Climate change poses a serious and significant threat to the planet, with dire consequences for the world’s environment, economy, and social welfare. Many of the negative environmental impacts associated with climate change are now increasingly becoming visible in California, including reduced snowpack and earlier runoff of the stored water supply, rising sea levels, and seasonal changes affecting crop production. This article provides a brief overview of the state’s approach to finding solutions to climate change.

California’s Climate Change Solution
An Integrated Model

Downtown Los Angeles Aerial
California’s transportation sources contribute nearly 40% of the state’s GHG emissions, and 55% percent of NOx in the San Joaquin Valley and South Coast Region. Thus, reducing emissions from transportation would play a critical role in meeting both the state’s midterm air quality goals, as well as its long-term climate targets.

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The latest climate science underscores the urgent need to accelerate greenhouse gas (GHG) emission reductions to avoid the most severe impacts of climate change. The Intergovernmental Panel on Climate Change’s recently released sub-report to the Fifth Assessment report\(^1\) also highlights the need for significant action—GHG emissions must be reduced to 80% below 1990 levels by mid-century to stave off the worst impacts of climate change. In addition to the benefits for climate change mitigation, research suggests that technologically feasible and cost-effective actions to reduce GHGs can also reduce emissions of smog-forming and toxic pollutants to meet federal air quality requirements, and provide healthy air for all Californians.

**A Strong Foundation**
California has a demonstrable reputation as a champion in improving air quality and public health for its residents. Over the years, California has implemented effective policies that have dramatically cut pollution from new cars, made its new buildings and appliances the most efficient in the country, created the cleanest-burning transportation fuels in the world, phased out dirty coal and oil burning power plants, and brought entire new industries to life and clean technologies to market. Consequently, California’s emissions have decreased tremendously, and are projected to continue to decrease in the coming years (see Figure 1).

These results are made possible by a strong research program, a solid scientific foundation, long-term vision, dedicated investments, and sustained and comprehensive actions that drive innovative policies. The same solid science which has served as the basis for California’s air quality regulations is the foundation for the California Air Resources Board’s (CARB) most recent climate mitigation efforts. (An article elsewhere in this issue details California’s climate change research program.)

**A State Plan with Global Implications**
CARB’s experience with climate change dates back to 2003 and adoption of the world’s first regulations to reduce GHGs from vehicles. Since then, the California Global Warming Solutions Act of 2006 (also known as AB 32) has given CARB responsibility for the design and implementation of a suite of programs to reduce GHG emissions. AB 32 directs CARB to reduce GHG emissions back to 1990 levels by 2020. California is well on its way to achieving that target, and has laid a solid foundation to maintain those reductions and reduce even more beyond 2020.
Planning, design, and development of many of the GHG reduction strategies began with the AB 32 Scoping Plan, released in 2008. This master plan involved input from numerous California government agencies, a vast array of stakeholders, and the public. It sets out an ambitious roadmap for the state, and establishes a framework for a portfolio of programs, including California’s Cap-and-Trade Program to address the largest emission sources of GHGs in the state; the Low Carbon Fuel Standard (LCFS) to provide for cleaner fuels; the Renewables Portfolio Standard (RPS) to deliver 33% of California’s electricity from the cleanest sources by 2020; and the Advanced Clean Car (ACC) regulations, setting standards and goals for fuel efficiency and zero-emission vehicles through 2025. The recommended reduction measures will drive innovation, improve the environment, enhance public health, and support the growth of clean energy technologies and businesses. The comprehensive approach in the initial scoping plan addressed key criteria, including technological feasibility, cost-effectiveness, overall societal benefits, and impacts on specific sectors, such as small business and disproportionately impacted communities.

AB 32 also requires the scoping plan to be updated every five years, and the latest version binds together efforts to gain the most benefits in criteria and GHG emission reductions. The proposed scoping plan update looks at progress in program implementation, successes to date, and what must be done beyond 2020 as California faces the long-term goal of reducing GHG emissions to 80% below 1990 levels by 2050. The update comprehensively assesses the scientific basis to support a realistic midterm reduction target in the 2030 time frame and also describes the need for sector-specific targets to achieve that goal.

The scoping plan update also sharpens CARB’s focus on Short-Lived-Climate-Pollutants (SLCPs), which include black carbon, methane, tropospheric ozone, and some hydrofluorocarbons (HFCs). A recent study shows California’s diesel regulations and burning restrictions will reduce black carbon emissions to 95% below 1990 levels by 2020. Reducing short-lived climate pollutants produces immediate climate benefits by mitigating emissions of especially potent GHGs, and is an important complement to long-term climate change mitigation efforts.

