

Carbon-Free Prosperity in California: Policies for Success

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Executive Summary

California is leading the country, and even the world, toward carbon-free prosperity. The state is on track to achieve its goal for carbon reductions in 2020, and California's businesses are global leaders in energy innovation. To keep pace toward its 2050 goal—an 80 percent reduction in greenhouse gas emissions below 1990 levels—recent research shows that California will need to accelerate policy development and pioneer new carbon reduction strategies. An overriding crucial step will be to properly set a 2030 carbon cap for the state. This policy will spur the necessary long-term investments. The following are our additional priority recommendations, by sector.

1. Electricity

California leads the country in both energy efficiency and the adoption of renewable energy. The state's electricity providers have already signed contracts to meet California's current goal of 33 percent renewables by 2020. Of course, contracts for renewable capacity are only part—albeit a large part—of the solution. New renewable capacity must be balanced with a more flexible grid as well as a regulatory scheme that aligns the financial interest of the utilities with the policy interests of the state and its residents. Thus, our top two recommendations in the electricity sector are:

- A. Ensure that wholesale power procurement and markets are designed to cost-effectively integrate high levels of renewables while maintaining reliability by creating a market for “flexible resources” including demand-side resources.
- B. Transition from cost-of-service regulation to a model that aligns incentives for utilities with achieving the state's long-term carbon pollution reduction goals.

2. Buildings

The state is on the right track with its plans for adding Zero Net Energy buildings into the Title 24 code for new construction. Faster progress is needed in the implementation of AB 758, addressing energy efficiency in existing buildings. The state should also move expeditiously to require building energy performance labels when homes are being sold. Expanding the coverage and ratcheting up the ambition for the state's energy performance standards for appliances is also required.

3. Transportation

Because of California's terrific accomplishments on reducing light duty vehicle GHG emissions, now reflected in federal policy, the two main challenges in the transportation sector involve cleaning up transportation fuels and reducing the need for vehicle miles traveled through smart growth. The state has programs in place addressing these fuels and smart growth, but they would benefit from enhancements.

- A. Ensure success of the Low Carbon Fuel Standard (LCFS) program. The LCFS is performing well and the supply of lower carbon fuels has been increasing steadily. Out of an abundance of

caution, CARB is contemplating a cost containment mechanism, which would render irrelevant the worst-case scenario concerns that industry has raised. Credit value created through a cost-containment mechanism should be directly reinvested in the expansion of the supply of very low carbon fuels and the distribution system to support their use. In addition to a cost cap to protect against unexpectedly high costs, there should be a price floor that gives advanced fuel providers some certainty regarding the value of their investments.

- B. The state's AB 32 cap-and-trade program generates significant revenue from carbon permit auctions. Some of these funds should be spent to support public transit. And those funds should be made available to local government contingent on their adoption of other favorable smart growth policies, such as steps to reduce sprawl, or the introduction of congestion pricing. California's Sustainable Communities and Climate Protection Act (SB 375), is the nation's first legislation to link transportation, land use planning, and greenhouse gas emissions, and it provides a strong framework for smart growth. Local communities are even more budget constrained than the state, and should receive the support needed to make foundational investments.

4. Fracking and methane emissions

The Governor's recent signature on SB 4 sets standards for fracking oil and natural gas wells, but the new law does not cover methane emissions. California should develop the gold standard in methane emissions standards for oil and gas production, processing, storage, transport and distribution. The Air Resources Board has this issue queued up for rulemaking starting in 2014.

5. Spurring action in other states, regions, and China

California should continue its efforts to cooperate with governmental counterparts beyond the state's borders. The state's leadership in energy and climate policy creates opportunities to supplement or fill the gap left in the absence of federal policy by joining forces with other states and regions. And China, the biggest factor in our global climate future, is hungry for technical assistance as it designs its emission reduction programs. Governor Brown has entered into agreements with Oregon, Washington, and British Columbia to build a west coast carbon strategy, and he has signed important agreements with several Chinese ministries for state agencies to give them technical support. These agreements will need political and financial support in the coming years. They will have an impact well beyond the state.

