control harmful pollution. In addition, research has demonstrated that today’s air quality standards are not strong enough to protect public health. The US EPA is in the process of strengthening the national ozone standard to better reflect current scientific research on the harm caused by smog. Stronger national standards will make progress to reduce vehicle petroleum combustion even more imperative.

Currently, the US EPA has designated California’s most populous regions as being in non-attainment for national air quality standards for ozone and fine particulates. The South Coast (Los Angeles metropolitan area) and the San Joaquin Valley air basins face the most entrenched challenges and are classified as being in “extreme” non-attainment of federal ozone standards. Unfortunately, these regions are not expected to achieve attainment status until 2024. Other urban areas including Sacramento, the San Francisco Bay Area and San Diego also have significant air pollution problems. The Sacramento metropolitan area was recently re-classified as a “severe” non-attainment area and has had the ozone standard attainment date pushed back to 2019. The shaded areas of the map at right indicate areas of California currently classified as being in non-attainment for national ambient air quality standards for ozone.

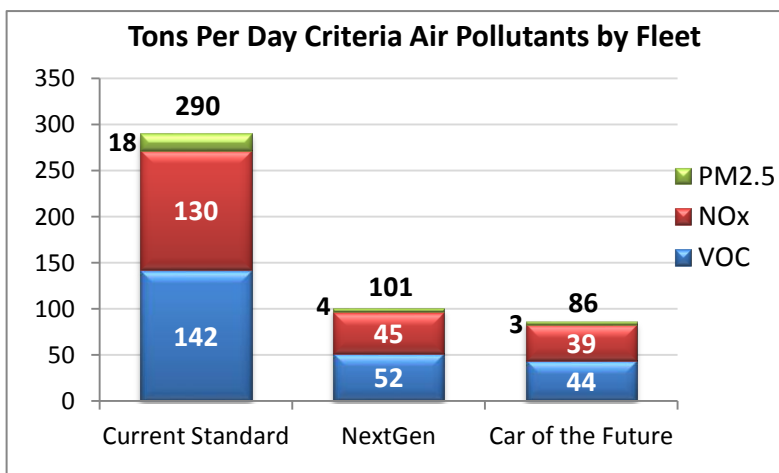


California faces significant challenges in reducing ozone and particulate pollution to levels low enough to meet federal standards. In the South Coast, for example, emissions of ozone precursors, nitrogen oxides and reactive organic gases must be reduced by approximately 858 tons per day and 310 tons per day respectively in the 2023 timeframe, as required in the State Implementation Plan (SIP) for ozone. In the San Joaquin Valley, the latest SIP for ozone identifies a reduction of 490 tons per day of nitrogen oxides and 112 tons per day of reactive organic gases. The Sacramento region similarly faces a challenge to reduce nitrogen oxide and reactive organic gas emissions by 76 tons per day and 19 tons per day by the region’s 2018 attainment deadline.

As soon as the federal EPA adopts new ozone standards later this year, the California Air Resources Board and air districts will initiate a new round of planning to update the state’s road map to achieving attainment. Adopting and implementing further measures to reduce harmful emissions from

passenger vehicles, heavy duty diesel trucks and buses, locomotives and agricultural and construction equipment is key to achieving SIP progress. Motor vehicle emission standards like those described in this study have played a key role in reducing emissions and California’s long term investments in healthy air are paying off, but work remains to be done. Strong standards adopted this year will signal the need to produce even more efficient and advanced technology vehicles to support attainment of clean air standards, and push further as more stringent standards are adopted to protect public health.

Adopting standards that signal a break from our oil dependency will also signal relief from some of the air pollution and health burdens of unhealthy air. Without more aggressive standards, California’s vehicle fleet will produce 290 tons of criteria pollutants every day, compared to around 85 tons per day (tpd) produced by a fleet that tracks with the 2050 goals, a reduction of 70 percent. This translates into a reduction of 189 tpd of nitrogen oxides and reactive organic gases, the ingredients of ozone.



For comparison, if California were to go to an all-electric drive future (vehicles would be either fully battery electric or fuel cell vehicles), the state could reduce emissions of nitrogen oxides and volatile organic compounds by 95 percent to 15 tons per day, the amount caused by electricity generation for the fleet. Doing so would reduce 116 tpd of nitrogen oxides and 142 tpd of reactive organic gases (See Appendix B for fleet electrification case study).

The combined tightening of vehicle emission standards and strong technology-forcing requirements for zero emission technology can provide significant clean air benefits, especially in terms of zero emission technology packages that will play a pivotal role as California moves to achieve even more stringent National Ambient Air Quality Standards being adopted this year.

VII. Public Health Benefits of Advanced Clean Car Regulations

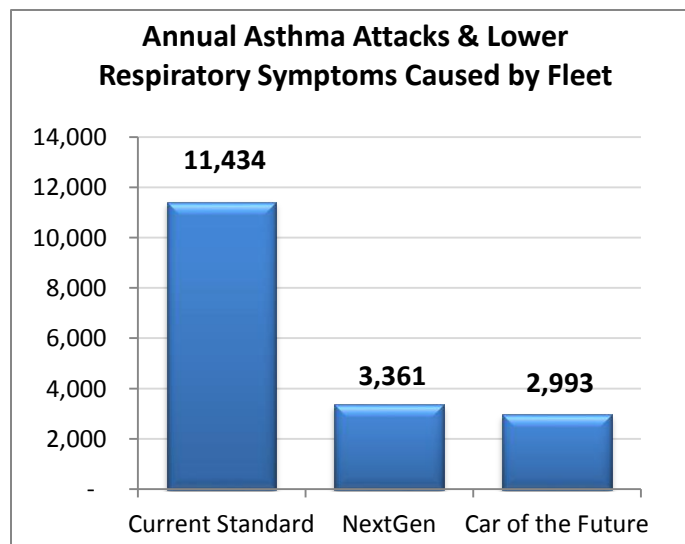
The public health benefits of transitioning to much stronger emission reduction and zero emission vehicle standards are dramatic. As detailed in Section V, all major health endpoints analyzed, including premature deaths, hospitalizations, asthma attacks and other respiratory symptoms, lost work days and lost school days could be reduced by 65-75 percent under the stronger regulatory scenarios proposed by the American Lung Association. (See Appendix A for additional health outcome charts). These avoided public health costs would lessen the load on hospitals and emergency rooms and reduce the pressure on family budgets from medical costs linked to pollution exposures by as much as \$3.9 billion annually compared to the health costs associated with a fleet that does not move beyond the current standards.

For the millions of Californians living with asthma, bronchitis, emphysema and other respiratory conditions, air pollution poses a daily challenge. A 2010 RAND Corporation study found that unhealthy air days caused 33,000 Emergency Room visits and hospitalizations at a cost of almost \$200 million dollars from 2005-2007. Children who grow up in areas with higher levels of pollution are particularly vulnerable to the effects of air pollution as their lungs develop. The Southern California Children's Health Study, a long-term investigation into air pollution and children's health has issued over 100 publications on the health effects of childhood exposure to ozone and particulates, including:

- a 2008 study that found a 30 percent increased risk for new asthma cases in children living in communities with higher levels of traffic-related air pollution;
- a 2004 study that reported significant and permanent reductions in lung function and growth by the age of 18 due to long-term exposure to current levels of particulate matter (PM_{2.5}) and other traffic-related pollutants;
- a 2002 study that linked asthma onset to exposure to elevated ozone levels in exercising children.

