

# CALIFORNIA'S CLIMATE CHANGE POLICY

**RAISING THE BAR**  
BY PAMELA M. DOUGHMAN

LAST YEAR, California's legislature passed one of the most sweeping laws on greenhouse gas emissions in the United States, requiring California to reduce greenhouse gas (GHG) emissions to 1990 levels by 2020. Due to the size of its economy and the amount of GHG emissions it produces, the Golden State's climate change policies have the potential to play an important role in the overall direction of U.S. policies.

The state of California has more than 37 million people. Out of the total U.S. population, more than one in eight live in California.<sup>1</sup> In 2006, California's gross domestic product (GDP) was \$1.7 billion, more than one-eighth of the U.S. GDP, making it the eighth largest economy in the world by this indicator and the largest of any state.<sup>2</sup> In terms of carbon dioxide (CO<sub>2</sub>) emissions from the combustion of fossil fuels, for 2003, California ranked second only to Texas within the United States and eleventh in the world.<sup>3</sup> (Carbon dioxide from the combustion of fossil fuels was about 80 percent of total U.S. GHG emissions in 2003.<sup>4</sup>) Although 1990 GHG emissions in California totalled more than any other state,

per capita California GHG emissions that year were below the national average.<sup>5</sup>

Including GHG emissions from imported electricity, California total gross GHG emissions in 1990 were about 410 million metric tons CO<sub>2</sub> equivalent. On a per capita basis, this is almost 14 metric tons per person.<sup>6</sup> For comparison, 1990 GHG emissions for the United States were about 6.1 billion metric tons carbon dioxide equivalent, excluding land use, land use changes, and forestry; this is about 24 metric tons carbon dioxide equivalent per person.<sup>7</sup>

To put this in a global perspective, California has about the same population as Poland but more than triple its GDP, and it follows Italy (\$1.8 billion) in rank order of 2006 GDP but has about 60 percent of

its population.<sup>8</sup> Poland's 1990 GHG emissions were almost 590 million metric tons CO<sub>2</sub> equivalent (about 15 metric tons CO<sub>2</sub> equivalent per person), and Italy's 1990 emissions were almost 520 million metric tons (about 9 metric tons CO<sub>2</sub> equivalent per person).<sup>9</sup>

To provide an overview of California's climate change policies, it is helpful to look closely at three key sectors: buildings, transportation, and electricity. In 2004, the building sector contributed 45 percent of California's GHG emissions; the transportation sector contributed 40 percent. Electricity generation, including imports, accounted for more than half of the GHG emissions from buildings, or 23.5 percent of state emissions.<sup>10</sup> At least four important questions arise from this. What is California's progress in each sector so far? What problems could stymie the state's efforts to reduce GHG emissions? Do the climate change plans for each sector support or undermine achieving sustainability outcomes? Why or why not?

## Overview of California Climate Policy

California is working to reduce greenhouse gas emissions through a broad range of programs, coordinated through the California Global Warming Solutions Act of 2006 (Assembly Bill (AB) 32).<sup>11</sup> In addition, Governor Arnold Schwarzenegger has created partnerships with a number of other subnational governments and initiatives to coordinate their greenhouse gas emission reduction policies.

AB 32 requires the California Air Resources Board (ARB) to adopt a state-wide greenhouse gas emissions limit to achieve 1990 levels by 2020. AB 32 makes clear the intent of the state legislature to continue greenhouse gas emission reductions beyond 2020, maintaining 1990 levels and directing the ARB to recommend further actions to the governor.<sup>12</sup> For the post-2020 timeframe, the governor has established a goal of 80 percent below 1990 levels by 2050.<sup>13</sup> Led by the California Environmental Protection Agency,

the California Climate Action Team (an interagency climate change group created by Schwarzenegger) prepares reports to the governor recommending strategies to achieve the state's greenhouse gas emission reduction targets, although specific suggestions to achieve the target for 2050 were not included in the 2006 Climate Action Team report.