To sum up, the best research indicates that California's long run climate goals are achievable through aggressively ramping up energy efficiency, decarbonization of electricity, and increased electrification of the transportation sector.¹ Each of the recommendations in this memo helps to accomplish these steps. The challenges are real and the necessary policies are ambitious. But the benefits of pioneering carbon-free prosperity are clear. By pursuing this path, Californians will enjoy cleaner air, will inspire others to act on climate, and will help to build clean energy technology companies that will be leaders in the enormous clean energy economy of the future.

¹ J. William et al. 2012. The Technology Path to Deep Greenhouse Gas Emissions Cuts by 2050: The Pivotal Role of Electricity. *Science* 335: 53-59 (January 6).

Background

With existing and nascent technologies, it is now possible to envision a prosperous future with very low carbon emissions—and there is every reason the state should continue to lead in realizing that future. California has a goal of an 80 percent reduction in greenhouse gas emissions by 2050, and is on track to achieve the interim goal in 2020 set under AB 32. California established the framework of best practice for comprehensive climate policy with its inclusion of both sector policies and economy-wide carbon pricing—and this mix is required for large emissions reductions at a low cost. But we will need a new round of smart, aggressive policymaking between now and 2030 to hit the 2050 goal.

This memo outlines the key issues the state will face on that path, and recommends policies to ensure success. It is intended as a conversation-opener, to be refined with more research, ideas from others, and lessons from experience.

The California story is important well beyond this state: If we can build a low-carbon economy that enhances prosperity, other states and countries will follow; if we fail, they will be unlikely to proceed. For better or worse, California will set the stage. We will not be alone, of course: Germany has a similar goal and has taken aggressive steps toward it, as have several other European countries. China has picked up the pace, and now has the world's largest renewable energy and energy efficiency commitments—but also the world's largest coal fleet. But even in these countries, success in California will have a major influence.

Success here will also help set the technology paths to the future. California's culture of innovation, venture capital, and markets has been, and can be, prime drivers to create low-cost, low-carbon technologies. To get there, we will need great policy. The market unleashes innovation, but policy must channel market dynamism in the right direction. We are fortunate in that Governor Brown understands the issue, and has been a national leader in smart energy policy. But even with that advantage, the state will need a fresh, smart, and aggressively promoted set of policies in order to succeed.

The Vision

Achieving California's long-term carbon goals requires, over time, a thorough rehab of our infrastructure. We need to convert our building stock to zero-net energy consumption, or at least make buildings super-efficient. We need very efficient autos and trucks powered by steadily lower carbon fuels, or low-carbon electricity—and those cars should drive fewer miles as California's citizens take advantage of rich public transportation options. Our electric system must be powered by renewable sources, and it must power the world's most efficient industry. These sector-by-sector transformations are all possible and affordable with good policy. California has a great head start in this race. It is now time to lay out plans to finish the job.

A crucial early step will be to set a 2030 carbon cap for the state. This will create policy certainty that will in turn spur long-term investments. This memo also argues for new initiatives in (1) electricity; (2) buildings; and (3) transportation. It suggests that California set best-practice policies for (4) hydraulic

fracturing in gas and oil drilling (fracking); and it makes the case to (5) extend this work with other U.S. states and with China. These five steps, added onto our rich set of existing policies, will keep the state on the course toward low-carbon prosperity.

1. Electricity

California holds the national lead in both utility energy efficiency and renewable energy. It must now pioneer the next steps. Fortunately, the California Public Utilities Commission is arguably the most sophisticated utility regulatory apparatus in the world, and has the resources to set an important pattern for many other parts of the U.S. and the world.