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Designing a Successful Program
CARB has assumed a leadership role in air quality and GHG regulations because conditions in the state demand it. Air pollution levels, especially in Los Angeles and the San Joaquin Valley, are still higher than the established federal air quality standards. Many of California’s air pollution challenges are unique to our climate, geography, and population, and CARB approaches all regulations with that in mind. Mandatory regional criteria pollutant reduction targets will be established in the 2016 State Implementation Plans (SIPs) with expected reductions in nitrogen oxides (NOX) emissions on the order of 90% below 2010 levels in the South Coast Region and similar reductions in the San Joaquin Valley needed by the year 2032. Many of the strategies employed to reduce GHG emissions will also help to meet the National Ambient Air Quality Standard (NAAQS) or ozone in...
2032. With that in mind, California is developing a comprehensive and cohesive strategy for meeting both the criteria and GHG targets.

One of the best examples of such an all-encompassing approach is to the transportation sector in California. Transportation is widely considered a three-legged stool, balanced on three equally important and critical elements: vehicle technology, transportation fuels, and activity. California’s transportation sources contribute nearly 40% of the state’s GHG emissions, and 55% percent of NO\textsubscript{X} in the San Joaquin Valley and South Coast Region. Thus, reducing emissions from transportation would play a critical role in meeting both the state’s midterm air quality goals, as well as its long-term climate targets.

California’s transportation control program relies on four major elements to build on the strong regulatory foundation that is already in place:

- **Drive development of efficient engine and zero-emission vehicle technology**—The Advanced Clean Car program combines further reductions in criteria pollutants with GHG emission reductions for internal combustion vehicles, while simultaneously driving clean car technology with the Zero Emission Vehicle (ZEV) standard, which calls for one in seven new car sales to be a zero-emission vehicle by 2025. California has signed a Memorandum of Understanding (MOU) with seven other states to more quickly develop the market for ZEVs. This collaboration calls for putting additional 3.3 million ZEVs on the road by 2025.

- **Drive innovation and investment in low-carbon fuels**—The Low Carbon Fuel Standard requires fuel suppliers to reduce the carbon intensity of transportation fuel by 10% by 2020. Two million excess credits had been generated through the third quarter of 2013, and more than 200 fuel pathways are now available for compliance. The Cap-and-Trade Program requires fuel suppliers to account for the carbon in their fuel to further encourage California’s transition to a clean energy supply.

- **Provide more mobility options**—California enacted the Sustainable Communities and Climate Protection Act (also known as Senate Bill 375) in 2008, which aims to reduce GHG emissions through coordinated transportation and land use planning with the goal of creating more sustainable communities. The statute requires California to develop regional GHG reduction targets for passenger travel for the various transportation planning regions, and CARB is working closely with all the regions to develop effective and sustainable land use and transportation management strategies for short- and long-term success.

- **Integrated systems to enhance environmental performance**—To meet California’s aggressive reduction targets, the state must integrate multiple systems to maximize efficiency and reduce emissions. For example, combining smoother road surfaces, cleaner fuels, and expanded use of GPS and broadband technology to increase both light-duty vehicle and freight movement efficiency (see Figure 2).
Together, the AB 32 rules combine regulation with economic incentives to create a “push–pull” mechanism that pushes compliance, while pulling in the technological innovation and development to achieve it. For example, the ACC and the LCFS create a regulatory push to achieve emission reductions. At the same time, the Clean Vehicle Rebate Project (CVRP) provides incentives for the zero-emissions vehicles required under the ACC program.

Conclusion
California has taken a leadership role in developing a comprehensive set of GHG reduction regulations with the goal of establishing collaborative efforts with other jurisdictions to reduce emissions worldwide. California has signed MOUs with many jurisdictions to exchange information and share experiences. This includes the Chinese city of Shenzen, which recently inaugurated its own cap-and-trade program. California linked its Cap-and-Trade Program with Quebec’s this year, and as the U.S. federal government pursues GHG emission standards for power plants, flexible compliance mechanisms such as cap-and-trade may provide options for other states.

California has built a suite of complementary programs which can serve as fundamental models for other states and countries. Toward that end, CARB has hosted a number of international teams, including delegations from China, Germany, and South Korea, who are hoping to learn from California’s experience and examine our procedures. For our programs to truly succeed, we must learn from, and help each other design the most successful programs for each jurisdiction.

References
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Abstract Submission Details
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