The baseline estimate used by the California Climate Action Team in its 2006 report shows GHG emissions rising from 426 million metric tons CO<sub>2</sub> equivalent in 1990 to 600 million metric tons in 2020. A more recent baseline estimate from staff at the California Energy Commission shows 1990 emissions to be about 410 million metric tons CO<sub>2</sub> equivalent,

increasing to about 580 million metric tons CO<sub>2</sub> equivalent by 2020.<sup>14</sup> To achieve 1990 levels by 2020, emissions need to be shaved by about 170 to 175 million metric tons from these business-as-usual estimates. Eighty percent below these estimates of 1990 emissions ranges between about 80 and 85 million metric tons CO<sub>2</sub> equivalent. Neither of these baseline estimates include emissions for 2050. If the 2020 target were met and maintained through 2050, California would be about 500 to 515 million metric tons above the governor's long-term target for greenhouse gas emissions. For comparison, Italy's 1990 emissions were about 520 million metric tons.<sup>15</sup> If California's population in 2050 is about 55 million, the



Workers construct an energy efficient house in Rocklin, California, a city just north of Sacramento. California's climate change policies encourage builders to build green.

per capita GHG emissions in 2050 should be about 1.5 metric tons CO<sub>2</sub> equivalent a year.<sup>16</sup> This is less than half of the per capita GHG emissions in the developing world in 2000.<sup>17</sup> Sweeping changes in the building, transportation, and electricity sectors will be needed to achieve this long-term goal.

By 1 January 2009, ARB will prepare a plan to achieve the 2020 GHG emissions reduction goal and update the plan every five years.<sup>18</sup> So far, ARB has approved the following discrete early action measures:

- *A low-carbon fuel standard—reducing carbon intensity in California fuels.*
- *Reduction of refrigerant losses from motor vehicle air conditioning system maintenance—restricting the sale of ‘do-it-yourself’ automotive refrigerants.*
- *Increased methane capture from landfills—requiring broader use of state-of-the-art methane capture technologies.*<sup>19</sup>

In preparing the plan to achieve the 2020 emissions reduction goal, ARB will consult with other state agencies, including recommendations from the California Climate Action Team, and programs in other states, cities, regions, and countries. The Climate Action Team will prepare a report every two years to incorporate updated information.<sup>20</sup> The team’s first report, published in April 2006, recommended the following approach to reduce GHG emissions to 2000 levels by 2010 and 1990 levels by 2020:

- Proceed with planned and existing programs in California in building and appliance efficiency, transportation, renewable energy, and waste recycling programs.
- Follow through with additional programs to be implemented by mid-2008 in building and appliance efficiency, transportation, renewable energy, waste recycling, landfill methane capture, forestry, water use efficiency, conservation tillage/cover crops, and enteric fermentation.

The report likens the 2050 target to the B1 scenario in the Intergovernmental Panel on Climate Change’s (IPCC) Special Report on Emissions Scenario (SRES), which assumes a world with a

“high level of environmental and social consciousness” and “alternative energy systems.”<sup>21</sup>

Many pieces of California’s climate change policy direct the state to coordinate with other agencies and jurisdictions, learning from efforts in progress in other countries as well. Schwarzenegger has signed agreements to cooperate on climate change with the United Kingdom and the Canadian provinces of Manitoba, British Columbia, and Ontario.<sup>22</sup>

In addition, the governor has directed state agencies to develop a market-based compliance program “that permits trading with the European Union, the Regional Greenhouse Gas Initiative and other jurisdictions.”<sup>23</sup> He also convened a market advisory committee to make recommendations to the state Air Resources Board on market-based compliance mechanisms to meet the AB 32 GHG emissions limit. The market advisory committee’s recommendations were issued 30 June 2007.