California has already signed contracts to meet its current goal of 33 percent renewables by 2020. Of course, contracts for renewable capacity are only part—albeit a large part—of the solution. New renewable capacity must be balanced with a more flexible grid as well as a regulatory scheme that aligns the financial interest of the utilities with the policy interest of the state and its residents. California can go much further with renewables if we get things right on these two supporting issues. Thus, our top two recommendations in the electricity sector are:

- A. ***Ensure that wholesale power procurement and markets value flexibility.*** Powering the electricity grid with a high share of renewables will require that the grid become much more flexible while the utilities and the California Independent System Operator become “system optimizers,” efficiently dispatching a wide range of supply and demand alternatives to meet total system demands. Detailed changes to the wholesale power markets² can ensure that options for flexibility are available to these system optimizers—from demand-response to storage to fast-start and fast-ramping natural gas.
- B. ***Transition from cost-of-service regulation to a model that aligns incentives for utilities with the state’s long run climate goals.*** Performance-based regulation rewards the utility for providing electricity services instead of electrons. The regulations for investor-owned utilities that have already decoupled revenue from the volume of electricity sold were the crucial first step, but there is a huge opportunity to drive efficiency within the utility business by setting performance goals along other metrics—such as environmental performance, distribution system performance, or even customer service. Special attention must be paid to publicly-owned utilities as well, to ensure that their financial health does not remain tied to the volume of electricity they sell, but instead to the services they provide. This transition should also include creating new opportunities for non-utility partners to participate in helping achieve these performance goals.

2. Buildings

California is to be commended for establishing specific Zero Net Energy goals, which make Zero Net Energy the standard for all new homes by 2020 and for all new commercial buildings by 2030. California’s Strategic Plan for Energy Efficiency sets these goals, and now the state is moving to

² Examples include: valuing capabilities instead of capacity (see [Aligning Power Markets to Deliver Value](#)), letting demand-side resources bid in on equal footing with supply-side resources (see [Policy Implications of Decentralization](#)). Expanding the electricity balancing area to include the Pacific Northwest would be another way to take advantage of latent flexibility, the first twinkle of which can be seen in the new electricity imbalance market with PacifiCorp (see [PacifiCorp-ISO Energy Imbalance Market Benefits](#)).

incorporate them in the detailed Title 24 building codes that will set minimum performance standards for new buildings. New standards go into effect January 1, 2014, and work has already begun on the next round of improvements. This type of continuous improvement and incorporation of new technologies is how policy should work, though examples of this in practice are few.

New building codes are not enough, since they cover only new buildings or major rehabs. Buildings last for decades, and many, perhaps most, of the buildings in existence today will be in use in 2050. Existing buildings must be upgraded, and policy is needed to support the transformation. As of 2012, despite a major push under the Energy Upgrade California effort, the state's whole house retrofit program was only accomplishing approximately 1,000 retrofits per year.³ AB 758 provides the right framework for working around this slow turnover, including a multifaceted push to expand the state's capacity to support meaningful building assessments and energy labels,⁴ to build up financing options to manage upfront costs, as well as to build up the workforce skills and certifications that are required.

The state has the authority under AB 758 to require energy labeling for new and existing buildings when they are sold (at the time of sale). This step should be taken expeditiously. The fact that energy efficiency upgrades may not be reflected in today's property prices is a barrier to the industry. Labeling represents a modest step toward achieving upgrades on existing buildings through improved market valuation of energy efficiency.

Expanding the coverage and ratcheting up the ambition for the state's energy performance standards for appliances is another necessary step to reducing greenhouse gas emissions attributable to buildings in California.

3. Transportation

California's leadership in setting CO₂ standards for automobiles spurred the federal government to adopt a national 54 mpg standard by 2025. This was a signal victory—and makes the case, yet again, for California's ability to lead the nation. This progress on vehicle efficiency leaves two further immediate transportation challenges: transportation fuels and the shape of cities in California, which determine dependence on car travel, and the amount of miles driven by California's residents. The state has programs in place addressing these transportation fuels and smart growth, but they would benefit from the following enhancements.

