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THE 2017 CLIMATE CHANGE SCOPING PLAN UPDATE

THE PROPOSED STRATEGY FOR ACHIEVING
CALIFORNIA'S 2030 GREENHOUSE GAS TARGET

JANUARY 20, 2017

California Air Resources Board

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Executive Summary

This Scoping Plan Update establishes a proposed framework of action for California to meet the most aggressive climate target in North America: a 40 percent reduction in greenhouse gases by 2030 compared to 1990 levels. This goal builds on California's success in establishing effective policies that are reducing emissions of greenhouse gases while delivering substantial economic and environmental benefits. Further, the goal aligns California with the rest of the world in the global effort to fight climate change. The Proposed Plan is designed to continue to shift the California economy away from dependence on fossil fuels to a thriving sustainable future that delivers continued economic growth, job generation, and a wide range of environmental benefits to all California communities through the coming decade and beyond.

> At the signing ceremony for SB 32 Governor Edmund G. Brown noted that the 2030 target will "keep California on the move to clean up the environment, to encourage vast innovation and to make sure we have the environmental resilience that ... Californians really want and expect."

This document marks the second chapter to California's groundbreaking efforts to fight climate change. The first Scoping Plan was required by Assembly Bill 32 (AB 32), The Global Warming Solutions Act, and adopted in 2008. Under that plan, California set in place a range of effective programs to slash greenhouse gases from cars, trucks, fuels, industry and electrical generation, and the State is well on its way to achieving the goal of AB 32 – to reach 1990 levels of greenhouse gases by 2020.

The Proposed Plan builds on those programs, and takes aim at the 2030 target established by Senate Bill 32 (SB 32) (Pavley). That bill, and related laws, is designed specifically to continue California's leadership in the fight against climate change and guide the State toward an equitable clean energy economy and prosperous future.

To reach that future, this Proposed Plan draws on the successes and the lessons learned from the first chapter of California's efforts to fight climate change under AB 32. It proposes continuing the major programs that have been a hallmark of our success, and the approach that has served as a model for other states and jurisdictions around the nation and world. The key programs that the Proposed Plan builds on include the Cap-and-Trade Regulation, the Low Carbon Fuel Standard, and much cleaner cars, trucks and freight movement, powering our State off of cleaner renewable energy, and strategies to reduce methane emissions from agricultural and other wastes by using it to meet our energy needs. It also comprehensively addresses for the first time the greenhouse gas emissions from natural and working lands of California – including the agriculture and forestry sectors.

The Proposed Plan was developed by the California Air Resources Board (CARB or Board) staff working alongside multiple agencies and departments within the

Administration. This effort was guided by, and fully addresses, direction provided by the Legislature and includes public comment from 15 Scoping Plan workshops statewide, and the input of the Environmental Justice Advisory Committee (EJAC) and many stakeholders.

By combating climate change at the level outlined in this plan, California joins the global effort to address the one overarching issue of our time that ties together all the strands of our energy and environmental policies – the escalating crisis of global climate change. The evidence for climate change is irrefutable and the scientific record today is even more definitive than when AB 32 was passed. The buildup of greenhouse gases released over many decades by the combustion of fossil fuels in our power plants and factories, and to move our people and goods, combined with the loss of carbon that was once stored in forests and natural lands, is creating an irreversible change in the earth's atmosphere, leading to an all-too familiar array of problems including from forest fires, coastal erosion, disruption of water supply, spread of insect-borne diseases and intractable urban air pollution.

And while climate change is without doubt a global phenomenon, its effects are felt close to home, and California is already experiencing its impact. A recent State report noted the following observed changes in California, harbingers of further shifts that, if left unchecked, will disrupt the economy and impact public health and air quality.

- Annual average temperatures in the State are on the rise, including increases in daily minimum and maximum temperatures.
- Extreme events, including wildfire and heat waves, are more frequent.
- Spring runoff volumes are declining as a result of a diminished snowpack.
- The number of "winter chill hours" – crucial for the production of high-value fruit and nut crops – are declining.
- Species are on the move, showing up at different times and locations than previously recorded, including both flora and fauna at higher elevations.

Those findings make an even more persuasive case for California's vulnerability to climate change and the need to us to take action – as well as partner with others at an even faster rate – to stave off the most severe impacts of climate change. This was the reason why SB 32, the new law extends the State's climate actions beyond 2020, was passed and signed.

SB 32 fully recognizes those impacts and drew on global scientific research and consensus among experts that a 40 percent reduction of greenhouse gases by 2030 is necessary to put California on the path to contain the rise in global temperatures to below 2 degrees Celsius, to prevent the worst-case scenarios of rising temperatures.

The approaches to reach the goal outlined in this document require choices that can forestall those impacts, while also making our communities and economy more resilient – and more equitable at the same time.

It achieves that goal by ensuring, as did AB 32, that environmental justice and equity is an integral and irreducible priority of the plan overall, and is considered and addressed in each of its component programs.

To ensure the Proposed Plan acknowledges and addressed the issue of equity, CARB worked extensively with the EJAC during the development of the Proposed Plan. This work included extending the Scoping Plan development timeline to hold a series of meetings in environmental justice communities throughout the State with presentations and participation from both State agency representatives and members of the EJAC. Members of the EJAC also presented at workshops they held with support from CARB throughout the development of the proposed Scoping Plan.

The EJAC presented a series of recommendations based on these meetings and in response to public materials provided by the State. As a result CARB added, for example, a scenario with a so-called cap-and-tax program, in addition to the other alternative scenarios: no cap-and-trade but rather relying exclusively of prescriptive regulations; a carbon tax; and 'all' cap-and-trade. In response to AB 197 and environmental justice community concerns, the Proposed Plan includes a measure for prescriptive regulations for refineries that would reduce greenhouse gases potentially along with harmful criteria and toxic air pollutants.

Achieving the 2030 target under the Proposed Plan will also spur the transformation of the California economy and fix its course securely on achieving an 80 percent reduction in greenhouse gas emissions by 2050, consistent with the global consensus of the scale of reductions needed to stabilize atmospheric greenhouse gas concentrations at 450 parts per million carbon dioxide equivalent, and reduce the likelihood of catastrophic climate change. Currently, global levels are at just above 400 parts per million.

This approach is consistent with additional efforts by California to move in concert with the global community. As one example, the creation of the Under 2 Memorandum of Understanding brought together states, provinces, and nations around the world committed to limiting their greenhouse gas emissions to less than 2 metric tons per capita by 2050. To date, 165 jurisdictions representing over 1 billion people and 35 percent of the global economy have signed on, providing a powerful signal of the world's intent to address climate change.

But, reducing greenhouse gases is only one part of the equation for California. As we build our clean energy future, we must also ensure that our efforts to fight climate change continue to meet clean air standards and benefit community and ecosystem resilience. Achieving these intertwined goals requires a multi-pronged strategy that also delivers reductions in criteria and toxic pollution especially in disadvantaged communities that are disproportionately burdened by the impacts of pollution. In addition to regulatory measures, investment in communities through the Affordable Housing and Sustainable Communities Program, the Transformational Climate Communities Program, Low Carbon Transportation Program and the Transit and

Intercity Rail Capital Program, result in reduced pollution, increased jobs and improved conditions in communities throughout California that are the most impacted. Investments in forests and farms and in the waste sector help sequester carbon on the State's valuable landscapes.

An additional challenge in a successful climate program is to control greenhouse gas emissions while also supporting economic growth. To date, California has reduced greenhouse gas emissions by about 10 percent from our historic highs in the early 2000s, and the State's economy has demonstrated continued growth at a rate above the national average. And, year over year, the amount of carbon 'embedded' in the Gross State Product (GSP), expressed in the number of tons of carbon dioxide per million dollars of GSP, has dropped. This means the economy is experiencing greater fiscal growth for each unit of energy expended; in short – more economic growth with less carbon.

The State's experience to date strongly suggests that continuing with the successful programs currently in place – strengthening the programs with additional elements – is the right course to take to continue on the road of growth and declining carbon intensity of the economy.

With this in mind, and drawing on the input of stakeholders and the EJAC while following the direction of the Legislature, the major elements of the framework proposed in this document are as follows:

1. SB 350
   - Achieve 50 percent Renewables Portfolio Standard (RPS) by 2030.
   - Doubling of energy efficiency savings by 2030.
2. Low Carbon Fuel Standard (LCFS)
   - Increased stringency (reducing carbon intensity 18 percent by 2030, up from 10 percent in 2020).
3. Mobile Source Strategy (Cleaner Technology and Fuels Scenario)
   - Maintaining existing GHG standards for light- and heavy-duty vehicles.
   - Put 4.2 million zero-emission vehicles (ZEVs) on the roads.
   - Increase ZEV buses, delivery and other trucks.
4. Sustainable Freight Action Plan
   - Improve freight system efficiency.
   - Maximize use of near-zero emission vehicles and equipment powered by renewable energy.
   - Deploy over 100,000 zero-emission trucks and equipment by 2030.
5. Short-Lived Climate Pollutant (SLCP) Reduction Strategy
   - Reduce emissions of methane and hydrofluorocarbons 40 percent below 2013 levels by 2030.
   - Reduce emissions of black carbon 50 percent below 2013 levels by 2030.
6. SB 375 Sustainable Communities Strategies
   - Increased stringency of 2035 targets.

7. Post-2020 Cap-and-Trade Program
    - Declining caps, continued linkage with Québec, and linkage to Ontario, Canada.
    - CARB will look for opportunities to strengthen the program to support more air quality co-benefits, including specific program design elements. In Fall 2016, ARB staff described potential future amendments including reducing the offset usage limit, redesigning the allocation strategy to reduce free allocation to support increased technology and energy investment at covered entities and reducing allocation if the covered entity increases criteria or toxics emissions over some baseline.
8. 20 percent reduction in greenhouse gas emissions from the refinery sector.
9. By 2018, develop Integrated Natural and Working Lands Action Plan to secure California's land base as a net carbon sink.

This proposed approach is structured to address policy requirements and criteria while providing the widest range of environmental and economic benefits.

On the economic front, the Proposed Plan presents significant opportunities for employment and growth for California investors, business, and households. As we have seen in the past decade, an increase in clean technology employment, and growth in service industries and sectors providing health care and education, will replace sectors heavily dependent on fossil fuels. In 2030, Californians will spend less money on cars and utility bills and increase spending on cleaner fuels, recreation, and public transportation. Overall, under the Proposed Plan the California economy is anticipated to grow to $3.4 trillion, roughly one-half percent less growth by that date when compared to a scenario where we did nothing at all.

In return, the State will continue to grow in the direction of a more balanced clean energy economy. The investments made in implementing the Proposed Plan will present significant opportunities for California investors and businesses; upfront capital investments will result in long-term fuel and energy efficiency savings, the benefits of which will continue far into the future.

We are already seeing these benefits. In 2015 California received 68% ($9.8 billion) of total US clean tech company investment ($14.5 billion), continuing California's first place finish over the past decade. These investments translate directly into jobs with 321,000 workers in energy efficiency jobs statewide, including 72,000 within Los Angeles County. Seventy percent of energy efficiency establishments in the State are small businesses.

The success stories are notable. As a whole, advanced energy enterprises employ over half a million workers in California – three times the combined total of motion pictures, television, and radio – bigger than agriculture, forestry, and fishing. And, the pace is quickening. In 2015, the advanced energy sector generated jobs at six times the rate of the State's economy overall.

The evidence of the transformation of California's economy is everywhere. It is impossible not to notice the number of houses with money-saving solar arrays, or the utility-scale solar and wind turbine installations throughout the State. They have become commonplace, and now ultra-clean transportation is rapidly becoming another California hallmark.

There are already more than one-quarter million electric vehicles in California – almost half the national total and clean transportation is fast becoming a significant part of the State's clean energy economy. In 2015, clean transportation was the hottest sector for venture capital investment in California, bringing in $3.4 billion in that year, 90.5 percent of all clean transportation vehicle capital investment in the nation. In the coming months and years, more and more zero-emission and hybrid trucks and buses will be on the State's streets and highways, including many destined for disadvantage communities.

Under the Proposed Plan, these ultra-clean vehicles and a wide range of other climate investments in and for these communities will continue to come from an established program, structure and mechanism that is distributing revenues from the Cap-and-Trade Program to disadvantaged communities.

California Climate Investments from Cap-and-Trade auction proceeds are being strategically invested to further the goals of California's climate legislation by reducing GHG emissions and providing benefits to disadvantaged communities. To date, over $3 billion has been appropriated from the Greenhouse Gas Reduction Fund, with approximately one third of the funding targeted to benefit disadvantaged communities.

The goal of this multi-billion dollar effort is to ensure the equitable transformation of the economy with a focus on investments to improve the environment and clean the air in the neighborhoods, communities and systems throughout the state that need them the most. Projects range from affordable housing close to transit, urban forestry projects, support for ultra-clean car purchases by low-income families, electric car-sharing programs, electric and hybrid buses for transit agencies, to solar roofs in disadvantaged communities to help slash energy costs for families who qualify.

There are other benefits of the Proposed Plan. The uncertainty in both forecast emissions and performance estimates of other measures means the Cap-and-Trade Program in the Proposed Plan, thanks to the declining cap, serves as a backstop and is able to 'scale' up to ensure that the 2030 target is met. By incorporating a refinery measure – which will likely also reduce criteria pollutants and toxic air contaminants – and advancing other measures, the Proposed Plan also prioritizes rules and regulations for direct emissions reductions at large stationary, mobile, and other sources.

The Proposed Plan protects against emissions leakage by allowing for a specified amount of free allocation of Cap-and-Trade Program allowances, where supported by research. It also supports the ability to link with other states and provinces, and develop further reductions through collaborative regional efforts.

A Comprehensive Approach

Working to propel the world's fifth largest economy to a clean energy future entails enacting policies at multiple governmental levels and across multiple agencies and organizations. The Proposed Plan draws much of its ability to respond to changing circumstances from the underlying network of crosscutting statewide programs that address GHG reductions through a comprehensive approach to broad, related economic activities or sectors.

For example, the Sustainable Freight Strategy achieves reductions through both increased efficiency and the transition to zero-emission equipment to move goods from production to your doorstep. The Mobile Source Strategy is designed to modernize and upgrade transportation infrastructure, enhance system-wide efficiency and mobility options, and promote clean economic growth in the mobile sector. The SB 375 Sustainable Communities Strategies and regional Climate Action Plans support safer streets, more walking and biking, improved transit options, more efficient land use and more vibrant communities. All three will deliver significant reductions in greenhouse gases and cut both smog-forming and toxic pollution.

The Proposed Plan sits at the center of this broad tapestry of California's other climate-oriented plans and strategies. These include, for example, the California Transportation Plan 2040, the State's Forest Carbon Plan, the State Wildlife Action Plan and the California Water Action Plan. These are designed to focus on reducing carbon pollution while also delivering targeted results and a broad range of co-benefits.

Conclusion

The Proposed Plan continues more than a half-century of California's nation-leading efforts to clean our air and water, and improve the environment. But, climate change poses a challenge of unprecedented proportions that will impact all Californians whether they are city dwellers in Los Angeles, San Diego, San Francisco, farmers in Salinas or the Central Valley, or the millions of Californians who live in the Sierra, the northern counties, or in the desert areas.

In this Proposed Plan, every sector in our thriving economy plays a crucial role. Cities and local governments are already rising to the challenge, and will play increasingly important roles with programs ranging from low-carbon and cleaner transit, to more walkable streets and the development of vibrant urban communities.

We will see a remarkable transformation of how we move throughout the State, away from cars that burn fossil fuels to cleaner, electric cars that will eventually even drive themselves. Freight will be moved around the State by trucks that are vastly cleaner than those on the road now, with our ports moving towards zero- and near-zero emissions technologies. The heavily travelled Los Angeles-San Francisco corridor will be serviced by comfortable, clean and affordable high speed rail.

These efforts will slash pollution now created from making and using gasoline and diesel fuel statewide. The greatest benefits of this shift away from fossil fuels will be in the disadvantaged communities of our State, which are so often located adjacent to ports, rail yards, freight distribution centers and freeways. And, thanks to the continued investment of auction proceeds from the Cap-and-Trade Program in these same communities, we can continue to work on bringing the benefits of clean technology – whether electric cars or solar roofs or other technologies – to those in our State who need them the most.