California is currently experiencing an epidemic of asthma that is exacerbated by air pollution. Approximately 3 million Californians are currently living with asthma, including over 700,000 children aged 5-17, according to the latest California Health Interview Survey (CHIS) data compiled by the UCLA Center for Health Policy Research. The tables below indicate the California counties with the largest numbers of children living with asthma, as well as the counties with the highest percentages of childhood asthma. CHIS data showed that in 2007, over 1.6 million school days were lost to asthma, as were 1.2 million days of work.

Research has clearly shown that air pollution increases the number and severity of asthma attacks and can even induce new cases of asthma. Children living near freeways and other high traffic areas are particularly vulnerable. In 2010, the National Health Effects Institute's panel on traffic-related air



pollution “concluded that the evidence is sufficient to support a causal relationship between exposure to traffic-related air pollution and exacerbation of asthma.” By adopting strong vehicle standards and promoting advanced technologies, California can significantly reduce, and even eliminate traffic emissions that contribute to increased asthma and illnesses.

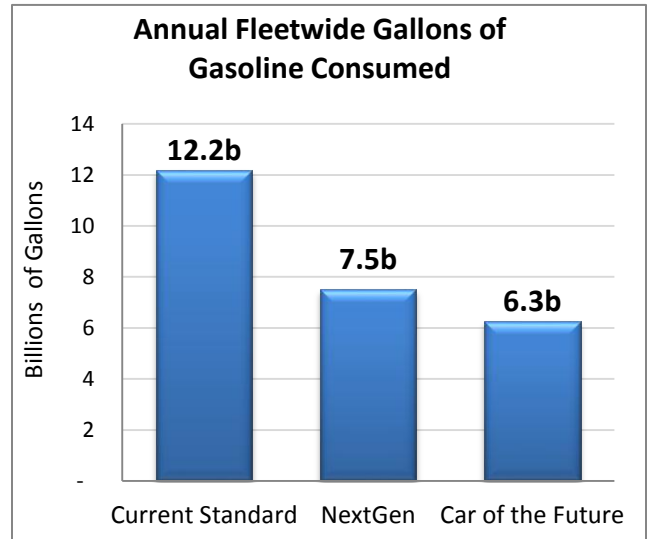
Highest Childhood Asthma Cases, by California County		Highest Childhood Asthma Rates, by California County	
Los Angeles	172,000	Kings	29%
San Diego	54,000	Imperial	19%
Alameda	44,000	Sutter	18%
Riverside	44,000	San Mateo	18%
San Bernardino	43,000	Alameda	17%
UCLA Center for Health Policy Research: California Health Interview Survey, 2009			

The impacts of air pollution on health are already serious and the impacts of climate change will only worsen this situation without serious action. California’s transportation sector constitutes the largest share of the emissions that drive global warming. As temperatures rise, the conditions become more suitable for the formation of ozone. CARB research suggests that California could face up to 30 more high ozone days per year by mid-century without significant efforts to curb greenhouse gases. The rise in conditions favorable to smoggy days weakens the effectiveness of our existing control programs and creates additional challenges and costs to providing healthy air in the future. For more information on respiratory health impacts of global warming, see Appendix C.

VIII. Kicking the Oil Habit, the Key to Clean Air

Petroleum represents 96 percent of the transportation fuel used in California. Our over-dependence on dirty fuels for the transportation needs of nearly 40 million Californians is a leading reason our state remains home to some of the most polluted areas of the country. Even the cleanest gasoline-powered vehicle is stuck in its addiction to dirty fuel, demonstrating the need for advanced vehicle technologies like hybrids and plug-in hybrid electric vehicles (PHEV), battery electric vehicles (BEV) or hydrogen fuel cell vehicles (FCV).

Boosting the share of advanced vehicles that use little to no gasoline will provide significant petroleum reductions and associated benefits. By adopting American Lung Association in California’s proposed standard that achieves a minimum of 6 percent annual reduction (NextGen scenario) in greenhouse gases, the advanced vehicle fleets could use as much as 4.7 to 5.9 billion fewer gallons of gasoline annually as compared to a fleet only meeting current standards (See chart at right). This amounts to consumer savings of as much as \$24 billion per year at current gas prices. Following this path brings tremendous benefits; in addition to the reduced impact to family budgets at the pump, Californians could avoid over \$8 billion in health and societal damages each year.



With each gallon of gasoline consumed, an average vehicle meeting the current standards adds \$1.19 in public health and other damages that don't show up at the pump – or about \$20 per tank.

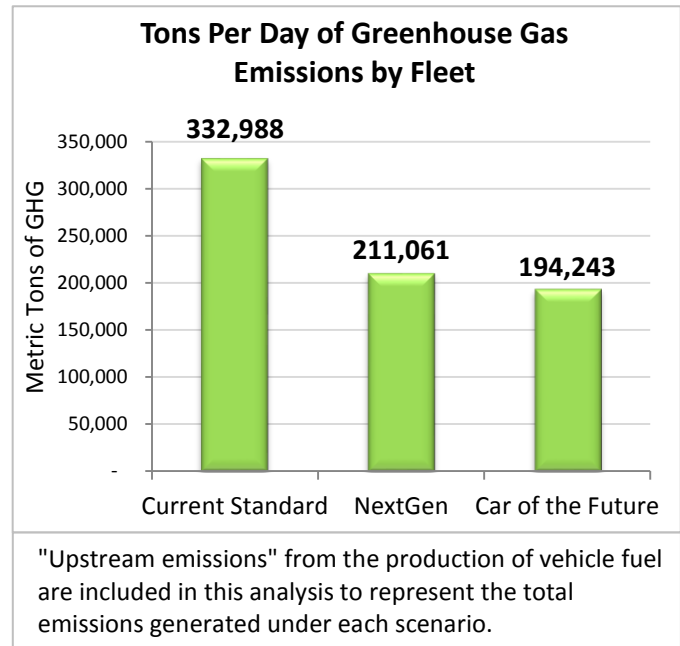
Health and Environmental Gasoline Premium

On an individual level, this study helps to illuminate the added health and environmental costs of our dependence on petroleum compared to the average cost of a fill-up. Each time we fill up an average mid-sized car with gasoline, there is an additional premium of almost \$20 worth of public health and societal damages caused by that tank of gas. Of course, these costs do not show up on the gas pump display next to gallons and dollars, but they do show up in the form of childhood asthma, hospitalizations, emergency room visits for asthma attacks, lost school and work days and premature deaths that result from the ongoing assault of smog and particle pollution in our lungs.

CARB must move forward with the goals of reducing California’s petroleum dependency on more harmful fuels and put forth standards that lead to a cleaner, healthier, more secure future. California must increase reliance on electric-drive vehicles that take advantage of its cleaner electrical mix, abundant renewable resources and leave petroleum behind.