A. Low Carbon Fuel Standard (LCFS) program enhancements

Ensure success of the Low Carbon Fuel Standard (LCFS) program. The LCFS is performing well and the supply of lower carbon fuels has been increasing steadily. Out of an abundance of precaution, CARB is contemplating a cost containment mechanism, which would be useful if well designed. Any credit value

³ CEC Staff Report, *Comprehensive Energy Efficiency Program for Existing Buildings: Scoping Report*, August 2012, CEC-400-2012-015.

⁴ Assessments provide specific guidance to building owners regarding recommended energy saving investments. Building energy labels provide information to the market place regarding energy performance, which allow potential owners or tenants to better judge the energy efficiency of a building.

raised from a cost-containment mechanism should be directly reinvested in the expansion of the supply of very low carbon fuels and the distribution system to support their use. In addition to a cost cap to protect against unexpectedly high costs, there should be a price floor that gives advanced fuel providers some certainty regarding the value of their investments.

The Air Resources Board already has built significant flexibility in to the LCFS, but industry concerns about the cost of compliance in future years have succeeded in creating uncertainty among investors and alternative fuel providers. In light of this, a carefully designed cost containment mechanism to avoid unlikely high cost scenarios, tied to greater investment in very low carbon fuels, makes sense. This additional compliance option would be available in lieu of traditional compliance should a cost cap be triggered, and should result in direct and timely investments in very low carbon fuel supply and infrastructure. Such investments should be prioritized according to their ability to bring companies back into compliance and to put in place the conditions needed for the expansion of the supply and use of very low carbon fuels in California.

In the long run, there is good reason to believe that electrification will be the most important strategy for reducing emissions from transportation. Research by Williams et al (2013), discussed in the appendix, makes this point persuasively. It is important to see the opportunity for idle electric vehicle batteries to serve a storage function. This could assist in the cost-effective integration of renewable energy. A pilot project is underway in Delaware to test the concept.

B. Support smart growth through public transit investments

Use carbon allowance auction revenue for public transit investment. Make receiving funds contingent on other favorable smart growth policies, such as steps to increase population density or the introduction of congestion pricing. California's cities are crucial to our state's commitment to pioneering the path of environmentally-sustainable economic growth. California's Sustainable Communities and Climate Protection Act (SB 375) is the nation's first legislation to link transportation, land use planning, and greenhouse gas emissions.

For our cities to remain livable as our urban population grows, they need to keep building up transit alternatives to cars. Public transit is steadily increasing its share of total trips. Bike ridership, including as a commute option, is taking off even more quickly than would have been predicted in places like San Francisco and Oakland. Given the resource constraints faced by cities, it would be extremely valuable to use some of the auction revenue associated with the expansion of the carbon cap in 2015 to support urban public transit. This would create an opportunity to insist on integrated regional planning (which avoids inefficiencies that occur when each city or transit district looks only within its borders and fails to consider the needs of the region as a whole). There is a natural tendency of residents to resist rapid change—they like things the way they are. But, California's cities are growing, and this growth should incorporate smarter transportation strategies, which will generate serious livability and environmental benefits.

Peter Calthorpe and collaborators have developed a persuasive, quantitative analysis of the benefits of intelligent growth, and find that the economic benefits are large.⁵ By 2050, smarter growth would be expected to save California households roughly \$12,000 annually (in 2008 dollars) in energy costs. Such a long time horizon is appropriate in this case because development patterns change slowly. It takes time for policy to make a difference. Incidentally, these cost savings do not capture related environmental and public health benefits, nor the livability benefits.