We will see enhanced efforts in our natural and working landscapes, ranging from efforts to restore forests to a natural condition that sequesters carbon, improves water quality, and protects residents from catastrophic wild fire, to converting waste to compost for application on the land base, to ensuring that wetlands can sequester carbon and clean our water.

In every sense possible, the Proposed Plan belongs to all Californians, and in one way or another, we will all have a role to play over the coming decades in making it work. Climate change presents us with unprecedented challenges – challenges that cannot be met with traditional ways of thinking or conventional solutions. As Governor Brown has declared, meeting these challenges will require "courage, creativity and boldness."

Over the last decade we proved to ourselves, and the world, that Californians recognize the danger of climate change and are willing to take action to address it head on. We have also seen over the past decade that by being bold and creative, we can all benefit from the transition to clean energy with cleaner air, less carbon pollution and continued economic growth and job generation.

This Proposed Plan builds on those early steps and moves California into a new chapter that will deliver a thriving and more resilient economy and a clean environment to our children and grandchildren. It is a commitment to the future, but it begins today.

I. Introduction

A. Background

In November 2016, California Governor Edmund G. Brown affirmed California's role in the United States, noting, "We will protect the precious rights of our people and continue to confront the existential threat of our time—devastating climate change." By working to reduce the threat facing the State and setting an example for other jurisdictions that aim to take action, California continues to lead in the climate arena. The Proposed Strategy for Achieving California's 2030 Greenhouse Gas Target (Proposed Plan) identifies how the State can build upon its legacy of climate leadership, reach our 2030 climate goals, and substantially advance toward our 2050 climate goals. By selecting and pursuing a sustainable and clean economy path for 2030, the State will continue to successfully execute existing programs, demonstrate the coupling of economic growth and environmental progress, and enhance new opportunities for engagement within the State to address and prepare for climate change.

This Proposed Plan builds on and integrates efforts already underway to reduce the State's greenhouse gas (GHG), criteria, and toxics emissions. Programs such as the Low Carbon Fuel Standard and Renewables Portfolio Standard are delivering cleaner fuels and energy, the Advanced Clean Cars Program has put more than a quarter million clean vehicles on the road, and the Sustainable Freight Action Plan will result in efficient and cleaner systems to move goods throughout the State. Enhancing and implementing these ongoing efforts puts California on the path to achieving the 2030 target. This Proposed Plan relies on these, and other, foundational programs paired with an extended more stringent Cap-and-Trade Program and new refinery regulations to deliver GHG, air quality, and other benefits.

1. Climate Legislation and Directives

California has made progress on addressing climate change during periods of both Republican and Democratic national administrations and Democratic and Republican State administrations. California governors and legislatures have taken bold steps to ensure the State's leadership, and commitment to improving public health and the environment are always a priority. A series of executive orders and laws generated policies and actions across State government, among local and regional governments, and within industry. These policies also encouraged collaboration with federal agencies and spurred partnerships with many jurisdictions beyond California's borders. The State has been consistent and bold in its efforts to address climate change and serve as an example of how other regions can take similar action in reducing GHG emissions. Moving forward, California will continue its pursuit of collaborations and advocacy for action to address climate change.

Assembly Bill 32: California's Global Warming Solutions Act

Assembly Bill 32 (AB 32), the California Global Warming Solutions Act of 2006 (Nuñez, Chapter 488, Statutes of 2006), represented a defining moment in California's long history of environmental stewardship and secured the State's role as a leader in reducing GHGs. In response to AB 32, California began to address climate change by employing a comprehensive, long-term approach to cut the State's GHG emissions to 1990 levels by 2020 and to maintain and continue reductions post 2020.

Pursuant to AB 32, the Scoping Plan must "*identify and make recommendations on direct emission reduction measures, alternative compliance mechanisms, market-based compliance mechanisms, and potential monetary and nonmonetary incentives*" in order to achieve the 2020 goal, and achieve "*the maximum technologically feasible and cost-effective GHG emission reductions*" by 2020 and maintain and continue reductions beyond 2020.

Executive Order B-30-15

In his January 2015 inaugural address, Governor Brown identified five key climate change strategy "pillars," which recognize that several major areas of the California economy will need to reduce their emissions to meet California's ambitious climate change goals. These five pillars are:

1. Reducing today's petroleum use in cars and trucks by up to 50 percent;
2. Increasing from one-third to 50 percent our electricity derived from renewable sources;
3. Doubling the efficiency savings achieved at existing buildings and making heating fuels cleaner;
4. Reducing the release of methane, black carbon, and other short-lived climate pollutants; and
5. Managing farm and rangelands, forests, and wetlands so they can store carbon.

Consistent with these goals, Governor Brown signed Executive Order B-30-15 in April 2015, establishing a California GHG reduction target of 40 percent below 1990 levels by 2030. Executive Order B-30-15 also calls on the California Air Resources Board (CARB or Board), in coordination with sister agencies, to update the AB 32 Climate Change Scoping Plan to incorporate the 2030 target. Executive Order B-30-15 also builds out the "sixth pillar" of the Governor's strategy—to safeguard California in the face of a changing climate—highlighting the need to prioritize actions to reduce GHG emissions and build resilience in the face of a changing climate.

Senate Bill 350: Golden State Standards

Senate Bill 350 (SB 350) (De Leon, Chapter 547, Statutes of 2015), Golden State Standards, requires the State to set GHG reduction planning targets both for the electricity sector as a whole and for individual utilities and other electricity providers

(collectively known as *load serving entities*), which will develop strategies to reduce GHG emissions through Integrated Resource Planning. The bill also codified an increase in the Renewables Portfolio Standard (RPS) to 50 percent by 2030[1] and doubling of energy savings in electricity and natural gas end uses as discussed in the Governor's inaugural address. By enacting these two complimentary targets into law, SB 350 aims to create jobs, grow the State's economy, and improve public health by setting new renewable energy standards for California's RPS and increasing energy efficiency, and by focusing long-term resource planning on reducing GHG emissions.[2]

Senate Bill 32: California Global Warming Solutions Act of 2016: emissions limit and Assembly Bill 197: State Air Resources Board: greenhouse gases: regulations.

In summer 2016 the Legislature passed, and the Governor signed, Senate Bill 32 (SB 32) (Pavley, Chapter 249, Statutes of 2016) and Assembly Bill 197 (AB 197) (Garcia, Chapter 250, Statutes of 2016). SB 32 affirms the importance of addressing climate change by codifying into statute the GHG emissions reductions target of at least 40 percent below 1990 levels by 2030 contained in Governor Brown's April 2015 Executive Order B-30-15. SB 32 builds on AB 32 and keeps us on the path toward achieving the State's 2050 objective of reducing emissions to 80 percent below 1990 levels, consistent with an Intergovernmental Panel on Climate Change (IPCC) analysis of the emissions trajectory that would stabilize atmospheric GHG concentrations at 450 parts per million carbon dioxide equivalent (CO_2e) and reduce the likelihood of catastrophic impacts from climate change.

The companion bill to SB 32, AB 197, provides additional direction to CARB on the following areas related to the adoption of strategies to reduce GHG emissions. Additional direction in AB 197 meant to provide easier public access to air emissions data that are collected by CARB was posted in December 2016:[3]

- It requires annual posting of GHG, criteria, and toxic air contaminant data throughout the State, organized by local and sub-county level for stationary sources and by at least a county level for mobile sources. Separate from the development of the Proposed Plan, CARB has begun the process to implement this provision of AB 197.
- When adopting rules and regulations to achieve emissions reductions to protect the State's most affected and disadvantaged communities, CARB shall consider the social costs of the emissions of GHGs, and prioritize both of the following:
    - Emission reduction rules and regulations that result in direct emission reductions at large stationary sources of GHG emissions and direct emission reductions from mobile sources.
    - Emission reduction rules and regulations that result in direct emission reductions from sources other than those listed above.

[1] http://www.cpuc.ca.gov/renewables/

[2] SB 350: Golden State Standards. Available at: focus.senate.ca.gov/sites/focus.senate.ca.gov/files/climate/505050.html

[3] ARB. 2016. ARB's Emission Inventory Activities. https://www.arb.ca.gov/ei/ei.htm

- In the development of each scoping plan, AB 197 also directs CARB to identify for each emissions reduction measure, including each alternative compliance mechanism, a market-based compliance mechanism, and potential monetary and nonmonetary incentives the following information:
    - The range of projected GHG emissions reductions that result from the measure.
    - The range of projected air pollution reductions that result from the measure.
    - The cost-effectiveness, including avoided social costs, of the measure.

Senate Bill 1383: Short-lived climate pollutants: methane emissions: dairy and livestock: organic waste: landfills.

Senate Bill 1383 (SB 1383) (Lara, Chapter 395, Statutes of 2016) requires the development, adoption, and implementation of a Short-Lived Climate Pollutant Strategy.[4,5] Short-lived climate pollutants (SLCPs), such as black carbon, fluorinated gases, and methane, are powerful climate forcers that have a dramatic and detrimental effect on air quality, public health, and climate change. These pollutants create a warming influence on the climate that is many times more potent than that of carbon dioxide. The State has issued a Proposed Short-Lived Climate Pollutant Reduction Strategy (Proposed SLCP Strategy), which establishes a path to decrease GHG emissions and displace fossil-based natural gas use. This includes deploying widely available technologies to avoid landfill methane emissions by reducing the disposal of organics, recovering methane from wastewater treatment facilities, and manure methane at dairies, and using the methane as a renewable source of natural gas to fuel vehicles or generate electricity. The Proposed SLCP Strategy also identifies steps to reduce natural gas leaks from oil and gas wells, pipelines, valves, and pumps to improve safety, avoid energy losses, and reduce methane emissions associated with natural gas use. SB 1383 includes the following specific goals for 2030 from 2013 levels:

- 40 percent reduction in methane,
- 40 percent reduction in hydrofluorocarbon gases, and
- 50 percent reduction in anthropogenic black carbon.[6]

CARB released a revised Proposed SLCP Strategy in late November 2016 that reflects the direction in SB 1383.

Assembly Bill 1504: Forest resources: carbon sequestration.

AB 1504 requires the Board of Forestry and Fire Protection to adopt district forest practice rules and regulations in accordance with specified policies to, among other things, assure the continuous growing and harvesting of commercial forest tree species.

[4] ARB. Reducing Short-Lived Climate Pollutants in California. www.arb.ca.gov/cc/shortlived/shortlived.htm
[5] Senate Bill No. 605. leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB605
[6] Senate Bill No.1383. leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160SB1383

The bill also requires the Board of Forestry and Fire Protection to ensure that its rules and regulations that govern the harvesting of commercial forest tree species consider the capacity of forest resources to sequester carbon dioxide emissions sufficient to meet or exceed the sequestration target of 5 million metric tons of carbon dioxide equivalent ($MMTCO_2e$)/year net annually, as established in the first AB 32 Climate Change Scoping Plan.

Senate Bill 1386: Resource conservation, natural and working lands.

SB 1386 (Wolk, Chapter 545, Statutes of 2016) declares it the policy of the State that protection and management of natural and working lands, as defined, is an important strategy in meeting the State's GHG reduction goals. In addition, State agencies must consider protection and management of natural and working lands in establishing policies and grant criteria, and in making expenditures, and "implement this requirement in conjunction with the State's other strategies to meet its greenhouse gas emissions reduction goals."

2. Initial Scoping Plan and First Update to the Scoping Plan

The Initial Scoping Plan[7] in 2008 presented the first economy-wide approach to reducing emissions and highlighted the value of combining both carbon pricing with other complementary programs to meet California's 2020 GHG emissions cap while ensuring progress in all sectors. The coordinated set of policies in the Initial Scoping Plan employed strategies tailored to specific needs, including market-based compliance mechanisms, performance standards, technology requirements, and voluntary reductions. The Initial Scoping Plan also described a conceptual design for a cap-and-trade program that included eventual linkage to other cap-and-trade programs to form a larger regional trading program.

AB 32 requires CARB to update the scoping plan at least every five years. The First Update to the Scoping Plan[8] (First Update), approved in 2014, presented an update on the program and its progress toward meeting the 2020 limit. It also developed the first vision for the long-term progress that the State endeavors to achieve. In doing so, the First Update laid the groundwork to transition to the post-2020 goals set forth in Executive Orders S-3-05[9] and B-16-2012.[10] It also recommended the need for a 2030 mid-term target to establish a continuum of actions to maintain and continue reductions, rather than only focusing on targets for 2020 or 2050.

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[7] ARB. Initial AB 32 Climate Change Scoping Plan. Available at: www.arb.ca.gov/cc/scopingplan/document/adopted_scoping_plan.pdf

[8] ARB. First Update to the AB 32 Scoping Plan. Available at: www.arb.ca.gov/cc/scopingplan/document/updatedscopingplan2013.htm

[9] https://www.gov.ca.gov/news.php?id=1861

[10] https://www.gov.ca.gov/news.php?id=17472

3. Building on California's Environmental Legacy

California's successful climate policies and programs have already delivered emission reductions resulting from cleaner, more fuel-efficient cars and zero emission vehicles (ZEVs), cleaner low carbon fuels, more renewable energy, greater waste diversion from landfills, water conservation, improved forest management, and additional actions to improve the energy efficiency of homes and businesses. These policies and programs have also improved public health, created green jobs, and given consumers more clean energy choices. The 2030 GHG emissions reduction target in SB 32 will ensure that the State maintains this momentum beyond 2020, mindful of the State's population growth and needs. The Proposed Plan lays out a path to simultaneously make progress on the State's climate goals and improve air quality improvement in all parts of the State.

Moving forward, California's climate strategy will require contributions from all sectors of the economy, including the land base, and will include enhanced focus on zero- and near-zero emission (ZE/NZE) vehicle technologies; continued investment in renewables, including solar roofs, wind, and other distributed generation; greater use of low carbon fuels; integrated land conservation and development strategies; coordinated efforts to reduce emissions of short-lived climate pollutants (methane, black carbon, and fluorinated gases); and an increased focus on integrated land use planning, to support livable, transit-connected communities and conservation of agricultural and other lands. Requirements for direct GHG reductions at refineries will further support air quality co-benefits in neighborhoods, including in disadvantaged communities historically located adjacent to these large stationary sources, as well as efforts with California's local air pollution control and air quality management districts (air districts) to tighten emission limits on a broad spectrum of industrial sources. Analyses indicate that continuing the Cap-and-Trade Program would provide compliance flexibility, as the lowest cost GHG emission reductions would be undertaken first, continue opportunities to collaborate with other regions and achieve even greater GHG emission reductions. Further, proceeds collected through the Cap-and Trade Program in the Greenhouse Gas Reduction Fund (GGRF) can contribute to residents in disadvantaged communities having equitable access to clean technology, clean energy options, transit options, and infrastructure improvements that reduce GHGs and improve quality of life. Finally, meeting the State's climate, public health, and environmental goals will entail understanding, quantifying, and addressing emissions impacts from land use decisions at all governmental levels.

4. Purpose of the 2030 Target Scoping Plan Update

The 2030 limit puts California on the path to meeting the 2050 GHG emission reduction goal. However, the State's long-term climate goal can only be achieved by employing a coordinated policy framework. This Proposed Plan incorporates and leverages many existing and ongoing efforts while identifying new policies to progress toward the State's climate and air quality goals.

The actions identified in this Proposed Plan can reduce overall GHG emissions in California, and deliver strong policy signals that will continue to drive investment and certainty in a low carbon economy. The Proposed Plan builds upon the successful framework established by the Initial Scoping Plan and First Update, while also identifying new, technologically feasibility and cost-effective strategies to ensure that California meets its GHG reduction targets in a way that promotes and rewards innovation, continues to foster economic growth, and delivers improvements to the environment and public health, including in disadvantaged communities. The Proposed Plan is developed to be consistent with requirements set forth in AB 32, SB 32, and AB 197. The plan includes policies to require direct GHG reductions at some of the State's largest stationary sources and mobile sources. These policies include the use of lower GHG fuels, efficiency regulations, and the Cap-and-Trade Program, which constrains and reduces emissions at covered sources.