IX. Reducing Global Warming Emissions

Transportation is the main source of greenhouse gases in California and a major source of harmful criteria air pollutants, both of which pose serious threats to public health. In December of 2009, the US EPA published its finding that “greenhouse gases from new motor vehicles and new motor vehicle engines contribute to the greenhouse gas air pollution that endangers public health and welfare.” California’s landmark clean cars law (AB1493, Pavley, 2002) has become the basis for national greenhouse gas emission standards, resulting in an approximate 30 percent cut in vehicle greenhouse gases by 2016. These standards are projected to return California emissions to below 2010 levels by 2020, but as noted in CARB’s AB 32 Scoping Plan: “Although the Pavley regulation results in significant GHG reductions, more is needed.” This is true because current standards are achievable through conventional vehicle technologies and fall short of what is needed to spur the transition to zero-emission vehicles. More advanced standards are needed to complete the transition to zero emission vehicle technologies that will allow California to meet its goal of an 80 percent reduction in greenhouse gases to 1990 levels by 2050.



The scenarios presented in this study would build on the strength of California’s current standards that are expected to reduce greenhouse gases by over 27 million metric tons in 2020. By adopting standards that result in a wholesale shift to commercial volumes of zero emission technologies in the next decade, we can achieve the levels of reductions needed to set California on the path to meeting its leading 2050 climate goals. At 2025 fleet levels, a fleet meeting more stringent NextGen or Car of the Future standards could avoid 45 to 50 million metric tons per year of global warming emissions when fully implemented, a reduction of 45 – 52 percent compared to current standards. Establishing a firm pathway to meeting California’s emission reduction goals will help to prevent significant climate and health damages for generations to come and set the bar for other state and national programs.

In addition to contributing to public health damages of over \$1,700 per vehicle, a vehicle meeting current standards will also contribute over \$1,200 in climate damages from the 39.6 tons of greenhouse gases it generates over its lifetime. On a fleetwide basis, that comes out to over 332,000 tons of greenhouse gases per day and amounts to \$3.8 billion in damages per year. By contrast, vehicles meeting more stringent greenhouse gas reduction standards (6 - 7.8 percent reduction annually) would generate between 23 and 25 tons of greenhouse gases, reducing between 122,000 and 138,000 tons per day. Fleetwide, reducing onboard and tailpipe emissions by 45 - 52 percent between 2017 and 2025 would avoid climate damages of \$1.4 - \$1.6 billion annually when standards are fully implemented.

“Climate damages” are calculated using the US Government’s Interagency Working Group’s “social cost of carbon” methodology and include impacts to:

- Human health (climate related diseases, pollution increases and death)
- Property damages from increased flood risk
- The value of ecosystem services
- Changes in net agricultural productivity

It is important to note that the “social cost of carbon” methodology used by US agencies is a more conservative methodology compared to other estimates. By comparison, a 2009 British government methodology review resulted in a cost estimate roughly three times higher than the US Interagency Working Group figures used in this assessment.

X. Conclusion

This study demonstrates the effectiveness of California's efforts to protect its citizens from the public health threats of air pollutants like smog and fine particles that affect public health today as well as greenhouse gases that threaten generations. Ensuring that California's motor vehicle fleet turns over into the cleanest possible fleet in the future is critical to meeting our air quality and climate protection goals.

The American Lung Association in California strongly supports adoption this year of advanced clean car standards that respond to the urgent need to improve our air quality, meet federal targets for ozone and particle pollution reduction, reduce the devastating lung health impacts of our transportation choices and reduce our dependence on petroleum.

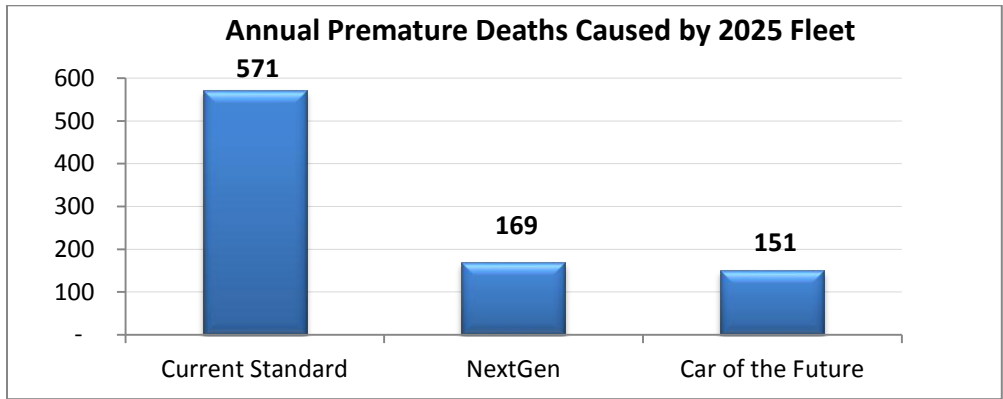
The California Air Resources Board should adopt a clean car package that couples strong smog and particle pollution controls and greenhouse gas emission standards with an aggressive zero emission vehicle requirement that achieves at least a 45 percent reduction in greenhouse gases in the new motor vehicle fleet by 2025 compared to levels achieved under current standards, including:

- Tailpipe pollution standards that cut smog forming emissions by 75 percent and place stringent controls on particle pollution.
- Greenhouse gas tailpipe emission standards that achieve a minimum 6 percent annual reduction in greenhouse gases between 2017 and 2025. To achieve the greatest health and global warming benefits, California should pursue even stronger requirements that will result in a 7.8 percent annual reduction in greenhouse gases and promote higher levels of zero emission vehicles and plug-in hybrid-electric vehicles.
- A requirement that at least 20 percent of new vehicles are zero emission vehicles by 2025.

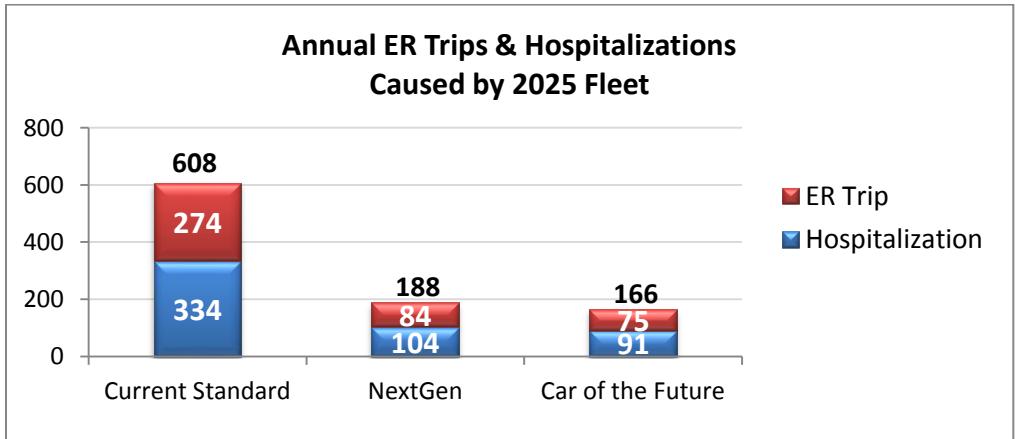
As presented in this report, adopting the strongest possible regulations will result in substantial future savings in reduced public health, global warming, environmental and societal damages. Fleetwide, savings in health and other societal costs could be as high as \$7.2 - \$8.1 billion annually.