There has been an effort to prevent the entry of transportation fuels under the state-wide carbon cap in 2015. We urge California to stand firm and keep transportation fuels subject to the cap. This feature would extend the coverage of the cap to 85 percent of the economy and can provide badly needed resources for low carbon transportation options, including the public transit investment discussed here. As a general principle, investing carbon auction money to reduce the cost of low-carbon technologies, and to spread their adoption, creates a “virtuous cycle,” constantly driving down the price of a clean energy economy.

4. Fracking

The governor recently signed SB 4 into law, regulating the use of hydraulic fracturing and other enhanced production techniques in California’s oil and gas extraction operations. This is a very positive step toward ensuring the protection of public health and environmental quality. History has shown that, absent strong standards, the energy industry will shift costs to the public in unacceptable ways. In a January 2012 [LA Times op-ed](#), we laid out a five-point plan for getting fracking right: prevent methane leaks, don’t undercut the transition to clean energy, mandate sound well construction, protect surface water and groundwater, and avert excess carnage on the landscape by clustering drilling and protecting the most valuable ecosystems. In our June report, [Frack or Fiction](#), we provided detailed input to the Division of Oil, Gas, and Geothermal Resources (DOGGR) as part of their rulemaking process. We are gratified to see many of the policy design features that we have recommended included in the draft regulation recently released by DOGGR.

Our preliminary assessment is that these draft regulations will go a long way toward ensuring that California is operating at the frontier of best practice, or is advancing the frontier, on aspects of fracking covered by the regulation, which is essentially everything except for issue of methane and other air emissions. We have a few further ideas we will suggest for the final rule, but, given the progress the draft regulation represents, the most pressing issue now for California is the issue of methane leakage.

California should develop the gold standard in methane emissions standards for oil and gas lifecycle activities. CARB’s rulemaking process on this topic, which will launch in 2014, indicates this is already on the state agenda. ***Equally important, the state must help pioneer the next generation of emission inventory and facility-level monitoring techniques.***

⁵ Calthorpe, Peter. 2011. *Vision California: Charting Our Future: Statewide Scenarios Report*. Calthorpe and Associates, California High Speed Rail Authority, California Environmental Protection Agency, California Health and Human Services Agency, and the California Department of Natural Resources.

Two recent studies found levels of methane in the Los Angeles area to be 50 percent higher than the level that would be consistent with the data from CARB.⁶ Methane is a powerful greenhouse gas and the main component of natural gas. It leaks from gas and oil operations, and is also an agricultural and landfill byproduct. New methane detection technologies will enable the next generation of regulatory procedures addressing methane emissions in inventories and mandatory reporting. ARPA-E is funding efforts to develop very low cost methane detectors, but currently available technologies that can help upgrade California's climate commitments provide a strong regulatory impetus for getting methane emissions accounting right. A company based in Santa Clara has developed a mobile detection device that can be car-mounted and used to measure emissions from industrial sources at some distance, "from the fence line." This has implications for sampling without going through a cumbersome approval process. CARB has identified improving methane emission measurement as a priority and should move quickly to incorporate new technologies. For example, Colorado's new methane regulation requires regular monitoring for leaks using infrared cameras.

Given the global surge of interest in natural gas as a fuel and related debates about the issue of methane leakage, California's efforts would have significant ripple effects beyond the state's borders.

5. Cooperation with other U.S. States, Regions, and China

California has never lost sight of the need to join with others in efforts to pioneer carbon-free prosperity, and has sought partnerships with other states and participated in international processes. The continuation of both of these efforts is crucial. When the right policies spread to other jurisdictions, they help to spur demand for cleaner production techniques and cleaner products. Greater demand is crucial for the businesses trying to commercialize emerging clean technologies, many of which are based in California or have important elements located here.