5. Process for Developing the Proposed 2030 Target Scoping Plan Update

This plan has been developed in an open and transparent manner, involving coordination with State agencies, engagement with the Legislature, and the opportunity for stakeholders and the public to engage in the process through workshops and other meetings. This plan was developed in close coordination with other State agency plans and regulations, including the Cap-and-Trade Regulation, the Low Carbon Fuel Standard (LCFS), the State Implementation Plan, the California Sustainable Freight Action Plan, California Transportation Plan 2040, the Forest Carbon Plan, and the Short-Lived Climate Pollutant Strategy, among others.

To date, CARB, in collaboration with the Governor's Office and other State agencies, has solicited comments and feedback from affected stakeholders and the Environmental Justice Advisory Committee (EJAC or Committee) that has informed the Proposed Plan. Below is a list of the public workshops and symposia where the development of the Proposed Plan has been discussed:

- Governor's Office Pillar Symposia – 2030 Climate Change Commitments
    - August 5, 2015: Natural and Working Lands Symposium
    - July 8, 2015: Symposium to Discuss Cutting Petroleum Use in Half by 2030
    - July 9, 2015: Renewables Symposium
- October 1, 2015: Kickoff Public Workshop on the Draft Scoping Plan Update to Reflect 2030 Target
- November 19, 2015: Board Hearing Informational Presentation on Status of the Draft 2030 Target Scoping Plan
- December 7, 2015: First Meeting of the EJAC to Inform Development of the Draft 2030 Target Scoping Plan
- January 15, 2016: Draft Scoping Plan Economic Analysis Workshop
- March 23, 2016: Public Workshop on the Natural and Working Lands Sector to Inform Development of the Draft 2030 Target Scoping Plan

- April 27, 2016: Public Workshop on the Agriculture Sector to Inform Development of the Draft 2030 Target Scoping Plan
- June 23, 2016: Board Hearing Informational Presentation on Status of the Draft 2030 Target Scoping Plan
- August 23, 2016: Public Workshop on the Energy Sector to Inform Development of the Draft 2030 Target Scoping Plan
- September 14, 2016: Public Workshop on the Transportation Sector to Inform Development of the Draft 2030 Target Scoping Plan
- November 7, 2016: Public Workshop on 2030 Target Scoping Plan: Greenhouse Gas Reduction Policy Scenarios, Natural and Working Lands, Local Action, and Public Health Analysis
- November 17, 2016: Board Hearing Informational Presentation on Status of the Draft 2030 Target Scoping Plan
- Details on additional EJAC, Community Meetings, and the EJAC's Initial Recommendations are provided in Section I D.5.
- Methods and Initial Results for the Natural and Working Lands Sector in the 2030 Target Scoping Plan
- December 16, 2016: Public Workshop on the 2030 Target Scoping Plan Discussion Draft, including Economic Modeling Updates

One key message conveyed during engagement with the legislature, EJAC, and environmental justice communities was the need to place more emphasis on large stationary sources, with a particular focus on multi-pollutant strategies for these sources that reduce GHGs and harmful criteria and toxic air pollutants that result in localized health impacts, especially in disadvantaged communities. Another consistent message was the need for infrastructure and other community improvements that enhance quality of life, increase access to safe and viable transportation options, and improve physical activity and related health outcomes.

B. Updated Climate Science Supports the Need for More Action

Climate scientists agree that global warming trends and other shifts in the climate system observed over the past century are caused by human activities. These changes are proceeding at an unprecedented rate when compared with climate change that human society has lived through to date.[11] According to new research, unabated GHG emissions could allow sea levels to rise close to two meters in total (more than six feet) by the end of this century—nearly twice as much as previously predicted—an outcome that could devastate coastal communities in California and around the globe.[12]

[11] Cook, J., et al. 2016. Consensus on consensus: A synthesis of consensus estimates on human-caused global warming. *Environmental Research Letters* 11:048002 doi:10.1088/1748-9326/11/4/048002. iopscience.iop.org/article/10.1088/1748-9326/11/4/048002.

[12] DeConto, R. M., and D. Pollard. 2016. Contribution of Antarctica to past and future sea-level rise. *Nature* 531:591–597, doi:10.1038/nature17145.

California is already feeling the effects of climate change, and projections show that these effects will continue and worsen over the coming centuries. The impacts of climate change have been reported by the Office of Environmental Health Hazard Assessment (OEHHA) in the climate change indicators report, which reports the following changes occurring already:[13]

- A recorded increase in annual average temperatures, as well as increases in daily minimum and maximum temperatures,
- An increase in the occurrence of extreme events, including wildfire and heat waves,
- A reduction in spring runoff volumes, as a result of declining snowpack,
- A decrease in winter chill hours, necessary for the production of high-value fruit and nut crops, and
- Changes in the timing and location of species sightings, including migration upslope of flora and fauna, and earlier appearance of Central Valley butterflies.

In addition to these trends, the State's current conditions point to a changing climate. California is in the middle of an historic drought. Recent scientific studies show that such extreme drought conditions are more likely to occur under a changing climate.[14,15] The total statewide economic cost of the 2013–2014 drought was estimated at $2.2 billion, with a total loss of 17,100 jobs.[16] In the Central Valley, the current drought has cost California agriculture about $2.7 billion and more than 20,000 jobs in 2015, which highlights the critical need for developing drought resilience, even if wet conditions mitigate the current drought.[17] Drought affects other sectors as well. An analysis of the amount of water consumed in meeting California's energy needs between 1990 and 2012 shows that while California's energy policies have supported climate mitigation efforts, they have increased vulnerability to climate impacts, especially greater hydrologic uncertainty.[18]

California has always been drought-prone, but the severity of this current drought (2013 was the driest year on record for the State, 2014 was the fourth driest, while 2015 was the warmest year on record) have led many to wonder whether global warming may be a contributing factor. Hence, several recent publications carefully examined the potential role of climate change in the California drought. One study examined both precipitation and runoff in the Sacramento and San Joaquin River basins, and found that 10 of the past 14 years have been below normal, and the past

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[13] Office of Environmental Health Hazard Assessment, Indicators of Climate Change (website): oehha.ca.gov/climate-change/document/indicators-climate-change-california

[14] Diffenbaugh, N., D. L. Swain, and D. Touma. 2015. Anthropogenic Warming has Increased Drought Risk in California. *Proceedings of the National Academy of Sciences* 112(13): 3931–3936.

[15] Cayan, D., T. Das, D. W. Pierce, T. P. Barnett, M. Tyree, and A. Gershunov. 2010. Future Dryness in the Southwest US and Hydrology of the Early 21st Century Drought. *Proceedings of the National Academy of Sciences* 107(50): 21272–21276.

[16] Howitt, R., J. Medellin-Azuara, D. MacEwan, J. Lund, and D. Summer. 2014. Economic Impacts of 2014 Drought on California Agriculture. watershed.ucdavis.edu/files/biblio/DroughtReport_23July2014_0.pdf.

[17] Williams, A. P., et al. 2015. Contribution of anthropogenic warming to California drought during 2012–2014. *Geophysical Research Letters* doi:onlinelibrary.wiley.com/doi/10.1002/2015GL064924/abstract.

[18] Fulton, J., and H. Cooley. 2015. The water footprint of California's energy system, 1990–2012. *Environmental Science & Technology* 49(6):3314–3321. pubs.acs.org/doi/abs/10.1021/es505034x.

three years have been the driest and hottest in the full instrumental record from 1895 through November 2014.[19] In another study, the authors show that the increasing co-occurrence of dry years with warm years raises the risk of drought, highlighting the critical role of elevated temperatures in altering water availability and increasing overall drought intensity and impact.[20] Generally, there is growing risk of unprecedented drought in the western United States driven primarily by rising temperatures, regardless of whether or not there is a clear precipitation trend.[21]

According to the U.S. Forest Service report, *National Insect and Disease Forest Risk Assessment, 2013–2027* (Krist et al. 2012), California is at risk of losing at least 25 percent of standing live forest due to insects and disease over 5.7 million acres, or 12 percent of the total forested area in the State. Some species are expected to lose significant amounts of their total basal area (i.e., whitebark pine is projected to lose 60 percent of its basal area; lodgepole pine, 40 percent). While future climate change is not modeled within the risk assessment, and current drought conditions are not accounted for in these estimates, the projected climate changes over the next 15 years are expected to increase significantly the number of acres at risk, and will increase the risk from already highly destructive pests such as the mountain pine beetle. Extensive tree mortality is already prevalent in California. The western pine beetle and other bark beetles have killed a majority of the ponderosa pine in the foothills of the central and southern Sierra Nevada Mountains. A recent aerial survey by the U.S. Forest Service identified more than 100 million dead trees in California.[22] As there is usually a lag time between drought years and tree mortality, we are now beginning to see a sharp rise in mortality from the past four years of drought. In response to the very high levels of tree mortality, Governor Brown issued an Emergency Proclamation on October 30, 2015.

A warming climate also causes sea level to rise; first, by warming the oceans which causes the water to expand, and second, by melting land ice which transfers water to the ocean. Even if storms do not become more intense and/or frequent, sea level rise itself will magnify the adverse impact of any storm surge and high waves on the California coast. Some observational studies report that the largest waves are already getting higher and winds are getting stronger.[23] The ocean is also changing as temperatures warm and GHG concentrations increase. Carbon dioxide is dissolving in the ocean, making it more acidic. More acidic ocean water affects a wide variety of marine species, including species that people use for food. This fundamental change is likely to have substantial ecological and economic consequences in California and

[19] Mann, M. E., and P. H. Gleick. 2015. Climate change and California drought in the 21st century. Proceedings of the National Academy of Sciences of the United States of America, 112(13):3858–3859. doi.org/10.1073/pnas.1503667112.

[20] Diffenbaugh, N. S., D. L. Swain, and D. Touma. 2015. Anthropogenic warming has increased drought risk in California. Proceedings of the National Academy of Sciences of the United States of America. 10.1073/pnas.1422385112. www.pnas.org/content/112/13/3931.full.pdf

[21] Cook, B. I., T. R. Ault, and J. E. Smerdon. 2015. Unprecedented 21st century drought risk in the American Southwest and Central Plains. *Science Advances* 1(1), e1400082, doi:10.1126/sciadv.1400082.

[22] USDA. New Aerial Survey Identifies More Than 100 Million Dead Trees in California. www.usda.gov/wps/portal/usda/usdahome?contentid=2016/11/0246.xml&contentidonly=true

[23] National Research Council of the National Academy of Sciences. 2012. Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future, National Academies Press.

worldwide.[24]

A growing body of scientific evidence also shows that healthy tropical forests are central to solving climate change, as tropical forests exchange large amounts of water and energy with the atmosphere (affecting atmospheric rivers), controlling regional and global climate. Atmospheric rivers are relatively narrow regions in the atmosphere that are responsible for most of the horizontal transport of water vapor outside of the tropics. Deforestation and climate change have the capacity to alter rainfall regimes, water availability, and surface-atmosphere flux of water and energy of tropical forests. Between 2010 and 2015, despite some successful efforts at reducing the global rate of deforestation, trends continued to show losses of upwards of 6.6 million hectares per year, mainly from loss of natural forests in the tropics. Tropical deforestation accounts for about 15 percent of global GHG emissions—larger than the entire global transportation sector. Preserving tropical forests will help meet the aggressive global emissions reduction targets necessary to avoid catastrophic climate change and may help to preserve California's historical rainfall patterns. While more intense dry periods are anticipated under warmer conditions, extremes on the wet end of the spectrum are also expected to increase, due to more frequent warm, wet atmospheric river events and a higher proportion of precipitation falling as rain instead of snow. In recent years, atmospheric rivers have also been recognized as the cause of the large majority of major floods in rivers all along the U.S. West Coast and as the source of 30–50 percent of all precipitation in the same region.[25] These extreme precipitation events, together with the rising snowline, often cause devastating floods in major river basins (e.g., California's Russian River). It was estimated that the top 50 observed floods in the U.S. Pacific Northwest were due to atmospheric rivers.[26] Looking ahead, computer models predict that climate change will cause the very worst atmospheric river storms hitting California to become much more frequent and larger.

Sea level rise, droughts, floods, and forest impacts are just some of the environmental systems disrupted by climate change. As GHG emissions continue to accumulate and climate disruption grows, such destructive events will become more frequent. The historical record, which once set our expectations for the traditional range of weather and other natural events, is becoming an increasingly unreliable predictor of the conditions

Climate Impacts at the Community Level

To better understand how climate will impact local communities, the California Energy Commission hosts best available data on climate change projections downscaled to the local level.

Please visit:
Cal-Adapt.org

[24] Chan, F., et al. 2016. The West Coast Ocean Acidification and Hypoxia Science Panel: Major Findings, Recommendations, and Actions. California Ocean Science Trust, Oakland, California, USA.

[25] Dettinger, M. D. 2013. Atmospheric rivers as drought busters on the U.S. West Coast. *Journal of Hydrometeorology* 14:1721-1732, doi:10.1175/JHM-D-13-02.1. journals.ametsoc.org/doi/abs/10.1175/JHM-D-13-02.1.

[26] Warner, M. D., C. F. Mass, and E. P. Salath´e. 2012. Wintertime extreme precipitation events along the Pacific Northwest coast: Climatology and synoptic evolution. *Monthly Weather Review* 140:2021–43. journals.ametsoc.org/doi/abs/10.1175/MWR-D-11-00197.

we will face in the future. Climate disruption can drive extreme weather events such as coastal storm surges, drought, wildfires, floods, and heat waves. Effective climate policy must be based in the best available science, so California is committed to further supporting new research on ways to mitigate climate change and how to understand its ongoing and projected impacts. California's Fourth Climate Change Assessment further updates our understanding of the many impacts from climate change in a way that directly informs State agencies' efforts to safeguard the State's people, economy, and environment.

Together, current conditions and future projections provide a picture of California's changing climate, with two important messages:

- Change is already being experienced and documented across California, and some of these changes have been directly linked to changing climatic conditions.
- Even with the uncertainty in future climate conditions, every scenario estimates further change in future conditions.

It is critical that California continue to take steps to reduce GHG emissions in order to avoid the worst of the projected impacts of climate change. At the same time, the State is taking steps to make the State more resilient to ongoing and projected climate impacts as laid out by the Safeguarding California plan.[27] Safeguarding California is being updated in 2017 with new policy recommendations and more actions to address California. California's efforts are vital steps toward minimizing the impact of GHG emissions and the three-pronged approach of reducing emissions, preparing for impacts, and conducting cutting-edge research can serve as a model for action.

C. California's Greenhouse Gas Emissions and the 2030 Target

1. Progress Toward Achieving the 2020 Limit

California has made progress toward achieving the 2020 statewide GHG target while also reducing criteria pollutants and toxic air contaminants and supporting economic growth. As shown in Figure I-1, in 2014, total GHG emissions decreased by 2.8 $MMTCO_2e$ compared to 2013, representing an overall decrease of 9.4 percent since peak levels in 2004. The 2014 GHG Emission Inventory and a description of the methodology updates can be accessed at: www.arb.ca.gov/cc/inventory/inventory.htm.