Also, California is a member of the Western Regional Climate Change Action Initiative, formed in February 2007. This initiative is working to set a regional emissions target by August 2007 and develop a market-based system by August 2008. The initiative also commits the member states (California, Washington, Oregon, Arizona, and New Mexico) to participate in a multi-state GHG registry.<sup>24</sup>

In the context of state, regional, and international GHG emission targets, California’s targets start off more gradually than the New England Governors and Eastern Canadian Premiers Climate Change Action Plan of 2001 (1990 levels by 2010; 10 percent below 1990 by 2020; 75 percent to 85 percent below 2001 long-term) and the Kyoto Protocol (an average of 5 percent below 1990 levels by 2008–2012). However, California’s long-term target is more aggressive than the target the IPCC has advised that the world must achieve to stabilize climate change at 2 to 2.4 degrees above pre-industrial levels. (This IPCC scenario avoids some of the most severe impacts of climate change but is still within the range of potential eventual melting of the Greenland ice sheet; IPCC currently

estimates this would take centuries to millennia.<sup>25</sup>) Oregon has adopted a similar long-term target: 75 percent below 1990 levels by 2050.<sup>26</sup> The province of Ontario, Canada, has also adopted a target to reduce greenhouse gas emissions to 80 percent below 1990 levels by 2050. Also, Ontario plans to adopt California’s low-carbon fuel standard.<sup>27</sup>

## Progress and Problems in Three Key Sectors

To achieve these targets, California is making significant efforts in a number of sectors. As mentioned earlier, three of these sectors are particularly important: buildings, transportation, and electricity.

### Buildings

California’s energy efficiency standards for buildings and appliances have achieved impressive cost and energy savings: about 30 percent of California’s annual electricity consumption compared to energy use if efficiency had not improved over the past three decades.<sup>28</sup> An example of such efficiency improvements is California’s 40 percent reduction in energy used for air conditioning from 1970 levels by 2001. This was the result of a combination of state building and appliance standards beginning in the mid-1970s and the 1992 federal appliance standard, which set federal energy conservation standards for air conditioning systems among other energy conservation measures.<sup>29</sup> The American Council for an Energy Efficient Economy reports that “California continues to lead the way on appliance efficiency standards” and lists California as having the most stringent standards for building energy efficiency.<sup>30</sup>

Nevertheless, further gains in energy efficiency are needed: according to 2004 data on California emissions sources, more than 45 percent of California GHG emissions come from buildings.<sup>31</sup>

Senate Bill (SB) 1, the California Solar Initiative, aims to promote further gains in energy efficiency as part of the effort to ramp up the use of roof-top solar

energy. The program requires a home or building to demonstrate a high level of energy efficiency to qualify for a solar energy rebate. The scale of the program is impressive: it aims to increase the use of solar energy on California buildings from about 200 megawatts (MW) to 3,000 MW in 10 years.<sup>32</sup> In the next 5–10 years or so, as the number of older photovoltaic (PV) panels increases, California needs to develop readily accessible PV recycling programs.<sup>33</sup>

Still, the cost of a photovoltaic system (\$18,000 to \$30,000 for a typical California home before rebates and tax incentives, about \$8,500 to \$20,500 after) can seem daunting to individual homeowners.<sup>34</sup> People who do not own their own home but support energy efficiency and solar energy can buy renewable energy certificates, but another outlet should be developed for those seeking a more tangible connection to their energy preferences.

Cooperatively owned PV systems installed in parking lots could help, providing an affordable and tangible way for the public to contribute to reducing GHG emissions in the state. The systems would also provide shaded parking, a highly sought-after commodity in California's inland communities.