California has been a leader among states, inspiring many state-level climate agreements. An early example was the Western Climate Initiative, which is continuing today, though it has lost some members. Quebec held its first allowance auction in December, and linkage – the trading of allowances between California and the Canadian province – is set to launch next year. More recently, Governor Brown has reached an agreement to promote electric vehicles with eight other states and as well as an accord on coordinated carbon pricing with Oregon, Washington, and British Columbia. In the electricity sector, we recommend an effort to increase coordination and integrate markets across the West, which would contribute to cost-effective renewable electricity integration. We encourage the pursuit of this arrangement as part of California's inter-state outreach.

In the international realm, the signing of three Memoranda of Understanding with Chinese government counterparts and continued follow on collaboration is encouraging. The Chinese desperately want to

⁶ Paul O. Wennenberg, et al. 2012. "On the Sources of Methane to the Los Angeles Atmosphere," *Environ. Sci. Technol.*, 2012, 46 (17): 9282–9289

J. Peischl et al. 2013. "Quantifying sources of methane using light alkanes in the Los Angeles basin, California," *Journal of Geophysical Research: Atmospheres*, Vol. 118: 1–17.

understand how the air in Los Angeles was cleaned at the same time economic growth continued. They want technical help on emissions trading markets. The Chinese need specific, detailed, technical assistance in (a) building a sound environmental enforcement system; (b) controlling air pollution; and (c) developing strategies to reduce CO₂ emissions. No one is better equipped to help on this than CARB, CEC, and the CPUC. The Governor's visit and his willingness to dispatch senior staff to help has been keenly observed and welcomed in Beijing. The continuation and deepening of this cooperation is key to China's success—and the world's. All of that should be backed up with further political attention: ***We urge another trip by Governor Brown in the next several months.***

Wrapping this all together

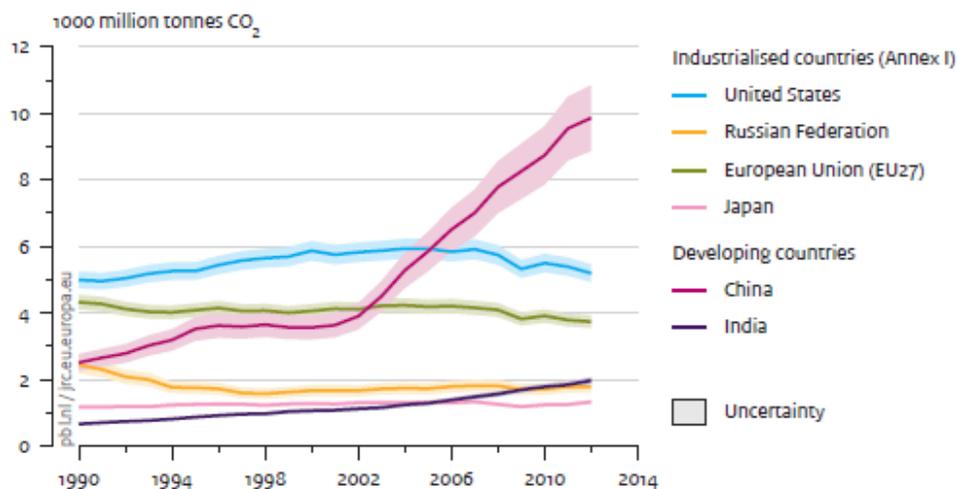
These strategies, plus all the other work underway, will help ensure California achieves our long run goals for carbon-free prosperity. There will be positive impacts on the local environment, the economy, and global climate change. California has been a leader in delivering this message that melds sustainability and prosperity, and has been a global inspiration in the process. The multiplier effects of this external work should not be underestimated.

Technical Appendix. Recent policy analyses relevant to California’s long term goals

Our urgency is grounded in global climate change science and global emissions trajectories. In *A Trillion Tons*,⁷ we analyzed the policy implications of climate science and offered strategies to land at a reasonable carbon concentration—via a carbon budget. Our conclusions were echoed in the recent IPCC report. To have a good chance of keeping global warming below 2 degrees Celsius, thought to be a threshold where dangerous climate change is more likely, we have a global carbon emissions budget of one trillion tons, and we have emitted somewhat more than half of the budget.