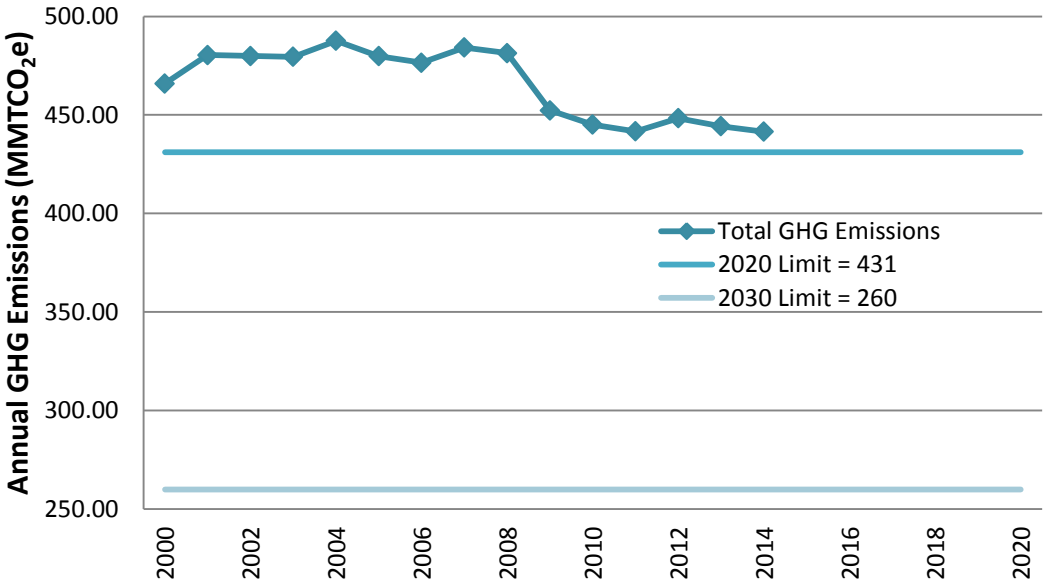
AB 32 directs CARB to develop and track GHG emissions and progress toward the target. California Health and Safety Code section 38505 identifies seven GHGs that CARB is responsible for monitoring and regulating to reduce emissions: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and nitrogen trifluoride (NF_3). The fluorinated gases are also referred to as "high global warming potential gases"

[27] California Natural Resources Agency. Safeguarding California. http://resources.ca.gov/climate/safeguarding/

(high-GWP gases). California's annual statewide GHG emission inventory has historically been the primary tool for tracking GHG emissions trends.

The 2014 GHG Emission Inventory includes improved methodology updates. For example, to align the GHG inventory with the IPCC guidelines and share consistent methods with other subnational jurisdictions, CARB is now separating biogenic CO_2 from transportation fuels from the total emissions and tracking those emissions separately as informational items (beginning with 2014 reporting). Figure I-1 provides the GHG inventory trend using this new method. Additional information on the methodology for the GHG inventory can also be found at: www.arb.ca.gov/cc/inventory/data/data.htm.

Figure I-1. California GHG Inventory Trend



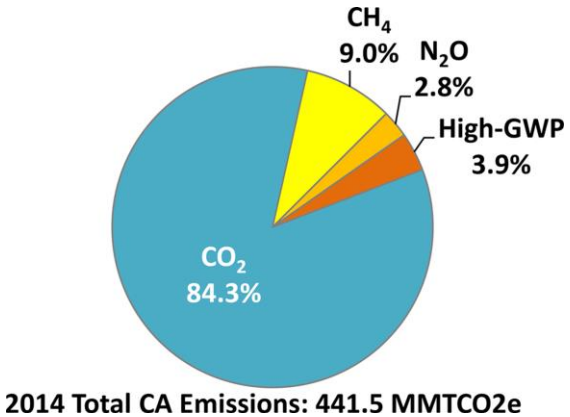
Carbon dioxide is the primary GHG emitted in California, accounting for 84 percent of total GHG emissions in 2014, as shown in Figure I-2 below. Figure I-3 illustrates that transportation, primarily on-road travel, is the single largest source of CO_2 emissions in California. Electricity production and industrial and residential sources also are important contributors to CO_2 emissions. Methane is the second most important GHG in California, accounting for 9 percent of California's 2014 GHG emissions in CO_2 equivalent units. Agriculture accounts for the majority of methane emissions, primarily from livestock enteric fermentation and manure management. Industrial sources and landfills are also important methane sources. Other sources contribute only a small fraction to methane emissions, and include residential, transportation, electricity generation, and commercial sources. Agriculture accounts for the majority of N_2O emissions, primarily from fertilizer and manure added to soil. Transportation and commercial and residential use of nitrogen fertilizer on turf are also important sources of

N_2O. Industrial sources of N_2O include solid waste and wastewater treatment, manufacturing, refining, and other sources.

High-GWP gases are fluorinated gases (F-gases) with GWPs hundreds to thousands of times greater than that of carbon dioxide. These gases are used across many different economic sectors, including energy, industry, commercial, residential, and transportation. High-GWP gases include: sulfur hexafluoride (SF_6), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and nitrogen trifluoride (NF_3). SF_6, PFCs, and NF_3 are long-lived F-gases whose emissions are being reduced by CARB regulations covering the semiconductor industry, electrical transmission, magnesium casting, and miscellaneous SF_6 uses. HFCs are short-lived climate pollutant synthetic gases used in refrigeration, air conditioning, insulating foams, solvents, aerosol products, and fire protection. HFCs comprise approximately 97 percent of the high-GWP gas emissions, and 4 percent of all GHG emissions from all sources, but are the fastest growing GHG emissions source globally as HFCs continue to replace ozone-depleting substances.

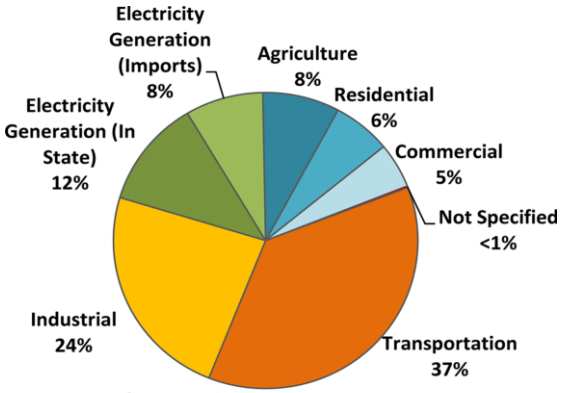
Figures I-2 and I-3 show State GHG emission contributions by pollutant and sector based on the 2014 GHG Emission Inventory.

Figure I-2. Emissions by GHG



2014 Total CA Emissions: 441.5 MMTCO2e

Figure I-3. Emissions by Sector



2014 Total CA Emissions: 441.5 MMTCO2e

Another important climate-forcing pollutant not listed among the Kyoto Protocol gases is black carbon, which is also a short-lived climate pollutant. CARB has developed a statewide emission inventory for black carbon in support of the Proposed SLCP Strategy, which is reported in two categories: non-forestry (anthropogenic) sources and forestry sources.[28] The State's major anthropogenic sources of black carbon include off-road transportation, on-road transportation, residential wood burning, fuel combustion, and industrial processes (Figure I-4). The forestry category includes non-agricultural prescribed burning and wildfire emissions. For forest-related sources, wildfires account for the majority of black carbon emissions during a typical year.

[28] Per SB 1383, the Proposed SLCP Strategy only addresses anthropogenic black carbon. The Forest Carbon Plan will include the goal to reduce black carbon emissions from unmanaged wildfire events through forest management and restoration activities that are designed to reduce the risk of wildfire.

Because the extent and severity of wildfire varies from year to year, the State's black carbon inventory uses a 10-year average of fine particulate matter ($PM_{2.5}$) emissions from wildfire to represent average conditions and avoid large variations (Table I-1). More information on CARB's black carbon inventory can be found at: www.arb.ca.gov/cc/inventory/slcp/slcp.htm.

Figure I-4. California 2013 Anthropogenic Black Carbon Emission Sources*

*Using 100-year GWP

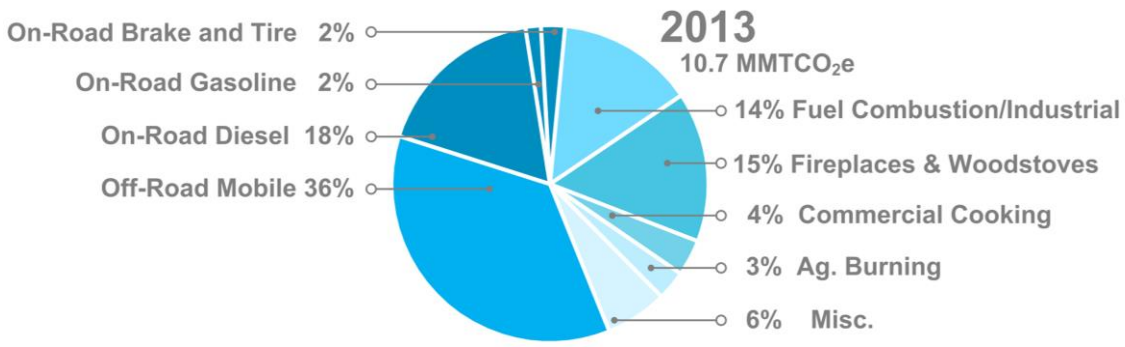


Table I-1. Ten Year Average California Forestry Black Carbon Emissions

Source	$MMTCO_2e$ (20-yr)	$MMTCO_2e$ (100-yr)
Prescribed Burning	3.6	1.0
Wildfire	86.7	24.4

The exchange of CO_2 between the atmosphere and California's natural and working lands sector is not currently quantified and therefore, not included in the inventory. A natural and working lands carbon inventory is essential for monitoring land-based activities that may increase or decrease carbon sequestration over time. CARB staff is working to develop a comprehensive inventory of GHG fluxes from all of California's natural and working lands using IPCC design principles. CARB released the Natural and Working Lands Inventory with the 2017 Scoping Plan Updated Discussion Draft.[29] This inventory provides an estimate of GHG emissions reductions and changes in carbon stock from some carbon pools in agricultural and natural and working lands. The CARB Natural and Working Lands Inventory includes an inventory of carbon stocks, stock-change (and by extension GHG flux associated with stock-change) with some attribution by disturbance process for the analysis period 2001–2010. Disturbance processes would include activities such as conversion from one land category to a different category, fire, and harvest. The CARB Natural and Working

[29] ARB. 2016. California Greenhouse Gas Inventory - Forests and Other Lands. https://www.arb.ca.gov/cc/inventory/sectors/forest/forest.htm

Lands Inventory covers varieties of forests and woodlands, grasslands, and wetlands (biomass-stock-change only). The CARB Natural and Working Lands Inventory includes default carbon densities for croplands and urban/developed lands to facilitate stock-change estimation for natural lands that convert to cropland, natural lands that convert to developed lands, and for croplands that convert to developed lands.

2. Setting the 2030 Statewide Target

The 2030 target set by SB 32 of 40 percent reduction from 1990 levels by 2030 reflects the same science that informs the agreement reached in Paris by the 2015 Conference of Parties to the United Nations Framework Convention on Climate Change (IPCC), aimed at keeping the global temperature increase below 2 degrees Celsius (°C). The California 2030 statewide target represents the most ambitious GHG reduction goal for North America. Based on the emissions reductions directed by SB 32, the annual 2030 statewide target emissions level for California is 260 $MMTCO_2e$.

3. Greenhouse Gas Emissions Tracking

California maintains a GHG inventory that is consistent with IPCC practices to allow for comparison of the statewide GHG emissions with those at the national level and with other international GHG inventories. Statewide GHG emissions are calculated using many data sources. The primary data source is from reports submitted to CARB through the Regulation for the Mandatory Reporting of GHG Emissions (MRR). MRR requires facilities and entities with more than 10,000 metric tons of carbon dioxide equivalent ($MTCO_2e$) of combustion and process emissions, all facilities belonging to certain industries, and all electric power entities to submit an annual GHG emissions data report directly to CARB. Reports from facilities and entities that emit more than 25,000 $MTCO_2e$ are verified by a CARB-accredited third-party verification body. More information on MRR emissions reports can be found at: www.arb.ca.gov/cc/reporting/ghg-rep/reported-data/ghg-reports.htm.

CARB also relies on data from other California State and federal agencies to develop an economy-wide GHG inventory for the State of California. All data sources used to develop the GHG Inventory are listed in the GHG Emission Inventory supporting documentation at: www.arb.ca.gov/cc/inventory/data/data.htm.

Concurrently, other State agencies, nonprofit organizations, and research institutions are developing and testing methodologies and models to quantify GHG fluxes from California's natural and working lands. CARB's ongoing work on this inventory will serve as one source of data to gauge the scope of GHG reduction potential from California's natural and working lands and monitor progress over time. CARB will evaluate other data sources and methodologies for use in validating or supporting the CARB inventory or project-scale tracking. Interagency work is also underway to integrate and account for the land use and management impacts of development, transportation, housing, and energy policies.

Greenhouse gas mitigation action may cross geographic borders as part of international and subnational collaboration, or as a natural result of implementation of regional policies. It is important to be able to track and attribute GHG reductions toward action and ensure any reductions claimed are real, without any double counting. CARB has begun exploring how to build an accounting framework that utilizes existing program data to better reflect the broader benefits of our policies. The ability for subnational regions to account for shared results of collaborative efforts, such as a linked cap-and-trade program, is important to support continued collaborative action at this level. California believes data transparency is critical to demonstrate real progress toward reducing GHGs in any context and fully understanding the impact of GHG mitigation policies.

D. California's Approach to Addressing Climate Change

1. Integrated Systems

A comprehensive approach is needed to achieve the State's climate goals. Therefore, this Proposed Plan integrates and builds upon multiple ongoing State efforts. For example, as we address future mobility, we must show how existing efforts underway—such as the California Sustainable Freight Action Plan, Mobile Source Strategy, California Transportation Plan 2040, High-Speed Rail,[30] urban planning, and goals for enhancement of the natural environment—can complement each other while providing multiple environmental benefits, including air quality and climate benefits. Each of these efforts is important in its own right, but considered together they provide insights into the synergies and conflicts between policies and demonstrate how the State will move toward a sustainable and resilient future. For example, land disturbance due to increased renewables through utility scale wind and solar and transmission can release GHGs from soil and disturb grasslands and rangelands that have the potential to sequester carbon. Further, policies that support sustainable land use not only reduce vehicle miles traveled (VMT) and its related emissions, but also avoid land disturbance that could result in GHG emissions or loss of sequestration potential in the natural environment. Identifying these types of trade-offs, and designing policies and implementation strategies to support goals across all sectors, will require ongoing efforts at the local, regional, and State level to ensure that sustainable action across both the built and natural environments help to achieve the State's long-term climate goals.

2. Promoting Resilient Economic Growth

The existing policies, strategies, plans, and regulations that we already have in place are helping many California businesses to better compete in a global economy, and have created new investments, businesses, and jobs to support a clean energy economy. We have learned that California's portfolio-based climate strategy can

[30] California's High-Speed Rail is part of the International Union of Railways (UIC) and California signed the Railway Climate Responsibility Pledge, which was commended by the Secretary of the UN Framework Convention on Climate Change as part of achieving global 2050 targets.

achieve great success when accompanied by consistent and rigorous GHG monitoring and reporting, a robust public process, and an effective enforcement program for the few that choose not to play by the rules. Our experience has also shown us that California's economy and infrastructure can be strengthened while also achieving other important environmental benefits such as reductions in criteria pollutants and toxic air contaminants, especially in California's most vulnerable communities.

The benefits to be achieved consistent with the Proposed Plan are part of California's comprehensive strategy to achieve lasting emissions reductions throughout the economy. California's strategic vision for achieving at least a 40 percent reduction in GHG emissions by 2030 is based on the principle that economic prosperity and environmental sustainability can be achieved together. Undertaking the actions that are presented in Proposed Plan presents opportunities for the future, but progress toward our goals is already evident today. For example, in 2015, California added more than 20,000 new jobs in the solar sector. This was more than half of the new jobs in this industry across the nation. Employment in the clean economy grew by 20 percent between 2002 and 2012, which included the period of economic recession around 2008.[31] Shifting to clean, local, and efficient uses of energy reinvests our energy expenditures in our local economies and reduces risks to our economy associated with exposure to volatile global and national oil and gas commodity prices. Indeed, a clean economy is a resilient economy.

Achieving our global goals requires a structural shift in the global economy, which is already underway. Successfully driving this transition will require cleaner and more efficient technologies, new policies and incentives that better recognize and reward innovation, and prioritizing low carbon investments. It also requires new policies and incentives at multiple jurisdictional levels to ensure that this transition advances land use and natural resource management objectives for both GHG mitigation and climate adaptation. Synergistic linkages between technological advances and resource stewardship must be intentional to be successful, and must result in sustainable development. These efforts are already underway, as highlighted through the development and implementation of Sustainable Communities Strategies (SCSs) pursuant to Senate Bill (SB) 375, which link transportation, housing, and climate policy, and are designed to reduce per capita GHG emissions while providing benefits ranging from improved air quality and expanded transportation options to revitalization of city centers and investment in disadvantaged communities. SB 375 is just one of many ways to address housing and transportation needs and provide climate benefits. The Proposed Plan identifies new ways to promote the technologies and infrastructure required to meet our collective climate goals, while also presenting the vision for California's continuing efforts to foster a sustainable, clean energy economy.