APPENDIX A: Additional Health Benefit Graphs

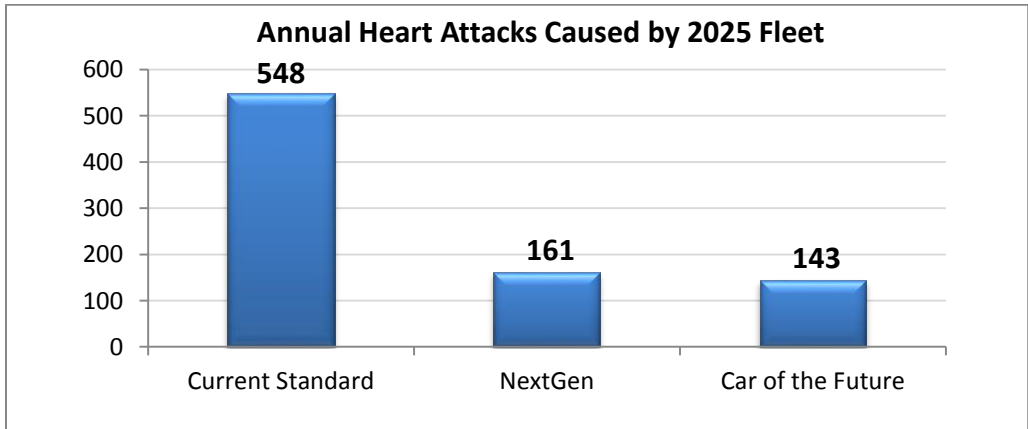
1. Annual Premature Deaths attributed to California vehicle fleet emissions, by scenario:



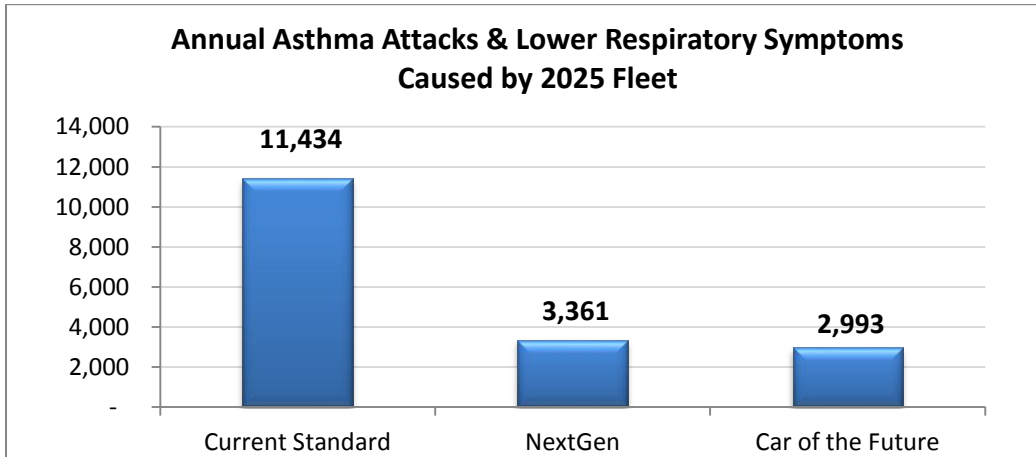
2. Annual Cardiac/Respiratory Hospitalization and Respiratory ER visits attributed to California vehicle fleet emissions, by scenario:



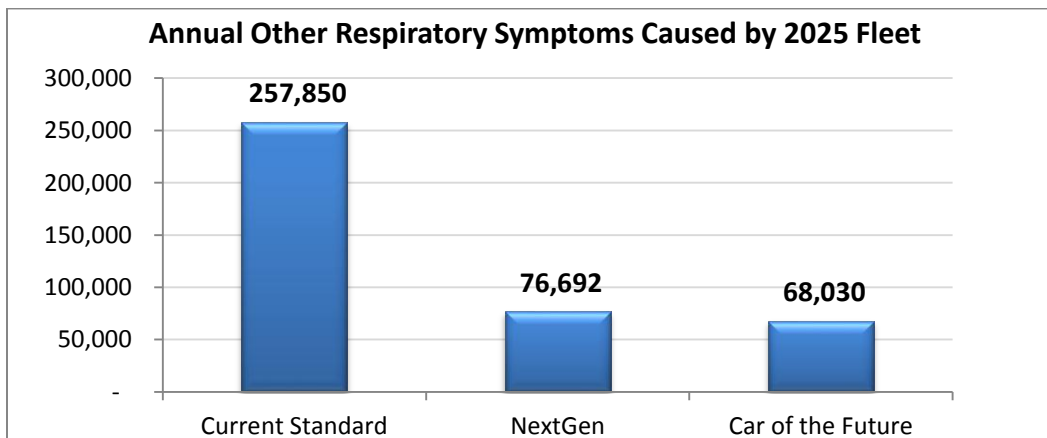
3. Annual Heart Attacks attributed to California vehicle fleet emissions, by scenario:



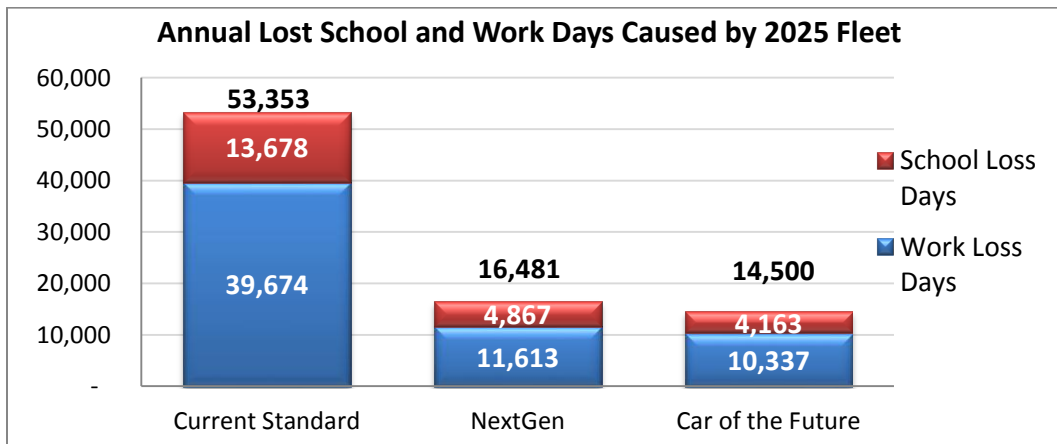
4. Annual Asthma Attacks and Lower Respiratory Symptoms attributed to California vehicle fleet emissions, by scenario:



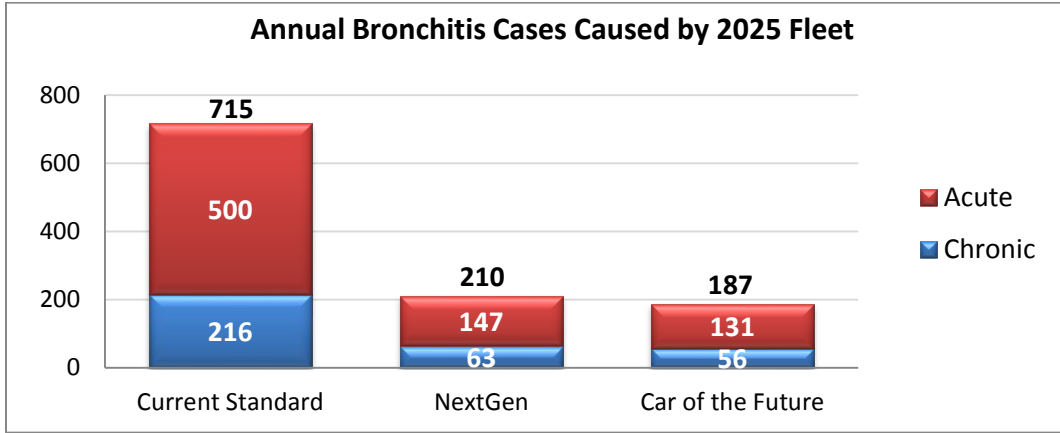
5. Annual Acute and Upper Respiratory Symptoms attributed to California vehicle fleet emissions, by scenario:



6. Annual Work and School Days Lost attributed to California vehicle fleet emissions, by scenario:

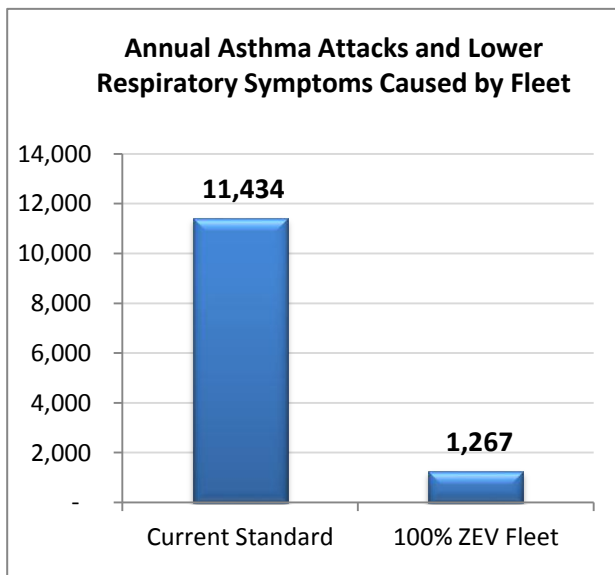


7. Bronchitis Cases attributed to California vehicle fleet emissions, by scenario:



APPENDIX B: Case Study: Electrifying the Fleet

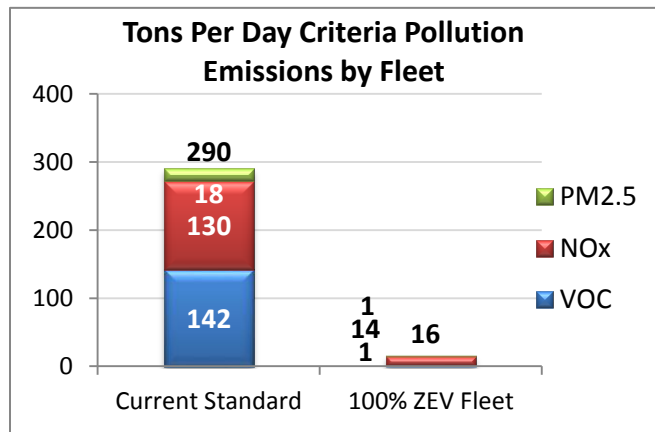
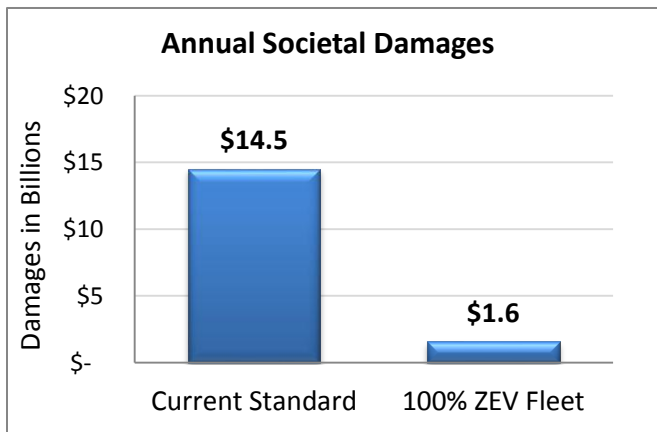
The California Air Resources Board describes the Zero Emission Vehicle program as “an important regulation for meeting California’s air quality and greenhouse gas reduction goals” and that “ZEVs are necessary for meeting California’s long term air quality and GHG emission reduction goals.” Fortunately, CARB is moving forward to strengthen this critical program, which is even more essential now as the US EPA moves to strengthen the national ozone standard this summer. The next round of standards must reflect the urgency of the role that zero emission vehicles will play in carrying out California’s State Implementation Plan to achieve the more stringent health-protective air standards and our state’s 2050 climate goals.



The key to moving beyond petroleum is establishing standards that promote the development and commercialization of zero emission technologies. As noted, the zero emission vehicle modeled in this study is a battery electric vehicle platform. Clearly, hydrogen fuel cell vehicles will play a significant role in a clean vehicle market that caters to all consumer needs.

For the purposes of highlighting the stark differences in oil addiction and oil independence linked to California’s transition to zero emission technologies, we have created a sketch of a 2025 vehicle fleet that creates no tailpipe emissions and is only responsible for emissions related to the manufacture of its fuel. For this study, we have assumed a California electrical grid that relies on renewable energy for one third of its power.

A pure ZEV fleet that consumes no petroleum would avoid almost \$13 billion in health, climate and other damages and avoid 275 tons per day of criteria air pollutants over a fleet that meets current standards. The ZEV fleet would significantly cut health impacts associated with criteria emissions, including premature deaths, from the new car fleet by 90 percent compared to a fleet only achieving the current standards. A strong ZEV mandate will save lives, cut petroleum dependency and further our state’s goals for clean air.