Looking at global trends, emissions have been stable or declining slowly in the more developed regions of the world, as Figure 1 shows. Though China has dominated recent growth in carbon emissions, China is ramping up its plans for continued energy efficiency and clean energy deployment.

Figure 1. CO₂ Emissions from Fossil Fuel Use and Cement Production in the Top 6 Emitting Countries



Source: *Trends in Global CO₂ Emissions*.⁸

An unavoidable characteristic of carbon math and carbon accumulation is that losing a decade or two causes irrecoverable damage. Timing is crucial; fast action is needed. Industrialized countries need to sharply turn down emissions, and developing countries quickly peak and then reduce their emissions. The need to sharply reduce emissions is why California’s 80 percent below 1990 by 2050 goal is so important.

Two recent studies have assessed the future trajectory implied by current policy and what additional policies might do to the emission pathways. One paper was published in *Science* magazine and the other is a Lawrence Berkeley National Laboratory report. Both provide evidence that the state is on a

⁷ Harvey, Hal, Franklin Orr, Clara Vondrich. 2013. “A Trillion Tons,” *Daedalus, the Journal of the American Academy of Arts and Sciences*.

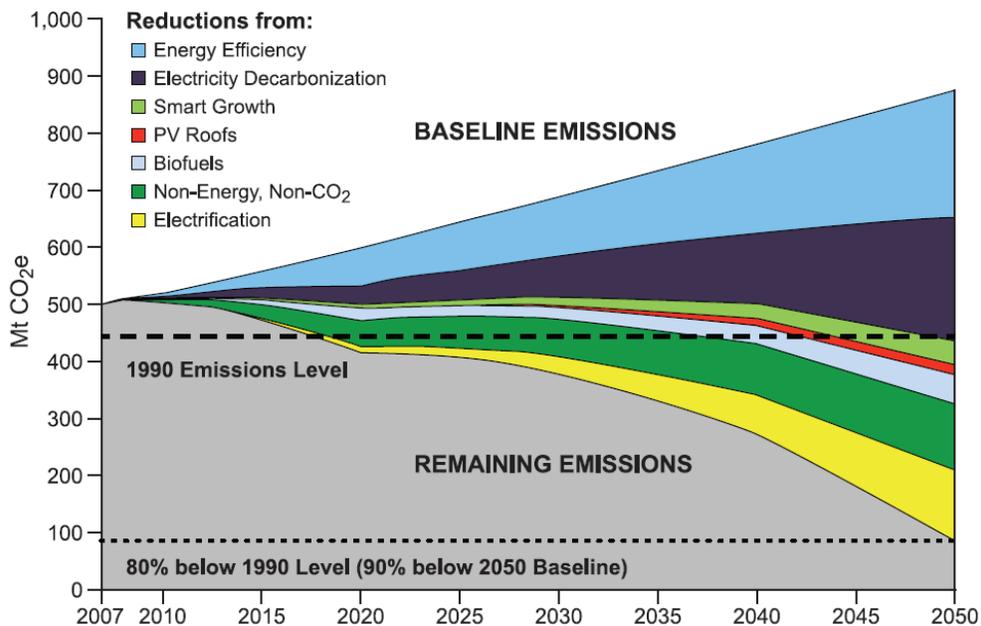
⁸ Netherlands Environmental Assessment Agency and European Community Joint Research Center. 2013. *Trends in Global CO₂ Emissions: 2013 Report*, JRC Technical note number: JRC83593

path to achieving its 2020 reduction, but that renewed policy work is needed to bend the state’s emissions path downward more sharply toward the 2050 goal.

The consultancy Energy and Environmental Economics conducted a study of what technologies would be needed to achieve California’s 80 percent below 1990 by 2050 reduction.⁹ Their most interesting finding is that widespread electrification of transportation will be required. Not surprisingly given the very long time horizon under consideration, the transformation demands technologies that are not yet commercialized, but they excluded technology considered too far from commercialization in the coming decades, such as fusion power.