## Transportation

Transportation generated about 40 percent of California GHG emissions in 2004, 32.3 percent from on-road vehicles and 4.6 percent from aircraft.<sup>35</sup>

In September 2004, California's ARB adopted standards for new cars and light-duty trucks, starting with the 2009 model year. If granted a waiver from federal preemption, the standards will apply to carbon dioxide, methane, nitrous oxide and hydrofluorocarbon emissions. The standards become progressively stricter from 2009 through 2016, achieving about a 30 percent reduction in regulated GHG emissions compared to 2002.<sup>36</sup> In describing the standards for the public, the ARB staff estimated that the controls would cost about \$1,000 per vehicle on average, but the changes would reduce vehicle

operating costs, resulting in a net savings to the consumer.<sup>37</sup>

Eleven states have adopted California's GHG-emission standards for motor vehicles, including 8 of the 10 states in the Regional Greenhouse Gas Initiative and Oregon, Pennsylvania, and Washington.<sup>38</sup>

In December, 2005, the state of California requested the U.S. Environmental Protection Agency (U.S. EPA) to issue a waiver to federal preemption of vehicle emissions control under the Clean Air Act. As of June, 2007, the U.S. EPA had not issued a decision. Until the waiver is granted, California and eleven other states' policies to reduce greenhouse gas emissions from vehicles cannot go into effect. On 13 June 2007, Schwarzenegger urged the U.S. EPA to decide whether to grant a waiver allowing California's GHG-emission standards for motor vehicles to go into effect, threatening a lawsuit if a decision is not made by 24 October 2007.<sup>39</sup> To receive a waiver, the state must show that the standards are necessary "to meet compelling and extraordinary conditions."<sup>40</sup>

Although implementation of California's law to reduce vehicular emissions of greenhouse gases, AB 1493 (authored by former Assembly Member Fran Pavley (D)), is being held up by the U.S. EPA, California is moving ahead with other policies to reduce greenhouse gas emissions from the transportation sector.<sup>41</sup> For example, California authorized 85,000 carpool lane stickers for hybrid vehicles, valid through 1 January 2011. The stickers became available on 10 August 2005.<sup>42</sup> By February 2007, all passes had been distributed and demand exceeded supply.<sup>43</sup> Hybrids, first available in the United States in 2000, are selling well in California but still represent a small portion of total registered vehicles.<sup>44</sup>

In addition, California is making progress on its low-carbon fuel standard. According to a University of California report, "Under the LCFS [low carbon fuel standard], fuel providers would be required to track the global warming intensity (GWI) of their products, measured on a per-unit-energy basis, and reduce this value over time."<sup>45</sup> Based

on a series of scenarios, the report finds that half of the LCFS could be met with electric vehicles such as plug-in hybrid vehicles, fuel cell vehicles, and battery electric vehicles.<sup>46</sup> The report finds: "a 10 percent Low Carbon Fuel Standard target seems plausible, though it requires innovation in fuel and/or vehicle technologies. Because innovation in the transportation sector is necessary to achieve long-term climate stabilization in any case, the fact that the LCFS will stimulate innovation in the near term is an advantage, not a problem."<sup>47</sup>

The report also considers scenarios based on biofuel technologies that are already commercialized, but it is not clear that ramping up production to meet California's expected demand in 2020 is advisable from an environmental perspective.<sup>48</sup>

The report recommends the following characteristics for the LCFS:

1. *Encourage investment and improvement in current and near-term technologies that will help meet the 2020 goal,*
2. *Stimulate innovation and development of new technologies that can dramatically lower GHG emissions at low costs and can start to be deployed by 2020 or soon thereafter, creating the conditions for meeting the later 2050 goal,*
3. *Contribute to attainment of related objectives as much as possible, including economic growth, air quality and other environmental protection goals, affordable energy prices, environmental justice, and diverse and reliable energy sources.*<sup>49</sup>

On 14 June 2007, ARB changed state regulations for reformulated gasoline to allow up to 10 percent ethanol effective 31 December 2009.<sup>50</sup> This brings California in line with federal law requiring ethanol use in gasoline. The new standards adjust the allowable characteristics of gasoline to compensate for an increased use of ethanol. Because ethanol has a higher vapor pressure than gasoline, it has higher evaporative emissions of hydrocarbons.<sup>51</sup> Also, ethanol may increase nitrogen oxide emissions.<sup>52</sup> The changes adopted by ARB accommodate up to 10 percent ethanol

in gasoline while meeting the state law requiring new formulations of gasoline to preserve the benefits of the previous formulation.<sup>53</sup> The new regulations for reformulated gasoline do not specify the source of ethanol.