[31] California Business Alliance for a Clean Economy. 2015. Clean Energy and Climate Change Summary of Recent Analyses for California. clean-economy.org/wp-content/uploads/2015/01/Clean-Energy-Climate-Change-Analyses_January2015.pdf

3. Protecting, Enhancing, Innovating, and Increasing Sequestration in the Natural Environment and Working Lands

California's natural and working lands make the State a global leader in agriculture, a U.S. leader in forest products, and a global biodiversity hotspot. These lands support clean air, wildlife and pollinator habitat, and rural economies, and are critical components of California's water infrastructure. Keeping these lands and waters intact and at high levels of ecological function (including resilient carbon sequestration) is necessary for the well-being and security of Californians in 2030, 2050, and beyond. Forests, rangelands, farms, wetlands, riparian areas, deserts, coastal areas, and the ocean store substantial carbon in biomass and soils.

Natural and working lands are a key sector in the State's climate change strategy. Substantially storing carbon in trees, other vegetation, soils, and aquatic sediment is the most effective way to remove carbon dioxide from the atmosphere. This Proposed Plan includes policies and programs that prioritize protection and enhancement of California's landscapes, including urban landscapes, and identifies the next steps to ensure management actions are taken to increase the sequestration potential of those resources. We cannot ignore the relationships between sectors or the adverse impacts that climate change is having on the environment itself. We must consider important trade-offs in developing the State's climate strategy by understanding the near and long-term impacts of various policy scenarios and actions on our State and local communities.

4. Improving Public Health

The State has committed to addressing public health issues, including addressing chronic and infectious diseases, controlling tobacco, providing nutrition education and obesity prevention, reducing occupational and other types of injuries, promoting mental health, and protecting communities from environmental exposures and toxins. As part of these efforts, California has been protecting and improving air quality for more than 50 years. State and local regulations have been a model for other states, the federal government, and other countries. Our drive to improve air quality and promote community health and well-being will continue to remain a priority as we address climate change. Several of the strategies included in this plan were primarily developed to help the State achieve ambient air quality standards for air pollutants with direct health impacts, while also delivering GHG reductions.

Climate change itself is already affecting the health of our communities and is exacerbating existing health inequities. Those facing the greatest health burdens include low-income individuals and households, the very young and the very old, communities of color, and those who have been marginalized or discriminated against based on gender or race/ethnicity.[32] Economic factors, such as income, poverty, and

[32] California Department of Public Health (CDPH). 2015. *The Portrait of Promise: The California Statewide Draft Plan to Promote Health and Mental Health Equity.* A Report to the Legislature and the People of California by the Office of Health Equity. Sacramento, CA: California Department of Public Health, Office of Health Equity.

wealth, are among the strongest determinants of health. Addressing climate change presents a significant opportunity to improve public health for all of California's residents and to further our work toward making our State the healthiest in the nation.

To successfully address public health inequities, we must continue to address environmental concerns in disadvantaged communities. At the same time, to achieve the 2030 target and the longer-term 2050 target, we must move forward with sustainable development. The United Nations defines sustainable development as "development that meets the needs of the present without compromising the ability of the future generations to meet their own needs."[33] By identifying and addressing the disproportionate impacts felt today and planning, designing, and implementing actions for a sustainable future, we can be part of the solution to make public health inequities an issue of the past.

5. Environmental Justice

Fair and equitable climate action requires that the inequities that create and intensify community vulnerabilities be addressed. The capacity for resilience in the face of climate change is significantly driven by living conditions and the forces that shape them, such as access to services such as health care, healthy foods, air and water, and safe spaces for physical activity; income; education; housing; transportation; environmental quality; and good health status. Thus, strategies such as alleviating poverty, increasing access to economic opportunities, improving living conditions, and reducing health and social inequities will result in more climate-resilient communities. Promoting a low carbon California economy will reduce GHG emissions and create a healthier environment for all of California's residents, especially those living in the State's most disadvantaged communities. We must also recognize there is a need to tailor policies to address the unique characteristics of economically distressed communities in the State's rural areas.

The impacts of climate change and the health inequities in our communities share similar root causes: the inequitable distribution of social, political, and economic power. These power imbalances result in systems (i.e., economic, transportation, land use zoning, etc.) and conditions that drive both health inequities and GHG emissions. As a result, we see communities with inequitable living conditions, such as low-income communities of color living in more polluted areas, facing climate change impacts that compound and exacerbate existing sensitivities and vulnerabilities. Effective climate action requires that the inequities that create and intensify community vulnerabilities be addressed.

It is critical that environmental justice communities share in the benefits of the cleaner economy that California is building, including environmental and economic benefits. An example of this is that low-income customers that are enrolled in the California Alternate Rates for Energy (CARE) Program or the Family Electric Rate Assistance (FERA) Program are also eligible to receive a rebate under the California Climate Credit, or a

[33] General Assembly of the United Nations. Sustainable Development. www.un.org/en/ga/president/65/issues/sustdev.shtml

credit on residential and small business energy bills resulting from the sale of allowances received by investor-owned utilities as part of the Cap-and-Trade Program. SB 1018 (Committee on Budget and Fiscal Review, Chapter 39, Statutes of 2012) and other implementing legislation requires that Cap-and-Trade Program auction monies deposited into the GGRF be used to further the purposes of AB 32, while also fostering job creation by promoting in-state GHG emissions reduction projects carried out by California workers and businesses.

Further, SB 535 (De Leon, Chapter 830, Statutes of 2012) and AB 1550 (Gomez, Chapter 369, Statutes of 2016) direct State and local agencies to make significant investments from monies deposited into the GGRF that improve California's most vulnerable communities. Specifically, these laws require that at least 35 percent of GGRF monies benefit disadvantaged communities and low-income communities and households. Based on agency data reported as of December 2015, we are on track to meet these goals; 39 percent ($356 million) of the approximately $912 million are funding projects located within disadvantaged communities.

Environmental Justice Advisory Committee

AB 32 calls for CARB to convene an Environmental Justice Advisory Committee (EJAC), to advise the Board in developing the Scoping Plan, and any other pertinent matter in implementing AB 32. It requires that the Committee be comprised of representatives from communities in the State with the most significant exposure to air pollution, including, but not limited to, communities with minority populations or low-income

Environmental Justice Advisory Committee

Martha Dina Argüello	Physicians for Social Responsibility	Los Angeles
Colin Bailey	The Environmental Justice Coalition for Water	Sacramento
Gisele Fong	End Oil	Los Angeles
Tom Frantz	Association of Irritated Residents	Central Valley
Katie Valenzuela Garcia	Oak Park Neighborhood Association	Sacramento
Sekita Grant	The Greenlining Institute	Statewide
Kevin Hamilton	Central California Asthma Collaborative	Central Valley
Rey León	Valley LEAP	Central Valley
Luis Olmedo	Comité Civico Del Valley	Imperial Valley
Kemba Shakur	Urban Releaf	Bay Area
Mari Rose Taruc	Asian Pacific Environmental Network	Bay Area
Eleanor Torres	The Incredible Edible Community Garden	Inland Empire
Monica Wilson	Global Alliance for Incinerator Alternatives	Bay Area

populations, or both. CARB engaged 13 environmental justice and disadvantaged community representatives for the Proposed Plan, which kicked off the deliberation process with its first EJAC meeting in December 2015.

Environmental Justice Advisory Committee Public Committee Meetings	
December 7, 2015	Sacramento
January 6, 2016	8 locations by webinar
February 5, 2016	San Bernardino
April 4, 2016	Brawley
May10, 2016	Sacramento
May 24–25, 2016	El Monte
June 6, 2016	8 locations by phone
June 21, 2016	8 locations by webinar
August 11–12, 2016	Huron
August 26, 2016	7 locations by phone
December 21–22, 2016	Bakersfield
January 18, 2017	Sacramento

As with the Initial Scoping Plan and First Update, this Proposed Plan development process to date includes extensive consultation with the EJAC. The consultation for this Proposed Plan also included extensive consultation and engagement directly with disadvantaged communities through 11 community meetings hosted by the EJAC and held throughout the State (see below).

Public Committee Meetings

The Committee has met twelve times across California since December 2015 to discuss this 2030 Target Scoping Plan and develop recommendations.

Statewide Community Engagement Meetings

Starting in July 2016, the EJAC hosted with CARB support, a robust community engagement process, conducting 11 community meetings throughout the State and collecting over 700 individual comments. The community meetings were well received and attended by several hundred residents and local community representatives. Additional community meetings are being planned through spring 2017.

Environmental Justice Advisory Committee Community Meetings	
July 11, 2016	San Bernardino
July 14, 2016	San Diego
July 19, 2016	Oakland
July 25, 2016	Wilmington
July 26, 2016	South Los Angeles
July 28, 2016	Modesto
July 28, 2016	Bakersfield
July 28, 2016	Fresno
July 29, 2016	Sacramento
October 22, 2016	Brawley
November 4, 2016	Orleans

To enhance the community engagement, CARB staff coordinated with staff from local government agencies and sister agencies. At the community meetings, staff from State and local agencies participated in extensive, topic-specific "world café" discussions with local residents at these meetings. The extensive collaboration between the EJAC, State agencies, and local agencies provided local residents the opportunity to meet with local advocates and local and State government officials to share concerns and provide input on ways California can meet its 2030 target while addressing a number of related issues and concerns.

EJAC Recommendations

The EJAC's recommendations for the Proposed Plan were informed by comments received at community meetings listed above and Committee member expertise. Recommendations were provided for the sector focus areas, overarching environmental justice policy, and California Climate Investments. The Committee also sorted their recommendations into five themes: partnership with environmental justice communities, equity, economic opportunity, coordination, and long-term vision. Finally, the EJAC provided direction that their recommendations are intended "to be read and implemented holistically and not independently of each other."

The EJAC's overarching recommendations for partnership with environmental justice communities, equity, coordination, economic opportunity, and long-term vision include the following recommendations:

- Encourage long-term community engagement, a culture shift in California, and neighborhood-level solutions to promote the implementation of the State's climate plans, using strategies identified by the Committee.

- Improve the balance of reducing greenhouse gases and compliance costs with other AB 32 goals of improving air quality in environmental justice communities while maximizing benefits for all Californians.
- Consider public health impacts and equity when examining issues in any sector and have CARB conduct an equity analysis on the Proposed Plan and each sector, with guidance from the Committee.
- Develop metrics to ensure actions are meeting targets and develop contingency plans for mitigation and adjustment if emissions increases occur as programs are implemented.
- Coordinate strategies between State, federal, and local agencies for strong, enforceable, evidence-based policies to prevent and address sprawl with equity at the center.
- Maximize the accessibility of safe jobs, incentives, and economic benefits for Californians and the development of a just transition for workers and communities in and around polluting industries.
- Ensure that AB 32 economic reviewers come from various areas around the State to represent insights on economic challenges and opportunities from those regions.
- Do not limit the Proposed Plan to examining interventions and impacts until 2030, or even 2050. Plan and analyze on a longer-term scale to prevent short-sighted mistakes and reach the long-term vision, as actions today and for the next 30 years will have impacts for seven generations.
- The Proposed Plan must prioritize GHG reductions and investments in California environmental justice communities first, before other California communities; and the innovation of new technologies or strategies to reach even deeper emissions cuts, whenever possible.
- Convene the Committee beyond the Scoping Plan development process.

The Committee's key Energy sector recommendations include developing aggressive energy goals toward 100 percent renewable energy by 2030, including a vision for a clean energy economy, and prioritizing actions in disadvantaged communities. Highlights of the Green Building sector recommendations include setting goals for green buildings, enforcing GHG reduction targets for existing buildings, and providing upgrades that enable buildings to use renewable energy technologies and water capture. Key Water sector recommendations include encouraging water conservation and recycling and prioritizing safe drinking water for all.

The Committee's key Industry sector recommendations include prioritizing direct emissions reductions in environmental justice communities and replacing the Cap-and-Trade Program with a carbon tax or fee and dividend program. The Committee also recommends eliminating offsets and the allocation of free allowances if the Cap-and-Trade Program continues.

The Committee's key Transportation sector recommendations include increasing access to affordable, reliable, clean, and safe mobility options in disadvantaged

communities, community-friendly land use planning, maximizing electrification, and restricting sprawl.

The Committee's key Natural and Working Lands, Agriculture, and Waste sector recommendations include diverting waste, returning carbon to the soil, not burning biomass, supporting healthy soils as a critical element to land and waste management, and integrating urban forestry within local communities.

Finally, the Committee provided recommendations for California Climate Investments. Those include ensuring that near-term technologies do not adversely impact communities and long-term investments move toward zero emissions, requiring GGRF projects to be transformative for disadvantaged communities as defined by each community, and eliminating funding for AB 32 regulated entities.

The EJAC's recommendations, in their entirety, are included in Appendix A and available at:www.arb.ca.gov/cc/ejac/ejac_recommendations_proposed_plan122216.pdf. At the EJAC's December 21–22, 2016 meeting, CARB provided the Committee with information about how their recommendations were incorporated in the Discussion Draft. CARB will update this information to reflect the Committee's current recommendations, as provided in Appendix A. CARB is also in the process of providing the Committee with information about the recommendations not incorporated in the Proposed Plan, which will be used as the Committee develops its final recommendations for the Final Plan. The Committee will continue to hold regular public meetings to discuss the Proposed Plan and formalize their recommendations to inform the Final Plan. More information about the EJAC and recommendations on the previous Scoping Plans and current Proposed Plan is located at: www.arb.ca.gov/ejac.

6. Relying on Sound Science and Research

Sound science underpins, updates, and strengthens climate policy. The scientific record overwhelmingly and undeniably demonstrates that climate change is occurring. It also connects human-related activities to the atmospheric burden of CO_2 with expansion at an unprecedented rate. In developing this Proposed Plan, time matters. The policies that are included must lead rapidly to real results to avoid the most catastrophic impacts of climate change. The Proposed Plan identifies policies based on solid science and identifies additional research needs, while also recognizing the need for flexibility in the face of a changing climate. Ongoing research to better understand systems where our knowledge is weaker will allow for additional opportunities to set targets and identify actionable policies.