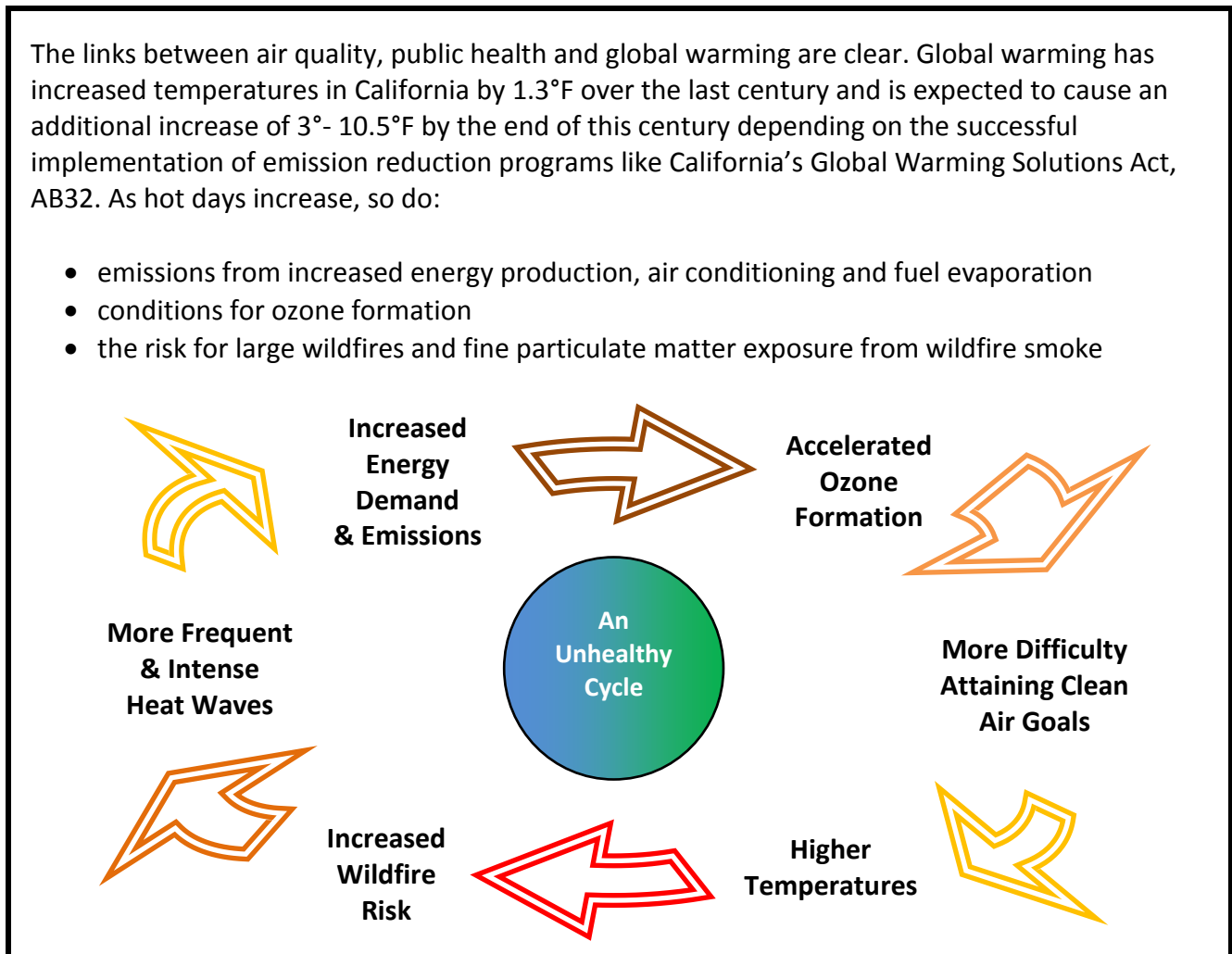


APPENDIX C: Climate Change and Public Health

Public health in California, particularly among vulnerable populations already most impacted by air pollution - children, the elderly, low income communities, communities of color, and those with heart and lung disease - will bear greater impacts as global warming raises temperatures and further threatens our air quality.

The links between air quality, public health and global warming are clear. Global warming has increased temperatures in California by 1.3°F over the last century and is expected to cause an additional increase of 3°- 10.5°F by the end of this century depending on the successful implementation of emission reduction programs like California's Global Warming Solutions Act, AB32. As hot days increase, so do:

- emissions from increased energy production, air conditioning and fuel evaporation
- conditions for ozone formation
- the risk for large wildfires and fine particulate matter exposure from wildfire smoke



Recent research suggests that without significant actions to reduce global warming emissions, California could experience:

- an additional 30 days per year when ozone levels exceed 1-hour state standards by 2050
- a 55% increase in wildfires - and associated particulate exposure by 2050
- a 20%-50% increase in energy demand by the end of the century
- a 75%-85% increase in the number of days conducive to ozone formation in Los Angeles and the San Joaquin Valley by the end of the century
- 100 days per year of temperatures over 95°F in Sacramento by the end of the century

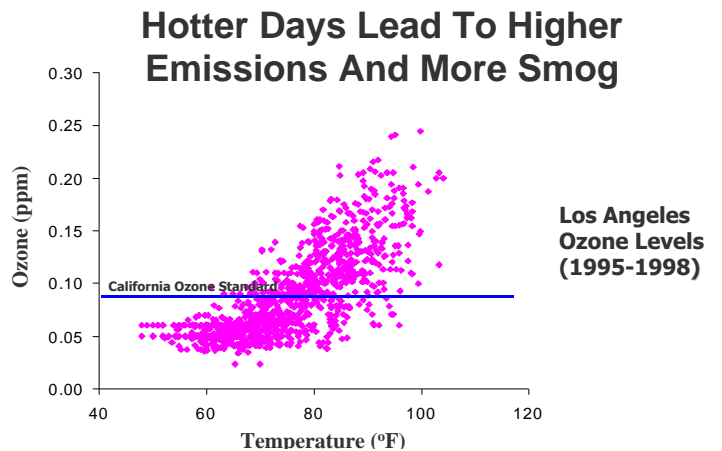
Global Warming Impacts on Public Health

1) Global Warming Accelerates Ozone Formation:

Higher temperatures, strong sunlight and a stable air mass are ideal for formation of ground-level ozone, the primary component of smog. Ozone attacks lung tissue by reacting chemically with it, causing inflammation and increased respiratory symptoms.

This chart shows the correlation between daily high temperatures and elevated ozone levels in Los Angeles.

Source: California Environmental Protection Agency



2) Global Warming Leads To More Smog and Particulate Matter Emissions: Hotter weather leads to increased emissions of ozone precursors, particulate matter and toxic air contaminants because of increased energy production, electricity use, fuel evaporation and other sources. During hot days, high demand for air conditioning leads to increased demand for electric power production and an associated increase in smog-forming pollutants, such as nitrogen oxide (NO_x) emissions.

3) Global Warming Leads To Heat Waves: Children, the elderly, outdoor workers, those suffering chronic illnesses and individuals in lower socioeconomic groups are most vulnerable to the effects of heat. An April 2009 report by California's Office of Environmental Health Hazard Assessment reported at least 140 deaths and over 16,000 emergency department visits associated with the 2006 California heat wave.

4) Global Warming Leads To Increased Wildfires: Hotter, drier weather associated with global warming creates ideal conditions for large wildfires. Wildfire smoke, a mixture of fine particles including soot and ash, poses significant health risks ranging from irritation to the eyes, nose and throat to aggravation of existing heart and lung disease, such as congestive heart failure, chronic obstructive pulmonary disease, emphysema and asthma. People with a prior heart attack are at higher risk for a second heart attack and children and seniors are also particularly vulnerable.

5) Global Warming May Slow Or Entirely Offset Progress Toward Clean Air Targets: While California has made significant progress toward improving air quality, global warming may overwhelm current emission control programs by mid-century, requiring the state and local districts to find additional reductions that may be difficult and costly to obtain. These additional costs and measures are known as the "climate penalty" that must be paid to protect air quality due to the effects of global warming.