In coordination with the LCFS, the California Energy Commission is developing a State Alternative Fuels Plan, as required by AB 1007 (Pavley) (a law on air quality and alternative fuels).<sup>54</sup> In support of this work, a consult report prepared for the Energy Commission discusses full fuel-

cant role in the suite of changes needed in the transportation sector to achieve the state's GHG emission reduction goals for 2020 and 2050. These vehicles link the GHG emissions of the transportation sector to the emissions from electricity generation, magnifying the impacts of success or failure in that sector to carry its weight as the state moves to a low-carbon economy. The Los Angeles Department of Water and Power (LADWP) is a leader in expansion of infrastructure for the greater use of electric vehicles. Cur-

as a percentage of total electricity consumption in California since the state's renewable portfolio standard (RPS) was established in 2002.<sup>59</sup>

California policymakers are impressed with the success that "feed-in tariffs" have achieved in Europe and are considering whether to use similar tariffs in California. In many European countries, owners of renewable energy facilities, including individuals, cooperatives, and businesses, receive payments per kilowatt-hour of electricity generated. The rate depends on the technology and the year the facility begins generating electricity. These payments have stimulated impressive increases in the amount of electricity generated by wind turbines and photovoltaic panels in Europe, especially Germany.<sup>60</sup>

California's richest areas of renewable energy potential are located in remote areas far from population centers. Transmission lines are needed to make development of these resources feasible. The state is working with federal agencies to coordinate transmission corridor planning, taking into account the state's renewable energy policies.

The state is also working on ways to reduce the impact of wind turbines on bats and birds, developing guidelines for siting wind turbines where they are least likely to interact with birds and bats and monitoring bird and bat activity before and after turbines are installed.<sup>61</sup>

Electricity from renewable energy is an important part of the state's policy to reduce greenhouse gas emissions. However, the state has not yet determined how renewable energy would interact with a cap-and-trade mechanism under AB 32. The California Energy Commission held a public workshop seeking input on the coordination of RPS with a market-based compliance mechanism, such as a cap-and-trade system, under AB 32. At the May workshop, participants compared the valuation and tradeability of carbon-reduction benefits from renewable energy in a range of states and countries. In its final report released on 30 June 2007, the Market Advisory Committee recommended the following principles



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*Wind turbines near Palm Springs, California.*

cycle analyses of GHG emission benefits and criteria pollutant emissions for a range of alternative fuels. The analyses showed a 15 percent increase to about 35 percent decrease GHG benefit for corn ethanol for mid-size autos, depending on the source of corn and the fuel used to process the corn into ethanol. Compared to gasoline, the analyses showed the largest GHG benefits for mid-size autos from cellulosic ethanol (60 percent to about 70 percent), battery electric vehicles (about 70 percent), and fuel cell vehicles using hydrogen from biomass (about 90 percent).<sup>55</sup> This accounts for the lower energy content of ethanol per gallon relative to gasoline.

Hybrid-electric, plug-in hybrid-electric, and all-electric vehicles can play a signifi-

currently, LADWP provides more than 400 free charging stations for electric plug-in vehicles.<sup>56</sup>

### **Renewable Energy**

Electricity generation accounts for more than half of the GHG emissions of buildings or 23.5 percent of state emissions.<sup>57</sup> More than half of those emissions (12.3 percent of total statewide emissions) come from imported electricity. In 2004, California imported about 23 percent of its electricity.<sup>58</sup>

Although California utilities have contracted for impressive amounts of renewable energy, delivered renewable electricity has not increased significantly

for the interaction of California's renewable energy policies with a future GHG cap-and-trade system:

*The cap-and-trade program should be separate from and complement, not replace, other regulatory efforts aimed at developing an efficient and less carbon-intensive electricity system.*<sup>62</sup>