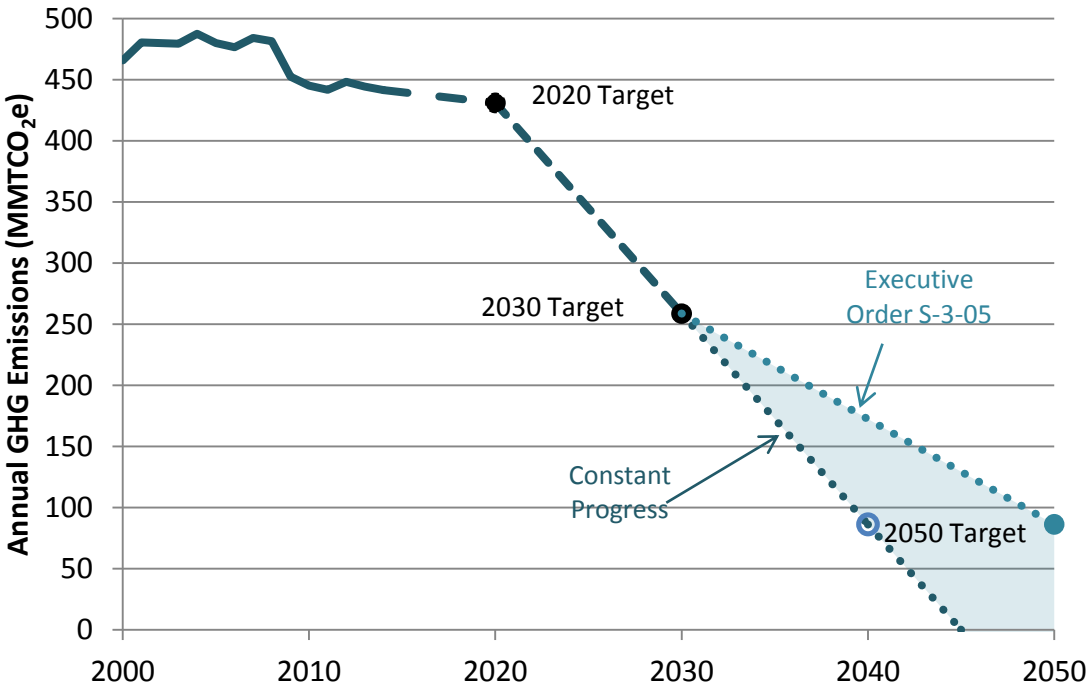
7. Setting the Path to 2050

While the Proposed Plan charts the path to achieving the 2030 GHG emissions reduction target, we need momentum to propel us to the 2050 statewide GHG target (80 percent below 1990 levels). In developing the Proposed Plan, we considered what policies are needed for the mid-term and long-term, knowing that some policies for the

long-term must begin implementation now. For example, Zero Net Carbon Buildings is an important strategy to achieve the 2050 target, but work must begin now to review and evaluate research in this area, establish a planning horizon for targets, and identify implementation mechanisms. At the same time, we need to consider policies for 2030 that do not simply dead end in 2030, but rather can continue to help support the State's long-term climate objectives. As with all investments, whether financial or personal, the approach we take must balance risk, reward, longevity, and timing. For the forest sector, are we comfortable with policies that may result in some near-term carbon loss, but ultimately support more resilient and healthier forests in the longer time frame? And, are we willing to pursue policies that we know are needed for the 2050 target, but may not significantly reduce GHG emissions in the near-term?

Figure I-5 illustrates the potential GHG reductions that are possible by making consistent progress between 2020 and the 2050, versus an approach that begins with the 2030 target and then makes progress toward the 2050 level included in Executive Order S-3-05. Depending on the success of our achieving the 2030 target, taking a consistent approach may be possible and would help achieve the 2050 target earlier and potentially prevent global warming of 1.5°C. The path to achieving the 2050 target should leave open the possibility for both paths. Note that Figure I-5 does not include emissions from or sequestration potential from the natural and working lands sector.

Figure I-5. Plotting California's Path Forward



8. Intergovernmental Collaboration

Federal, State, and local action can be complementary. We have already seen federal action through the Clean Air Act, regulations for GHG emissions from passenger cars

and trucks, development of the Clean Power Plan to limit GHGs from power plants, and the advancement of methane rules for oil and gas production. There are also times when California, working with other climate leaders, acts to advance more ambitious federal action and protect the ability of states to move forward to address climate change. Both collaboration and advocacy will mark the road ahead. However, to the extent that California cannot implement policies or measures included in the Proposed Plan because of the lack of federal support, the State will develop alternative measures to achieve the reductions from the same sector to ensure we meet our GHG reduction targets.

Regional and local governments and agencies are leaders in addressing climate change and are uniquely positioned to reduce emissions from certain sources, especially by reducing the demand for electricity, transportation fuels, and natural gas. Many local governments have already initiated efforts to reduce GHG emissions beyond those required by the State. For example, many cities and counties are improving their municipal operations by upgrading their vehicle fleets, retrofitting government buildings and streetlights, purchasing greener products, and implementing waste-reduction policies. In addition, they are adopting more sustainable codes, standards, and general plan improvements to reduce their community's footprints and emissions. The State is striving to provide a supportive framework to advance these and other local efforts, while also recognizing the need to build on, and export, this success to other regional and local governments through California and beyond.

Local actions are critical for implementation of California's ambitious climate agenda. Importantly, at the same time, State policies, programs, and actions—such as many of those identified throughout this Proposed Plan—can help to support, incentivize, and accelerate local actions to achieve mutual goals, and are indeed critical to achieving both State and local goals and priorities for more sustainable and resilient communities. Local municipal code changes, zoning changes, or policy directions that apply broadly to the community within the general plan or climate action plan area can help promote the deployment of renewable, zero emission, and low carbon technologies such as zero net energy buildings, renewable fuel production facilities, and zero emission charging stations. Local decision-making has an especially important role in achieving reductions of GHG emissions generated from transportation. Over the last 60 years, development patterns have led to sprawling suburban neighborhoods, a vast highway system, growth in automobile ownership, and under-prioritization of infrastructure for public transit and active transportation. Local decisions about these policies today can establish a more sustainable built environment for the future. Local governments can incentivize locally generated renewable energy and infrastructure for alternative fuels and electric vehicles, implement water efficiency measures, develop waste-to-energy and waste-to-fuel projects, and preserve and enhance carbon sequestration in both rural and urban landscapes. Indeed, many local agencies are already implementing ambitious climate strategies. These types of local actions complement statewide measures and may be more cost-effective and provide more co-benefits than relying exclusively on top-down statewide regulations to achieve the State's climate stabilization goals. The Proposed

Plan explores the potential benefit of any regional or local targets to assist local agencies in their efforts to address climate change.

9. International Efforts

California is not alone in its efforts to address climate change and is committed to working at the international level to reduce global GHG emissions. The agreement reached in Paris by the 2015 Conference of Parties to the United Nations Framework Convention on Climate Change (UNFCCC), aimed at keeping the global temperature rise below 2°C, is spurring action across the world. The results of this agreement will translate into worldwide action to reduce GHGs and support decarbonization across the global economy. And, it is not just action and coordination at the international and national levels that is important. Subnational governments are front and center on this issue. With the establishment of the Under 2 Memorandum of Understanding (MOU),[34,35] the Governors' Climate and Forests Task Force,[36] and the Western Climate Initiative,[37] among other partnership initiatives, subnational jurisdictions from the around the world are collaborating on how best to address climate change and are leading the way.

From its inception, AB 32 recognized the importance of California's climate leadership and engagement with other jurisdictions, and directed CARB to consult with the federal government and other nations to identify the most effective strategies and methods to reduce GHGs, manage GHG control programs, and to facilitate the development of integrated and cost-effective regional, national, and international GHG reduction programs. California undertook a two-pronged approach: first, we assessed our State-specific circumstances to develop measures that would apply specifically in California; and second, we simultaneously assessed which measures might lend themselves, through careful design and collaboration with other interested jurisdictions, toward linked GHG reduction programs. Under the Clean Air Act, California has a special role as an innovator and leader in the area of motor vehicle emission regulations, which allows our State to adopt motor vehicle emission standards that are stricter than federal requirements. These motor vehicle standards have been emulated around the country and the world, leading to widespread health benefits. Similarly, by enacting a comprehensive strategy that can be exported nationally and internationally, California can lead the world in tackling climate change.

Today, the State's Cap-and-Trade Program is linked with Québec's program; ongoing discussions to link with Ontario's emerging emissions trading system are underway.

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[34] Under 2 MOU website: under2mou.org/

[35] One of the Brown Administration's priorities is to highlight California's climate leadership on the subnational level, and to ensure that subnational activity is recognized at the international level. In the year preceding the Paris negotiations, the Governor's Office recruited subnational jurisdictions to sign onto the Memorandum of Understanding on Subnational Global Climate Leadership (Under 2 MOU), which brings together states and regions willing to commit to reducing their GHG emissions by 80 to 95 percent, or to limit emissions to 2 metric tons CO_2-equivalent per capita, by 2050. The governor led a California delegation to the Paris negotiations to highlight our successful climate programs and to champion subnational action and international cooperation on meeting the challenge of reducing GHG emissions. By the end of 2016, nearly 170 jurisdictions representing more than 1 billion people and more than one-third of the global economy had joined California in the Under 2 MOU.

[36] Governors' Climate and Forests Task Force website: www.gcftaskforce.org/

[37] Western Climate Initiative website: www.wci-inc.org/

Low carbon fuel mandates similar to California's LCFS have been adopted by the United States Environmental Protection Agency (U.S. EPA) and by other jurisdictions including Oregon, British Columbia, the European Union, and the United Kingdom. Over two-dozen states have a renewables portfolio standard. California is a member of the Pacific Coast Collaborative with Alaska, British Columbia, Oregon, and Washington, who collaborate on issues such as energy and sustainable resource management, among others.[38] California continues to discuss carbon pricing through a cap-and-trade program with international delegations. We have seen design features of the State's Cap-and-Trade Program incorporated into other emerging and existing programs, such as the European Union Emissions Trading System and China's emerging national trading program.

Recognizing the need to address the substantial GHG emissions caused by the deforestation and degradation of tropical forests, California worked with a group of subnational governments to form the Governors' Climate and Forests Task Force (GCF) in 2008.[39] The GCF is currently comprised of 35 different subnational jurisdictions—including states and provinces in Brazil, Colombia, Indonesia, Ivory Coast, Mexico, Nigeria, Peru, Spain, and the United States—that are contemplating or enacting programs for low-emissions rural development and reduced emissions from deforestation and land use. GCF members continue to engage in discussions to share information and experiences about the design of such programs and how the programs could potentially interact with carbon markets. Ongoing engagement between California and its GCF partners, as well as ongoing discussions with other stakeholders, continues to provide lessons on how such programs could fit within California's Cap-and-Trade Program.[40]

Further, California's High-Speed Rail is part of the International Union of Railways (UIC), and California has signed the Railway Climate Responsibility Pledge, which was commended by the Secretary of the UNFCCC as part of achieving the global 2050 targets. This initiative is to demonstrate that rail transport is part of the solution for sustainable and carbon free mobility.

California will continue to engage in multi-lateral forums that help develop the policy foundation and technical infrastructure for GHG regulations in multiple jurisdictions. Recognizing that many efforts around the world were underway to use market forces to motivate GHG emission reductions, California worked with other governments to establish the International Carbon Action Partnership (ICAP) in 2007. The ICAP

[38] Pacific Coast Collaborative website: pacificcoastcollaborative.org/
[39] Governors' Climate and Forests Task Force Website: www.gcftaskforce.org/
[40] ARB staff identified the jurisdictional program in Acre, Brazil, as a program that is ready to be considered for linkage with California, and has committed to proposing regulatory standards for assessing tropical forestry programs and to proposing a linkage with the program in Acre as part of a future rulemaking process. From October 2015 to April 2016, ARB held public workshops that addressed the potential of approving the use of sector-based offset credits from the tropical forestry sector within the Cap-and-Trade Program. ARB will conduct additional stakeholder engagement before proposing any regulatory amendments. Furthermore, reducing emissions from tropical deforestation is a key topic within the United Nations Framework Convention on Climate Change (UNFCCC) and between national and subnational jurisdictions, including through collaboration between California and the U.S. Department of State. Continued evaluation of the tropical forestry sector and other sector-based offset programs further demonstrates California's ongoing climate leadership and could result in partnering on other mutually beneficial climate and low emissions development initiatives, including measures to encourage sustainable supply chain efforts by public and private entities.

provides a forum for sharing experiences and knowledge among jurisdictions that have already implemented or are actively pursuing market-based GHG programs.[41] California has also participated in meetings of the Partnership for Market Readiness (PMR), a multilateral World Bank initiative that brings together more than 30 developed and developing countries to share experiences and build capacity for climate change mitigation efforts, particularly those implemented using market instruments.[42] In November 2014, CARB became a Technical Partner of the PMR, and CARB staff members have provided technical information on the design and implementation of the Cap-and-Trade Program at several PMR meetings.

Many foreign jurisdictions seek out California's expertise because of our history of success in addressing air pollution and climate change. California also benefits from these interactions. Expanding global action to fight air pollution and climate change expands markets for clean technology. This can bolster business for companies in California developing clean energy products and services and help to bring down the cost of those products globally and in California. Additionally, innovative policies and lessons learned in our partners' jurisdictions can help inform future climate policies in California.

Governor Brown's focus on subnational collaborations on climate change and air quality has strengthened and deepened California's existing international relationships and forged new ones. These relationships are a critical component of reducing emissions of GHGs and other pollutants worldwide. As we move forward, CARB and other State agencies will continue to communicate and collaborate with international partners to find the most cost-effective ways to improve air quality and fight climate change, and to share California's experience and expertise in reducing air pollution and GHGs while growing a strong economy.

[41] International Carbon Action Partnership website: icapcarbonaction.com/
[42] Partnership for Market Readiness website: www.thepmr.org/

II. The Proposed Scenario

This chapter examines the Proposed Scoping Plan Scenario along with four alternative scenarios in terms of the most important criteria and priorities the State's comprehensive climate action must deliver. All the scenarios are set against what is called the business-as-usual (BAU) yardstick—that is, what would the GHG emissions look like if we did nothing at all beyond the existing policies that are required and already in place to achieve the 2020 limit. It includes the existing renewables requirements, advanced clean cars, the "10 percent" Low Carbon Fuel Standard, and the SB 375 program for more vibrant communities, among others. However, it does not include a range of new policies or measures that have been developed or put into statute over the past two years.

The Reference scenario (BAU) shows continuing but modest reductions followed by a later rise of GHG emissions as the economy and population grow. The comprehensive analysis of all five alternatives indicates that the Proposed Scenario—continuing the Cap-and-Trade Program with additional reductions from the refinery sector—is the clear choice to achieve the State's climate and clean air goals. It also protects public health, provides a solid foundation for continued economic growth, and supports California's quality of life.

All of the alternative scenarios outlined in this chapter are the product of a process of development informed by public input and Board and legislative direction over the course of a year and a half. They also all include a range of additional measures developed or required over the past two years with 2030 as their target date and include: extending the LCFS to 18 percent reduction beyond 2020, the requirements of SB 350 to increase renewables to 50 percent, and doubling energy efficiency savings. They also all include the Mobile Source Strategy with its targets for more zero emission vehicles and much cleaner trucks and transit, the Sustainable Freight Action Plan to improve freight efficiency and transition to zero emission freight handling technologies, and the requirements under SB 1383 to slash black carbon 50 percent, and hydrofluorocarbon and methane emissions by 40 percent.

At this time, work is still underway on how to quantify the GHG emissions within the natural and working lands sector. As such, the analyses in this chapter do not include any estimates from this sector. Additional information on the current efforts to better understand emissions fluxes and model the actions needed to support the goal of net carbon sequestration in natural and working lands can be found in Chapter lV. Even absent any quantification data, the large potential role for this sector in achieving the State's climate goals should be considered in conjunction with any efforts to reduce GHG emissions in the energy and industrial sectors.

The alternatives CARB evaluated have evolved over time. The original 2016 Concept Paper[43] included the following scenarios: cap-and-trade, carbon tax, direct regulations for all industry, and direct regulations for mobile GHG sources. Initial analysis indicated

[43] ARB. State of California. 2016. 2030 Target Scoping Plan Update Concept Paper. June 17, 2016. https://www.arb.ca.gov/cc/scopingplan/document/2030_sp_concept_paper2016.pdf

that neither of the latter two scenarios that focused on just prescriptive regulations in the mobile or stationary source sectors could deliver the reductions needed to reach the 2030 target. This led to a three-scenario approach in the December 2016 Discussion Draft[44]: cap-and-trade, a carbon tax, and only prescriptive regulations (on both industry and mobile sources).

As a result of Board direction and public input, including that from the EJAC, the number of alternative scenarios was increased to include the following:

> **Proposed Scenario**: Continuing the Cap-and-Trade Program combined with an additional 20 percent reduction of greenhouse gases in the refinery sector.
>
> **Alternative 1**: Direct regulations on a wide variety of sectors, such as specific required reductions for all large GHG sources, more renewables, etc.
>
> **Alternative 2**: A carbon tax to put a price on carbon, instead of the Cap-and-Trade Program.
>
> **Alternative 3**: All Cap-and-Trade. This would remove the refinery measure and keep the LCFS at 10 percent.
>
> **Alternative 4**: Cap-and-Tax. This would place a declining cap on industry, and natural gas and fuel suppliers, while also requiring them to pay a tax on each ton of GHG emitted.