APPENDIX D: Methodology and References

To demonstrate the health, climate and other benefits of moving forward with the next generation of California vehicle standards, the American Lung Association in California contracted with TIAX, LLC to conduct a technical analysis comparing the benefits a future with and without more stringent standards.

For each component of this study, TIAX relied on numerous state and federal regulatory documents, technical models and input from the American Lung Association in California (ALAC). Details on each of the components of this report are provided below, with a description of the methodologies used and supporting references.

California Passenger Vehicle Standards

TIAX evaluated the emissions levels allowed under current California motor vehicle regulations as well as future estimated emissions regulations for light duty passenger vehicles. The three passenger vehicle fleet scenarios modeled in this study were then compared using the 2025 estimated California fleet of approximately 30.7 million vehicles over a 150,000 mile lifetime. This study quantifies and compares the benefits of a future fleet meeting more stringent standards to a future without more stringent standards.

Current Standards

The baseline vehicle criteria emission standards used were California's Low Emission Vehicle II (LEV II) standards for smog-forming gases and fine particulates (*i.e.* PM_{2.5}, NO_x, VOCs, SO_x). The LEV II standard remains in effect until 2014 under CARB's proposed pathway to LEV III standards. The greenhouse gas (GHG) emission levels were determined using California's Clean Cars Standard (AB 1493: Pavley: 2002) which extend to 2016.

Future Standards

To estimate more stringent "NextGen" and "Car of the Future" vehicle emission standards to 2025, TIAX relied on regulatory documents created by the California Air Resources Board, the US EPA and National Highway Transportation Safety Administration.

- Criteria emission estimates for 2025 were based on regulatory documents created by CARB in the development of the next round of LEV standards (LEV III) which extend as far as 2025.
 - CARB: "Proposed Regulation to Implement the Low Carbon Fuel Standard: Volume I: Staff Report: Initial Statement of Reasons." March 5, 2009.
 - CARB: "LEVIII PM Update for Nov 16 Workshop." November 16, 2010.
- Greenhouse gas emission estimates for 2025 were based on technical and regulatory documents created by CARB, US EPA and NHTSA in the development of the national tailpipe emission standards, as well as CARB documents related to California's Zero Emission Vehicle (ZEV) Standard.
 - US EPA, NHTSA, CARB: "Interim Joint Technical Assessment Report: Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2017-2025," September 2010.
 - CARB: "White Paper: Summary of Staff's Preliminary Assessment of the Need for Revisions to the Zero Emission Vehicle Regulation." November 25, 2009.

Health Impact Estimates

TIAX evaluated US EPA regulatory impact assessment documents to determine the health effects (*i.e.* premature deaths, asthma attacks, heart attacks, hospitalizations, ER trips, work days lost) and monetary health costs associated with criteria air pollutant emissions allowable at each regulatory endpoint, and by vehicle type.

- Monetized health damages were evaluated using US EPA methodology contained in the April 2010 rulemaking documents for the national GHG and Corporate Average Fuel Economy (CAFE) standards and the EPA's March 2011 quantification of Clean Air Act benefits. Consistent with the methodology used in the March EPA assessment, TIAX utilized a conservative estimate of PM-related damages that relies on an average of the valuation metrics presented in the American Cancer Society (Pope et al, 2002) study methodology and the Harvard Six Cities Study (Laden et al, 2006) study that are used as references in the federal documents. Ozone related estimates were also derived from the March EPA assessment. All monetized health values contained in this report can be viewed as a conservative data set.
 - US EPA, NHTSA: "Final Rulemaking to Establish Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards: Regulatory Impact Analysis." April 2010.
 - US EPA: "Benefits Per Ton PM_{2.5} Reduced." Environmental Benefits Mapping and Analysis Program (BENMAP). Update of Fann N, Fulcher C, Hubbell B. "The influence of location, source, and emission type in estimates of the human health benefits of reducing a ton of air pollution." Air Quality, Atmosphere & Health Volume 2, Number 3, 169-176. 2009.
 - US EPA: Office of Air and Radiation: "The Benefits and Costs of the Clean Air Act 1990-2020." March 2011.
- Health endpoints provided in this assessment were derived from US EPA regulatory impacts analysis associated with National Ambient Air Quality Standards for particulate matter and the March 2011 EPA assessment of the Clean Air Act health benefits. Health endpoints aggregated in this report represent health cases that result from the emissions caused by a fleet of approximately 30 million vehicles that comply with current and future California vehicle standards.
 - US EPA: Regulatory Impacts Analysis for the 2006 National Ambient Air Quality Standards for Particle Pollution (Chapter 5). October 6, 2006.
 - US EPA: Office of Air and Radiation: "The Benefits and Costs of the Clean Air Act 1990-2020." March 2011.

Greenhouse Gas Estimates

TIAX reviewed technical documents prepared in 2010 by a federal agency panel, which included the US EPA, Department of Energy and Department of Transportation among others, to evaluate the monetary costs to society per ton of GHG emitted. It is important to note that the "social cost of carbon" methodology used by US agencies is a more conservative methodology. By comparison, a 2009 British government methodology review resulted in a cost estimate roughly three times higher than the US Interagency Working Group figures used in this assessment.

- US Interagency Working Group (US EPA and US Departments of Agriculture, Commerce, Energy, Transportation, and Treasury): "Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis, Under Executive Order 12866." February 2010.

- UK Department of Energy and Climate Change. "Carbon Valuation in UK Policy Appraisal: A Revised Approach." July 2009.

Energy Security Estimates

The energy security costs included in this assessment reflect the macroeconomic cost adjustments for importing oil (above purchase price) into the United States. These costs account for sudden disruptions in the supply of imported oil into the United States as well as the purchase power (monopsony) effect of the United States. The costs of maintaining military presence to secure stable oil supplies from volatile regions of the world are not included in the scope of this study.

- US EPA, NHTSA: "Final Rulemaking to Establish Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards: Regulatory Impact Analysis." April 2010.
- US Federal Register, Volume 75, No. 58, March 26, 2010, pp. 1476-14818.

Fleet Mix Assumptions

TIAX generated representative mid-sized passenger cars across a variety of technology platforms to achieve future vehicle standards. Conventional gas, hybrid (HEV), plug-in hybrid electric vehicle (PHEV), and Battery Electric Vehicles (BEV) were modeled for this assessment. Hydrogen Fuel Cell Vehicles (FCV) were not modeled in this scenario, but will play a critical role in California's clean transportation future. For this assessment, BEVs serve as a marker for Zero Emission Vehicles. To evaluate the fleet mixes needed to achieve future greenhouse gas emission requirements, TIAX relied upon the greenhouse gas emission projection resources noted above to model individual vehicles which were then used to create the following fleet mix scenarios:

- Current Standard: Follows existing criteria emission reduction requirements of the California Air Resources Board (LEV II), as well as the existing Clean Cars program (Pavley I standards).
- "NextGen": Assumes full fleet turnover to reflect both: CARB's proposed criteria emission reductions in 2025 (LEV III) as well a vehicle mix needed to achieve a greenhouse gas emission reduction path of 6 percent per year from 2017 to 2025 (Pavley II or "LEV III – GHG"). A growing market share for zero emission vehicles (ZEV) is required to meet this pathway.
 - (CARB Mar. 2009, Nov. 2010).
 - (CARB, US EPA, NHTSA, Sept. 2010).
- "Car of the Future": Assumes full fleet turnover to reflect both: CARB's proposed (LEV III) criteria emissions reductions in 2025 and the fleet mix needed to achieve annual greenhouse gas reductions of 7.8 percent. The fleet mix assumed contains a greater share of zero emission vehicles needed to align vehicle standards with California's goal for an 80 percent reduction in greenhouse gases by 2050.
 - (CARB Nov. 2009).
- A 100 percent Zero Emission Vehicle (ZEV) fleet was also modeled and provided as Appendix B to this report to provide a sketch of the benefits of a new car fleet in California that would not consume petroleum as compared to the fleet meeting current standards.