*. . . The Committee recommends that California use a portion of the allowance value created under a cap-and-trade program to promote investment in low-GHG technologies and fuels (including energy efficiency) by providing incentives to firms and consumers.*<sup>63</sup>

These principles confirm that a cap and trade system for GHG emission reductions should not replace existing regulatory programs to expand the use of renewable energy and energy efficiency. Such programs reduce demand for GHG-intensive sources of electricity, but the Market Advisory Committee recommended against the use of energy efficiency or renewable energy to generate emission offsets or emission reduction credits. The Market Advisory Committee provides the following explanation:

*[A] California facility that is not itself regulated but that is included within a capped sector cannot earn offsets from its emissions-reductions. Such actions simply reduce demand for allowances from regulated sources within the sector and are not additional to the cap-and-trade program. For example, if the electric sector is capped, the emissions reductions within this sector attributable to investments in renewable energy and energy efficiency do not qualify as offsets, although they help achieve the emissions reductions required by the cap.*<sup>64</sup>

*. . . Complementary government policies represent another category of cost-containment mechanism. These policies include investments in energy efficiency, standards for renewable energy procurement, and other efforts to reduce demand for high-carbon commodities. In particular, many of the regulatory strategies necessary to achieve the goals of the*

*Global Warming Solutions Act may also lower allowance prices and reduce price volatility. CARB should investigate the complementary benefits of these policies on the carbon market while ensuring that specific emission reductions required under other regulations are not double-counted in that market.*<sup>65</sup>

In addition to double-counting, the complementary benefits should be carefully monitored to see that the progressive tightening of the cap and the

reducing GHGs in each sector.

Leaders in the building sector in California include Clarum Homes, Grupe, Premier Homes, and Treasure Homes.<sup>66</sup> The city of Riverside has adopted a green builder program that offers expedited review of development plans for builders who go beyond the state's standards for energy efficiency, water conservation, and reduce waste from construction.<sup>67</sup>

Hybrid vehicles are available from a growing list of auto manufacturers, including Ford and Mercury, General Motors,



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*Rising sea levels increase the risk of storm damage to coastal properties such as these. Stabilizing climate change can reduce sea level rise.*

price at which emission credits trade support investment in low-carbon technologies. This is essential to put the state on track to achieve the 2050 goal. The 2020 goal should be viewed as a mid-course milestone rather than an endpoint in the state's efforts to reduce GHG emissions.

## Conclusion

California recognizes the risk of climate change and has established ambitious policies to reduce greenhouse gas emissions. To succeed, these policies need the support of the builders, automobile manufacturers, utilities, and the general public. There are leaders and laggards in

Honda, Nissan, Toyota, and Lexus.<sup>68</sup> Hertz and Avis have announced they will rent hybrid-electric vehicles.<sup>69</sup> In addition, hybrid-electric commercial vehicles are also available and in use, on a limited but growing scale, by companies with large commercial fleets such as FedEx and UPS.<sup>70</sup> Working with Environmental Defense and Eaton Corporation, FedEx began using innovative hybrid-electric delivery vehicles in 2004 to test their viability for commercial use.<sup>71</sup> As of May 2007, FedEx had about 90 hybrid-electric vehicles, with more to be delivered next year.<sup>72</sup> UPS is adding 50 hybrid-electric vehicles to its fleet and has more than 1,400 alternative fuel vehicles.<sup>73</sup> Thirteen percent of U.S. Postal Service vehicles are alternative fuel vehicles, including

hybrids, biodiesel, and hydrogen fuel cell vehicles.<sup>74</sup>

In 2006, the Energy Commission reported that investor-owned utilities had signed RPS contracts with build-out options for more than 3,900 MW of new and existing renewable capacity, stating that “if all these contracts come to fruition, they will represent significant progress toward meeting the state’s RPS goals.” Citing the slow change in additional renewable energy to date, however, the Energy Commission urged the utilities to take into account the potential for a contract failure rate of about 20 to 30 percent and pick up the pace of renewable energy development to meet the state’s goals.<sup>75</sup> For comparison, the state’s largest publicly owned utility, Los Angeles Department of Water and Power, has increased its renewable energy from about 3 percent in 2002 to 8 percent eligible RPS renewable energy in the first quarter of 2007.<sup>76</sup>