Since the statutory direction on GHG reductions is definitive, the issue of certainty of reductions is paramount, and alternatives vary greatly as to the certainty of meeting the target. The year-over-year reductions under a Cap-and Trade Program, for instance, provide certain and measurable reductions over time; a carbon tax, while putting a price on carbon to be sure, may not be enough to drive reductions by altering behavior.

Then there are other considerations: to what extent does an alternative meet the target, but also deliver clean air benefits, prioritize reductions at large stationary sources, and allow for continued investment in disadvantaged communities? Does an alternative allow for California to link with other jurisdictions, and support the Clean Power Plan and other federal climate programs? Does an alternative provide for flexibility for regulated entities, and a cost-effective approach to reduce greenhouse gases?

On balance it is clear that the Proposed Scoping Plan Scenario is the only alternative to meet all the criteria.

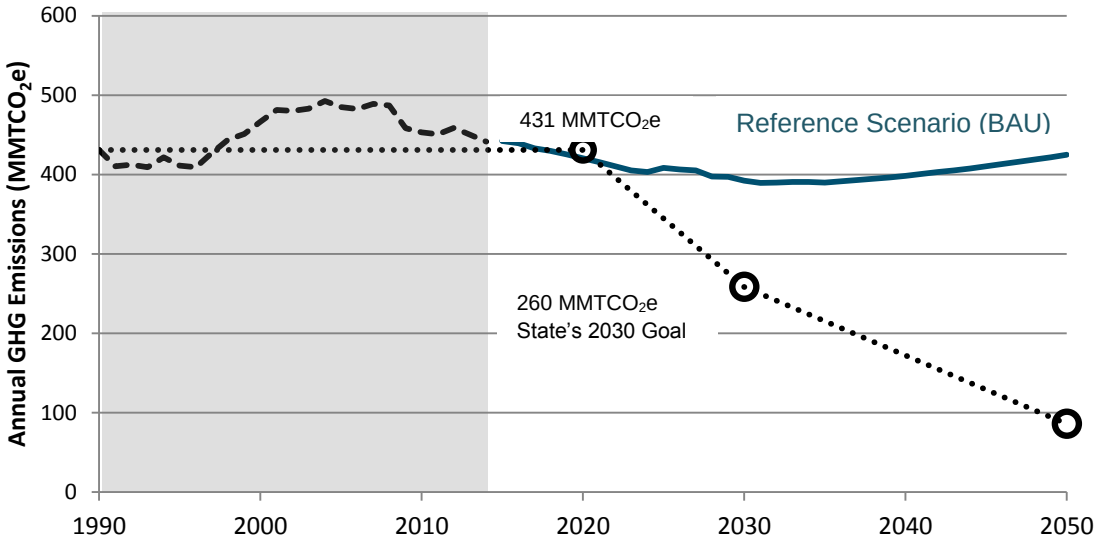
A. Proposed Scoping Plan Scenario

The development of the Proposed Plan began by first modeling a Reference scenario (the BAU). The Reference scenario is the forecasted statewide GHG emissions through 2030 with existing policies and programs, but without any further action to reduce GHGs. Figure ll-1 provides the modeling results for a Reference scenario for this

[44] ARB. 2016. Discussion Draft 2030 Target Scoping Plan Update. December 2, 2016. https://www.arb.ca.gov/cc/scopingplan/meetings/meetings.htm

Proposed Plan. The graph shows the State is expected to reduce emissions below the 2020 statewide GHG target, but additional effort will be needed to maintain and continue GHG reductions to meet the mid- (2030) and long-term (2050) targets. More details about the modeling for the Reference scenario can be found in Appendix D.

Figure ll-1. 2030 Target Scoping Plan Reference Scenario



The Proposed Plan is summarized in Table II-1. As shown in the table, most of the measures are identified as "known commitments" (marked with "*"), meaning that they are already underway or required. The known commitments are not part of the Reference scenario in Figure ll-1. The two primary newly proposed measures are: (1) a 20 percent reduction by 2030 in GHG emissions in the refinery sector from 2014 levels, and (2) a post-2020 Cap-and-Trade Program.

Table II-1. Proposed Scoping Plan Scenario

Policy	Primary Objective	Highlights	Implementation Time Frame
SB 350[45]*	Reduce GHG emissions in the electricity sector through the implementation of GHG emission reduction planning targets in the Integrated Resource Plan (IRP) process.	• Load-serving entities file plans to achieve GHG emission reduction planning targets while ensuring reliability and meeting the State's other policy goals cost-effectively. • 50 percent RPS. • Doubling of energy efficiency savings in natural gas and electricity end uses statewide.	2030
Low Carbon Fuel Standard (LCFS)*	Transition to cleaner/less-polluting fuels that have a lower carbon footprint.	• At least 18 percent reduction in carbon intensity, as included in the Mobile Source Strategy.	2030
Mobile Source Strategy (Cleaner Technology and Fuels [CTF] Scenario)[46]*	Help the State achieve its health-based air quality standards and climate goals.	• 1.5 million zero emission and plug-in hybrid light-duty electric vehicles by 2025 (4.2 million ZEVs by 2030). • Medium and Heavy-Duty GHG Phase 2. • Advanced Clean Transit: 20 percent of new urban buses purchased beginning in 2018 will be zero emission buses, ramping up to 100 percent of new sales in 2030. Also, new natural gas buses, starting in 2018, and diesel buses, starting in 2020, meet the optional heavy-duty low-NOx standard. • Last Mile Delivery: Requirement to purchase low-NOx engines if available, and phase-in of zero emission trucks for Class 3–7 last mile	Various

[45] SB 350 Clean Energy and Pollution Reduction Act of 2015 (De León, Chapter 547, Statutes of 2015). leginfo.legislature.ca.gov/faces/billNavClient.xhtml?billid=201520160SB350 This policy also includes increased demand response and PV.
[46] ARB. 2016. 2016 Mobile Source Strategy. www.arb.ca.gov/Draft Planning/sip/2016sip/2016mobsrc.htm

Policy	Primary Objective	Highlights	Implementation Time Frame
		delivery trucks starting in 2020. ZEVs comprise 2.5 percent of new Class 3–7 truck sales in local fleets starting in 2020, increasing to 10 percent in 2025 and remaining flat through 2030. • Reduction in vehicle miles traveled (VMT), to be achieved in part by continued implementation of SB 375 and regional Sustainable Community Strategies; forthcoming statewide implementation of SB 743; and additional VMT reduction strategies not specified in the Mobile Source Strategy, but included in the document "Potential VMT Reduction Strategies for Discussion" in Appendix C.[47]	
SB 1383*	Approve and Implement Short-Lived Climate Plan[48] to reduce highly potent GHGs	• 40 percent reduction in methane and hydrofluorocarbon (HFC) emissions. • 50 percent reduction in black carbon emissions.	2030
California Sustainable Freight Action Plan[49]*	Improve freight efficiency, transition to zero emission technologies, and increase competitiveness of California's freight system.	• Improve freight system efficiency by 25 percent by 2030. • Deploy over 100,000 freight vehicles and equipment capable of zero emission operation and maximize near-zero emission freight vehicles and equipment powered by renewable energy by 2030.	2030
20% Refinery Sector	Reduce GHGs	• Direct regulations would be promulgated to	2030

[47] ARB. Potential State-Level Strategies to Advance Sustainable, Equitable Communities and Reduce Vehicle Miles of Travel (VMT)--for Discussion. www.arb.ca.gov/cc/scopingplan/meetings/091316/Potential%20VMT%20Measures%20For%20Discussion_9.13.16.pdf
[48] ARB. 2016. Reducing Short-Lived Climate Pollutants in California. www.arb.ca.gov/cc/shortlived/shortlived.htm
[49] State of California. California Sustainable Freight Action Plan website. www.casustainablefreight.org/

Policy	Primary Objective	Highlights	Implementation Time Frame
Measure	emissions by 20 percent in the sector.	improve efficiencies across the sector. • Best available retrofit control technology (BARCT) may be used to identify and implement actions that reduce traditional air pollutants with co-benefits of reducing GHGs.	
Post-2020 Cap-and-Trade Program	Reduce GHGs across largest GHG emissions sources	• Continue the existing Cap-and-Trade Program with declining caps to ensure the State's 2030 target is achieved.	
***These measures and policies are referred to as "known commitments."**			

Table ll-2 summarizes the results of the modeling for the Reference scenario and known commitments. Per SB 32, the 2030 limit is 260 $MMTCO_2e$. That is a limit in a specific year. At approximately 392 $MMTCO_2e$, the Reference scenario is expected to exceed the 2030 limit by about 132 $MMTCO_2e$.

Table II-2 also shows that there is a cumulative gap in required emission reductions of 680 $MMTCO_2e$ between 2021 and 2030 to achieve the 2030 limit. While there is no statutory cumulative limit, the analysis considers and presents some results in cumulative form for several reasons. It is important to note that policies and measures may perform differently over time. For example, in early years, a policy or measure may be slow to be deployed, but over time it has greater impact. If you were to look at its performance in 2021 versus 2030, you would see that it may not seem important and may not deliver significant reductions in the early years, but is critical for later years as it results in greater reductions over time. A cumulative construct provides a more complete way to evaluate the effectiveness of any measure over time, instead of just considering a snapshot for a single year.

Table ll-2. 2030 Modeling GHG Results for the Reference Scenario and Known Commitments

Modeling Scenario	2030 GHG Emissions ($MMTCO_2e$)	Cumulative GHG Reductions 2021–2030 ($MMTCO_2e$)	Cumulative Gap to 2030 Target ($MMTCO_2e$)
Reference Scenario (Business-as-Usual)	392.4	n/a	680
Known Commitments	310	459	221

Also shown in the table, the known commitments are expected to result in emissions that are 50 $MMTCO_2e$ above the target in 2030, and have a cumulative emissions reduction gap of about 221 $MMTCO_2e$. Consequently, for the Proposed Plan, the Post-2020 Cap-and-Trade Program and refinery measure would need to deliver 221 $MMTCO_2e$ cumulative GHG emissions reductions from 2021 through 2030. The refinery measure is estimated to account for about 30 $MMTCO_2e$ cumulatively from 2021 to 2030. Onsite action to improve combustion efficiency or process lighter crude would also provide air quality co-benefits. If the estimated GHG reductions from the known commitments and the refinery measure are not realized due to delays in implementation or technology deployment, the post-2020 Cap-and-Trade Program would deliver the additional GHG reductions to ensure the 2030 target is achieved. Figure ll-2 illustrates the cumulative emission reduction contributions of the known commitments, the refinery measure, and the Cap-and-Trade Program from 2021 to 2030.

20 Percent Reduction in GHGs at Refineries

The refinery sector was chosen for direct regulation because it includes some of the largest stationary sources of GHG emissions and is part of the largest economic sector of GHG emissions—transportation. Further, this refinery measure prioritizes direct GHG reductions at large stationary sources pursuant to AB 197. Studies have shown that many of the largest sources of emissions are in disadvantaged communities, and in addition to reducing GHG emissions it may provide co-benefits of reducing criteria pollutants and toxic air contaminants in some of the most polluted and disadvantaged communities in the State.

The proposed new regulation to achieve a 20 percent GHG reduction in the refinery sector would require all refineries, by 2030, to achieve the benchmark of the most efficient existing refinery on a simple barrel basis. An efficiency benchmark is reflected as GHG emissions per unit of product. This regulation would not limit mass GHG emissions, but would require facilities to become more efficient through any combination of actions such as fuel switching; boiler electrification; onsite investments in newer, more energy efficient technologies; use of lighter crude slates; and any other process efficiencies that would be identified in consultation with local air districts and CARB. As part of the development process for this measure, other metrics such as complexity-weighted barrel may also be evaluated.

The potential effectiveness of this measure was determined by reviewing the benchmarking data provided by the refineries when the Cap-and-Trade Regulation was being developed. From those data, CARB staff was able to identify the most efficient refinery in the State. Staff then assumed that all refineries could achieve this same efficiency and calculated the resulting emissions using individual refinery production data for 2014. A comparison between the actual reported emissions for 2014 and the emissions calculated by assuming all refineries were as efficient as the most efficient refinery allowed staff to compare the difference between the two values and estimate the GHG difference. While not all refineries are designed the same way and each would be starting from a different efficiency level, this measure assumes some refineries may be able to do more than others to reduce their GHG emissions. Therefore, the actual measure would need to accommodate unique circumstances at individual facilities in this sector.

It would take time to develop and implement regulations for this measure. There would likely need to be several different regulatory paths based on facility type. The final control effectiveness could be different, pending a rulemaking effort that gathers more detail about specific opportunities for reductions that would also need to account for potential increased production activity, especially for biofuels.

One initial implementation step for this measure could be for the State to partner with California's local air districts, which traditionally permit these facilities for criteria pollutants and toxic air contaminants. Together, the State and local air districts could identify efficiency improvement opportunities for stationary source combustion equipment. This strategy would be prioritized for all refinery facilities subject to the

Energy Efficiency Audit[50] in the areas where Best Available Retrofit Control Technology (BARCT) requirements are applicable.[51] BARCT measures could be implemented through the existing air district BARCT/All Feasible Measures process and would be required to demonstrate reductions of criteria pollutants while accounting for GHG emissions effects. The BARCT determinations also promote consistency of controls for similar emission sources among districts with the same air quality attainment designations. The BARCT/All Feasible Measures process could be required to demonstrate reductions of criteria pollutants and GHGs. Examples of possible BARCT/All Feasible Measures combustion controls include:

- Energy efficiency standards for larger combustion equipment.
- Mandatory equipment replacement requirements.
- Installation of new and emerging technologies.
- Heat rate improvement projects.
- Installation of electronic controls.
- Installation of waste heat recovery systems.
- Optimization study and implementation.

Post-2020 Cap-and-Trade Program with Declining Caps

This measure would extend the existing Cap-and-Trade Program post-2020. The program is up and running and has a four-year-long record of auctions and successful compliance. In the face of a growing economy, dry winters, and the closing of a nuclear plant, it is delivering GHG reductions. This is not to say, by any means, that California should continue on this road simply because the Cap-and-Trade Program is already in place. Far from it, the analyses in this chapter, and the economic analysis in Chapter III, clearly demonstrate that the most secure, reliable, and feasible clean energy future for California—one that will continue to provide crucial investments to improve the quality of life and the environment in disadvantaged communities— partially lies in extending the Cap-and-Trade Program through to 2030.

Under this measure, funds would also continue to be deposited into the Greenhouse Gas Reduction Fund (GGRF) to support projects that fulfill the goals of AB 32. Investment of the Cap-and-Trade Program proceeds furthers the goals of AB 32 by reducing GHG emissions, providing net GHG sequestration, providing co-benefits, investing in disadvantaged communities and low-income communities, and supporting the long-term, transformative efforts needed to improve public and environmental health and develop a clean energy economy. These investments support programs and projects that deliver major economic, environmental, and public health benefits for Californians, including meaningful benefits to the most disadvantaged communities. Investments are providing a multitude of benefits to disadvantaged communities including increased affordable housing opportunities, reduced transit and transportation

[50] ARB. 2015. Energy Efficiency and Co-Benefits Assessment for Large Industrial Sources - Regulatory Activities. www.arb.ca.gov/cc/energyaudits/energyaudits.htm

[51] Bay Area, El Dorado (partial), Monterey Bay, Placer (partial), Sacramento, San Diego, San Joaquin Valley, South Coast, Ventura, and Yolo-Solano.

costs, access to cleaner vehicles, improved mobility options and air quality, job creation, energy and water savings, and greener and more vibrant communities.