Additional Technical Notes:

Electricity Assumptions

Emissions generated from natural gas fired combined cycle power plants were included in this assessment to provide a more complete accounting of the damages associated with our transportation choices, in terms of both GHG and criteria pollution. California's Renewable Portfolio Standard (RPS) requirement for 33 percent renewable electricity by 2020 (per Senate Bill 2x: Simitian: 2011, signed into law April 12, 2011) was assumed in the base load.

Petroleum Assumptions

Assumes California Reformulated Gasoline (Cal GREET, ver2.1, 2009) following a Low Carbon Fuel Standard (LCFS) pathway of 10 percent reduction in carbon emissions by 2020, incorporates LCFS and US EPA assessment of full lifecycle emissions. The assessment does not incorporate baseline petroleum fuel changes expected over time (i.e. higher carbon-intensity crudes).

Vehicle Footprint Assumptions

The vehicle modeling in this study is based on a passenger vehicle footprint of approximately 45 square feet to correspond with US EPA greenhouse gas tailpipe emissions of ~225 grams of Carbon Dioxide equivalent (CO₂e) per mile (equivalent to approximately 38 miles per gallon) in 2016.

Reference List:

- California Air Resources Board (CARB), "Detailed California-Modified GREET Pathway for California Reformulated Gasoline (CaRFG)," Version: 2.1, Release Date: February 27, 2009.
- CARB, "Estimate of Premature Deaths Associated with Fine Particle Pollution (PM2.5) in California Using a US Environmental Protection Agency Methodology." August 31, 2010.
- CARB "Climate Change Impact on Air Quality in California." Principal Investigator: Michael J. Kleeman, PhD. University of California, Davis. 2010. 04-349. July 21, 2010.
- CARB, "Preliminary Discussion Paper – Amendments to California's Low-Emission Vehicle Regulations for Criteria Pollutants – LEV III," ARB Workshop: March 2, 2010, ARB: "LEVIII PM Update for Nov 16 Workshop." November 16, 2010.
- CARB, "Proposed Regulation to Implement the Low Carbon Fuel Standard: Volume I: Staff Report: Initial Statement of Reasons," March 5, 2009.
- CARB, "Public Workshop on Proposed Revisions to the Low-Emission Vehicle Program," Presentation to ARB Workshop: March 2, 2010.
- CARB, "White Paper: Summary of Staff's Preliminary Assessment of the Need for Revisions to the Zero Emission Vehicle Regulation," November 25, 2009.
- CARB, "California Zero Emission Vehicle Program - Frequently Asked Questions." January 26, 2011.
- California Code of Regulations, Title 17, Subchapter 10, Subarticle 7 Section 95480-95490.
- California Energy Commission (CEC), "Full Fuel Cycle Assessment: Well To Tank Energy Inputs, Emissions and Water Impacts," AB1007's CEC Report # CEC-600-2007-002-D, February 2007.
- CEC, "Full Fuel Cycle Assessment: Well To Wheels Energy Inputs, Emissions, And Water Impacts," AB1007's CEC Report # CEC-600-2007-004-D, February 2007.
- CEC, "State Alternative Fuels Plan," AB1007's CEC Report # CEC-600-2007-011-CMF, December 2007.

- Department of Energy (DOE), Argonne National Laboratory, The Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET) model, Version 1.8d.1.
- US Environmental Protection Agency (EPA), Office of Air and Radiation: "The Benefits and Costs of the Clean Air Act 1990-2020." March 2011.
- EPA and National Highway Traffic Safety Administration (NHTSA), "Final Rulemaking to Establish Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards: Regulatory Impact Analysis," Report #EPA-420-R-10-009, April 2010.
- EPA, NHTSA, and CARB, "Interim Joint Technical Assessment Report: Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards for Model Years 2017-2025," September 2010.
- Health Effects Institute, Special Report 17: "Traffic-Related Air Pollution: A Critical Review of the Literature on Emissions, Exposure, and Health Effects." January 2010.
- McCubbin, D., Delucchi, M., "The Social Cost of the Health Effects of Motor-Vehicle Air Pollution," UC Davis, Report # UCD-ITS-RR-96-3 (11), August 1996.
- NHTSA, Fatality Analysis Reporting System website. November 19, 2010 <http://www-fars.nhtsa.dot.gov/States/StatesFatalitiesFatalityRates.aspx>.
- RAND Corporation (Romley JA, Hackbarth A, and Goldman, DP): "The Impact of Air Quality on Hospital Spending." TR-777-WFHF, March 2010.
- TIAX, LLC, personal communication with Neal Fann, US EPA, Office of Air Quality Planning & Standards, Air Benefit and Cost Group (August/September 2010). Using the same model that also produced the benefits per ton results for the EPA's Environmental Benefits Mapping and Analysis Program website: <http://www.epa.gov/oaqps001/benmap/bpt.html>.
- TIAX LLC, "Appendix A: Benefits of Reducing Demand for Gasoline and Diesel (Task 1)," TIAX report for CARB and CEC's AB2076 "Reducing California's Petroleum Dependence," Report #P600-03-005A1, September 2003.
- US Government, Interagency Working Group (US EPA and US Departments of Agriculture, Commerce, Energy, Transportation, and Treasury): "Technical Support Document: Social Cost of Carbon for Regulatory Impact Analysis, Under Executive Order 12866." February 2010.
- Southern California Children's Health Study:
 - Gauderman, et al. "The Effect of Air Pollution on Lung Development from 10 to 18 Years of Age" New England Journal of Medicine 351:1057-1067. 2004.
 - Jerrett, et al. "Traffic-Related Air Pollution and Asthma Onset in Children: A Prospective Cohort Study with Individual Exposure Measurement". Environmental Health Perspectives 116:1433-1438. 2008.
 - McConnell, et al., "Asthma in exercising children exposed to ozone: a cohort study". Lancet 359:386-9. 2002.
- US Federal Register, Volume 75, No. 58, Friday March 26, 2010, pg. 14769-14818.
- US Federal Register, Volume 75, No. 88, [40 CFR Parts 85, 86, and 600], "Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards; Final Rule," May 7, 2010

Additional resources and methodological information available online at www.lungusa.org/california.