Some climate change is already set in motion, and some of the effects are becoming noticeable in California. The hottest days are hotter and the coldest days are less cold, the mountain snow pack is melting sooner, and sea level is rising.<sup>77</sup> Due to inertia in the climate system, the full effects of twentieth-century carbon dioxide emissions have not yet been realized.

To minimize additional climate change the world needs to substantially reduce GHG emissions. Momentum is building from the ground up in the United States, with more than 400 cities committing to reduce total greenhouse gas emissions, ambitious policies in a number of states, and discussion in Congress to do more.

A future where the governor’s GHG-emission goals for 2050 are achieved could have the following characteristics:

- Buildings would be certified under the U.S. Green Building Council’s Leadership in Energy and Environmental Design (LEED) designation and/or meet the challenge of the American Institute of Architecture for carbon-neutral buildings by 2030,<sup>78</sup> and half of new homes and businesses would have PV panels and/or building-integrated PV, including the evolving thin film technology.

- California would have more extensive and reliable commuter rail service, and transit centers and other community facilities would have cooperatively owned PV-covered parking lots and parking structures.

- Plug-in hybrid vehicles and all-electric vehicles would be more common than not, and gas stations would regularly sell a diverse mix of fuels, including biodiesel, hydrogen, and reformulated gasoline with ethanol made from switchgrass.

- Utility-scale renewable energy would be widely visible, including many large wind turbines in the Tehachapi Mountains (between the San Joaquin Valley and the Mojave Desert) and Imperial County (near the Mexican border);<sup>79</sup> also, the southeastern desert would have large fields of solar dishes and solar troughs, located away from pristine and protected areas.

- Additional high-voltage transmission lines would run into renewable-rich areas—including the Tehachapi Mountains, the Salton Sea area, and southeastern California, as well as renewable-rich areas in other western states—using existing transportation and/or utility corridors where possible.

A future where the long-term goals are not achieved could require additional infrastructure investment to

- expand the reservoir capacity in the Sierra Nevada and replumb the Sacramento-San Joaquin River Delta;

- expand fire-fighting capabilities, especially in the forested mountain areas east of Sacramento and east of the coastal communities in southern California;

- move coastal properties inland and/or strengthen/rebuild coastal infrastructure (more frequently) to account for reduced width of beaches, increased wave erosion of cliffs.

- change agricultural crops, processes, infrastructure, water supply, and/or irrigation methods to accommodate increased rate of evapotranspiration.

In the context of the United States, California has made a great start, but the current policies will only reach so far. California is a sizeable market and can help stimulate and expand demand for

low-carbon alternatives. Recognizing that some climate change has already been set in motion due to past GHG emissions, further climate change can be minimized only if other states and countries also shift to low-carbon alternatives, substantially reducing greenhouse gas emissions on a global scale by 2050.

California can achieve these reductions if small and large investors make it a priority and state agencies have the staff and resources needed to implement these policies effectively. The opportunity to achieve these reductions by 2020 and 2050, when they can have the largest impact, may be lost if California’s policies are met with protracted litigation, inadequate resources, or simple inertia rather than cooperation and investment.

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## NOTES

1. Data are for 2006 and are from “Population of California and the United States, 1940 to 2006. Table B1,” in California Department of Finance, *California Statistical Abstract* (Sacramento, January 2007), [http://www.dof.ca.gov/html/fs\\_data/stat-abs/sec\\_B.htm](http://www.dof.ca.gov/html/fs_data/stat-abs/sec_B.htm) (accessed 25 June 2007).

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