Figure 2 presents the results of the Williams et al. study, which finds a technology pathway to the required 2050 reductions using a mix of current state policy and additional policies.

Figure 2. Science Magazine Article (Williams et al.) Pathway to 2050 Reductions for California



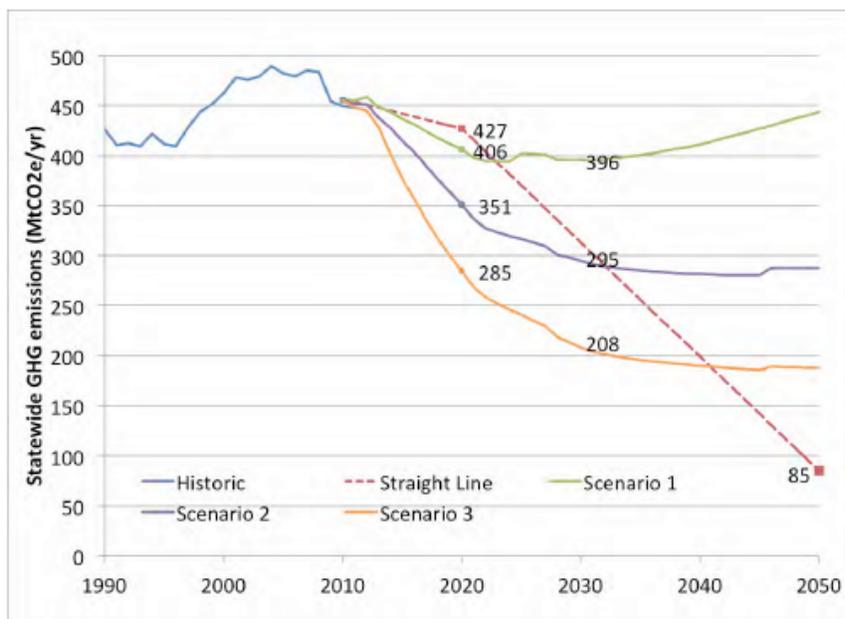
Source: Williams et al. (2012)⁷

In his November 2013 report,¹⁰ Dr. Jeffrey Greenblatt also looks at emission pathways for California through the 2050 time frame. This report forecasts future emissions if only currently committed policies are pursued (Scenario 1) and in scenarios that collect additional policy ideas in various states of play (Scenarios 2 and 3, with Scenario 3 the more stringent). Figure 3 is the principal graphic from the report.

⁹ J. William et al. 2012. The Technology Path to Deep Greenhouse Gas Emissions Cuts by 2050: The Pivotal Role of Electricity. *Science* 335: 53-59 (January 6).

¹⁰ Jeffrey Greenblatt. 2013. Estimating Policy-Driven Greenhouse Gas Emissions Trajectories in California: The California Greenhouse Gas Inventory Spreadsheet Model, Lawrence Berkeley National Laboratory, LBNL-6451E

Figure 3. Future California Emissions under Scenarios Constructed for LBNL Analysis



Comparison of GHG emissions by Scenario, along with historical and “straight-line” connections between 2020 and 2050 policy targets.

Source: Greenblatt (2013)⁸

Both Scenario 2 and 3 achieve more than the reductions that would be required to hit the red dashed line, which represents a straight line pathway between the AB 32 requirement and the 2050 executive order. However, after 2030, both scenarios then plateau. This is largely a result of the way the policies included in the scenarios are constructed. For example, in Scenario 3, the RPS stops increasing when it reaches 51 percent in 2030. The most important implication in the Greenblatt report is that the current set of policies, which are brought together in Scenario 1 (the green line in Figure 3), are not sufficient to achieve reductions post 2020. In this memo we have identified priorities for what more must be done.