Further, the Cap-and-Trade Program is designed to protect electricity and natural gas residential ratepayers from higher energy prices. The program includes a mechanism for electricity and natural gas utilities to auction their freely allocated allowances, with the auction proceeds being returned to residential ratepayers as a Climate Credit. The Climate Credit is a twice-annual bill credit given to all investor-owned utility and natural gas utility residential customers. The total value of the Climate Credit for just vintage 2013 auction allowances was over $400 million. The first of these credits appeared on customer bills in April 2014.[52]

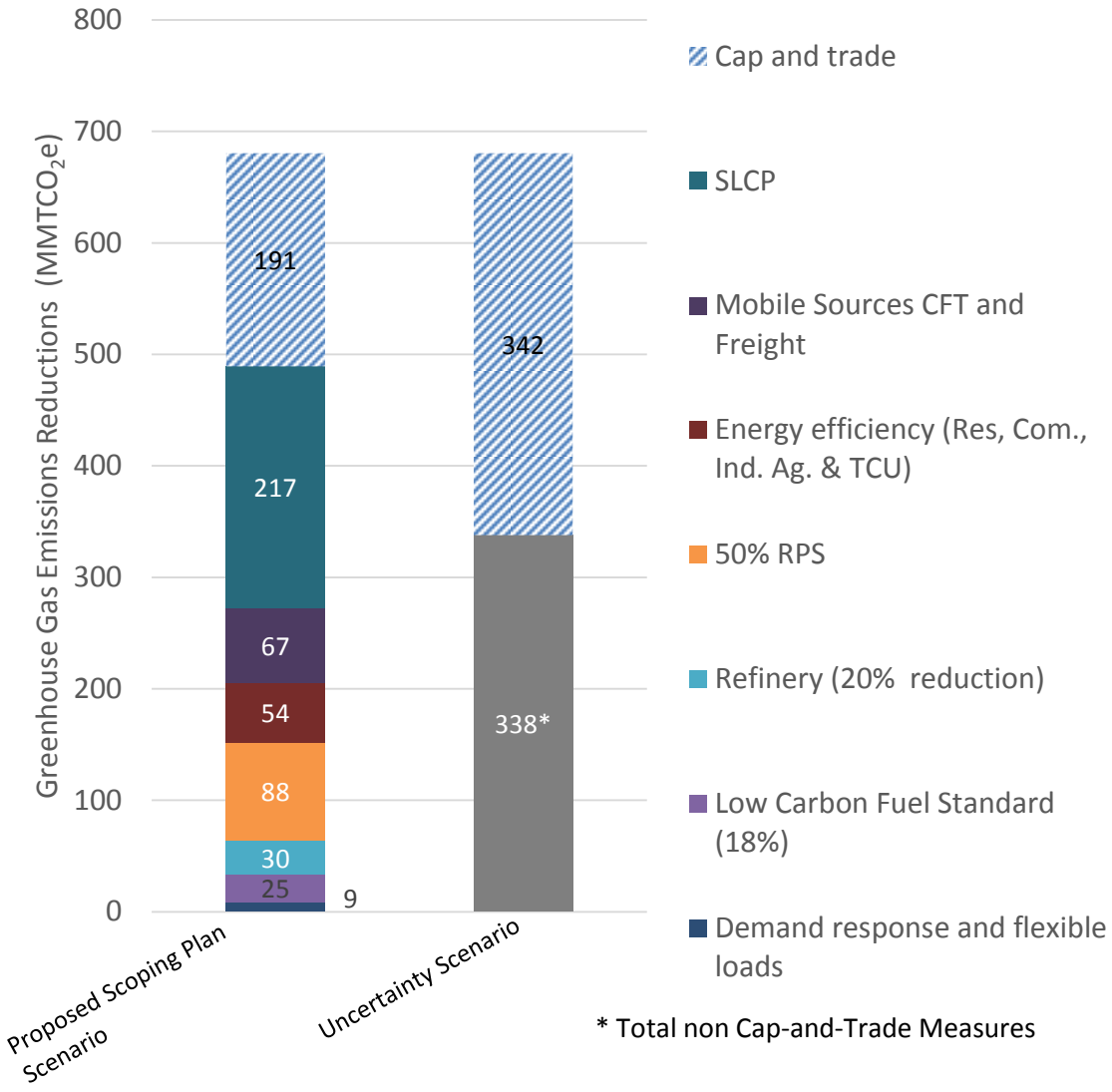
Under this measure, the State would preserve its current linkages and supports future linkages with other jurisdictions, thus facilitating international action to address climate change. The high compliance rates with the Cap-and-Trade Program also demonstrate that the infrastructure and implementation features of the program are effective and understood by the regulated community. This measure also lends itself to integration with the Clean Power Plan requirements and is flexible to allow expansion to other sectors or regions.

While GHG reductions will occur at covered entities under the current design of the Cap-and-Trade Program, CARB has begun the process to evaluate potential changes to program design features that would support greater direct GHG emissions reductions at Cap-and-Trade Program covered entities. These potential program design changes would need to be further evaluated for economic impacts, coordinated with linked partners, and be part of a future rulemaking. The areas to be evaluated include, but are not limited to the following:

- Reducing the offset usage limit. Offset use is currently limited to 8 percent of each covered entity's compliance obligation.
- Redesigning the allocation strategy to reduce free allocation at a rate to support increased technology and energy investment at covered entities to reduce GHG emissions.
- Reducing allocation if the covered entity increases criteria or toxics emissions over some baseline.

[52] https://www.arb.ca.gov/cc/capandtrade/allowanceallocation/edu-v2013-allowance-value-report.pdf

Figure II-2. Proposed Scoping Plan Scenario – Estimated Cumulative GHG Reductions by Measure (2021–2030)



The Proposed Scoping Plan Scenario represents an expected case where current and proposed GHG reduction policies and measures begin as expected and perform as expected, and technology is readily available and deployed on schedule. The GHG reductions with the Uncertainty Scenario represent uncertainty surrounding measure performance. This uncertainty was modeled by assumptions around the ability of the measure to achieve its full estimated potential GHG reductions as provided in the modeled scenario. Measures set in statute, like the 50 percent RPS, are more certain to achieve anticipated, or very close to anticipated, results. Other measures for which no policy mechanism has yet been designed, such as the 20 percent reduction in refinery emissions, may result in more, or fewer, reductions than anticipated, depending on how such a regulation is ultimately designed. Emissions ranges were created for

each measure based on the CARB staff's assessment of reduction uncertainty and stakeholder input.

The uncertainty analysis is conservative in that it assumes measures may achieve fewer reductions, but not greater reductions. The two bars in Figure II-2 represent a range of potential cumulative reductions between 2021 and 2030. An important strength of the Cap-and-Trade Program is that it scales up or down within the overall strategy depending on how the other measures perform. In the Proposed Scoping Plan Scenario, the Cap-and-Trade Program would need to deliver approximately 191 $MMTCO_2e$ net savings of the 680 $MMTCO_2e$, which would account for about 28 percent of the total reductions between 2021 and 2030. In the Uncertainty Scenario, California still meets its target, even though the direct measures do not meet their predicted effectiveness, because the Cap-and-Trade Program makes up the difference.

Another way to look at this scenario is to understand the trajectory of GHG reductions over time, relative to the 2030 target. Figure ll-3 provides the trajectory of GHG emissions modeled for the proposed strategy.

Figure ll-3. Proposed Scoping Plan Scenario GHG Reductions

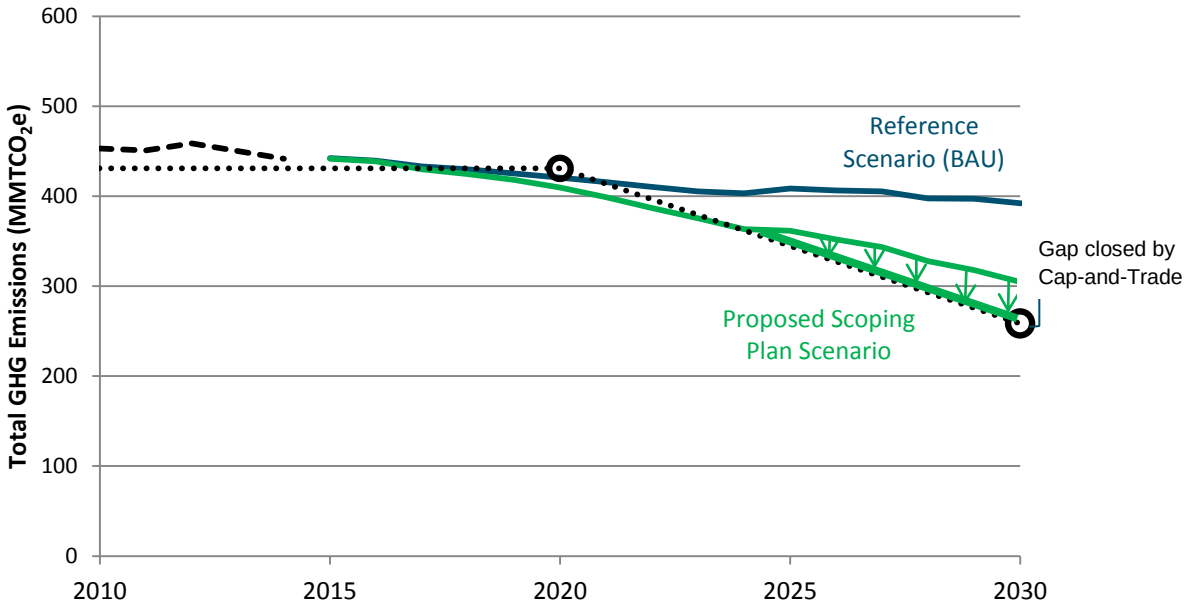


Figure II-3 shows the Reference scenario (blue) and the version of the Proposed Scoping Plan Scenario that excludes the Cap-and-Trade Program (green). Between the periods of 2020 and about 2025, the measures in the Proposed Scoping Plan Scenario constrain GHG emissions below the dotted straight line. After 2025, GHG emissions continue to fall, but at a slower rate than needed to meet the 2030 target. It is the Cap-and-Trade Program that will constrain the emissions to the necessary levels

to achieve the 2030 target. In this scenario, it is estimated that the known commitments and the refinery measure will result in an emissions level of about 305 $MMTCO_2e$ in 2030. Thus, for the proposed scenario, the Cap-and-Trade Program would deliver about 45 $MMTCO_2e$ in 2030 and ensure the 2030 target is achieved.

To understand how the Proposed Plan affects the main economic sectors, Table ll-3 provides estimated GHG emissions by sector, compared to 1990 levels, and the range of GHG emissions for each sector estimated for 2030. This comparison helps to illustrate which sectors are reducing emissions more than others and where to focus additional actions to reduce GHGs across the entire economy.

Table ll-3. Estimated Change in GHG Emissions by Sector

Estimated GHGs by Sector [$MMTCO_2e$]			
	1990	2030 Proposed Plan Ranges	% change from 1990
Agriculture	26	24–25	-4 to -8
Residential and Commercial	44	38–40	-9 to -14
Electric Power	108	42–62	-43 to -61
High GWP	3	8–11	167 to 267
Industrial	98	77–87	-11 to -21
Recycling and Waste	7	8–9	14 to 29
Transportation (Including TCU)	152	103–111	-27 to -32
Net Sink*	-7	TBD	TBD
Sub Total	**431**	**300–345**	**-20 to -30**
Cap-and-Trade Program	n/a	40–85	n/a
Total	**431**	**260**	**-40**

***Work is underway through 2017 to estimate the range of potential sequestration benefits from the natural and working lands sector.

The sector ranges may change in response to how the sectors respond to the Cap-and-Trade Program. While the known commitments will deliver some reductions in each sector, the Cap-and-Trade Program will deliver additional reductions in the sectors it covers. Annual GHG reporting and the GHG inventory will track annual changes in emissions, and those will provide ongoing assessments of how each sector is reducing emissions due to the full complement of known commitments, refinery measure, and the Cap-and-Trade Program, as applicable.

B. Scenario Modeling

There are a variety of models that can be used to model GHG emissions. For this plan, the State is using the PATHWAYS model.[53] PATHWAYS is structured to model GHG emissions while recognizing the integrated nature of the industrial economic and energy sectors. For example, if the transportation sector adds more electric vehicles, PATHWAYS responds to reflect an energy demand increase in the electricity sector. However, PATHWAYS does not reflect any change in transportation infrastructure and land use demand associated with additional ZEVs on the road. The ability to capture a subset of interactive effects of policies and measures helps to provide a representation of the interconnected nature of the system and impacts to GHGs.

At this time, PATHWAYS does not include a module for natural and working lands. As such, PATHWAYS cannot be used to model the natural and working lands sector, the interactive effects of polices aimed at the economic and energy sectors and their effect on land use or conditions, or the interactive effects of polices aimed at the natural environment and their impact on the economic and energy sectors. For this plan, external inputs had to be developed for PATHWAYS to supply biofuel volumes. The natural and working lands sector is also being modeled separately as described in Chapter lV, Section D. CARB and other State agencies will work to integrate all the sectors into one model to fully capture interactive effects across both the natural and built environments before the next Scoping Plan update.

Lastly, the PATHWAYS assumptions and results in this plan show the significant action that the State must take to reach its GHG reduction goals. It is important to note that the modeling assumptions may differ from other models used by other State agencies. Modeling exercises undertaken in future regulatory proceedings may result in different measures, programs, and program results than those used in the modeling for this Scoping Plan. State agencies will engage on their specific policies and measure development processes separately from CARB Scoping Plan activities, in public forums to engage all stakeholders.

Uncertainty

Several types of uncertainty are important to understand in both forecasting future emissions and estimating the benefits of emission reduction packages. In developing the Proposed Plan, we have forecast a Reference scenario and estimated the GHG emissions outcome of the Proposed Plan using PATHWAYS. Inherent in the Reference scenario modeling is the expectation that many of the existing programs will continue in their current form, and the expected drivers for GHG emissions such as energy demand, population growth, and economic growth will match our current projections. However, it is unlikely that the future will precisely match our projections, leading to uncertainty in the forecast. Thus, the single “reference” line should be understood to represent one possible future in a range of possible predictions. For the Proposed Scoping Plan Scenario, PATHWAYS utilized inputs that are assumptions external to the model. PATHWAYS was provided plausible inputs such as energy demand over time,

[53] ARB. 2016. AB 32 Scoping Plan Public Workshops. www.arb.ca.gov/cc/scopingplan/meetings/meetings.htm

the start years for specific policies, and the penetration rates of associated technologies. Each of the assumptions provided to PATHWAYS has some uncertainty, which is also reflected in the results. Thus, while the results presented in the Proposed Plan may seem precise due to the need for precision in model inputs, these results are estimates, and the use of ranges in some of the results is meant to capture that uncertainty.

Further, as noted in the November 7, 2016, 2030 Target Scoping Plan Workshop, "All policies have a degree of uncertainty associated with them."[54] As this Proposed Plan is meant to chart a path to achieving the 2030 target, additional work will be required to fully design and implement any policies identified in this plan. During the subsequent development of policies, CARB and other State agencies will learn more about technologies, cost, and how each industry works as a more comprehensive evaluation is conducted in coordination with stakeholders. Thus, the actual reductions may be different than what is estimated as part of this plan's modeling. Given the uncertainty around assumptions used in modeling, and performance uncertainty as specific policies are fully designed and implemented, estimates associated with the Proposed Scoping Plan Scenario are certain to be different than what is actually implemented. One way to mitigate for this risk is to develop policies that can adapt and increase certainty in GHG emissions reductions. Periodic reviews of progress toward achieving the 2030 target and performance of specific policies also provide opportunities for the State to consider any changes to ensure we remain on course to achieve the 2030 target. The need for this periodic review process was anticipated in AB 32, as it calls for updates to the Scoping Plan at least once every five years.

C. Policy Analysis of Proposed Scoping Plan Scenario

The following are key criteria that were considered while evaluating potential policies beyond the known commitments. Also, the results of the economic analysis (presented in Chapter III) were important in the design of the plan.

- **Ensure the State achieves the 2030 target.** The strategy must ensure that GHG emissions reductions occur and are sufficient to achieve the 2030 target.
- **Provide air quality co-benefits.** An important concern for environmental justice communities is for any Proposed Plan to achieve air quality co-benefits.
- **Prioritize Rules and Regulations for Direct GHG Reductions.** Requires CARB in developing this Scoping Plan to prioritize emission reduction rules and regulations that result in direct emission reductions at large stationary sources of GHG emissions sources and direct emission reductions from mobile sources.
- **Provide potential to protect against emissions leakage.** Require any policies to achieve the statewide limits to minimize emissions leakage to the extent possible. Emissions leakage can occur when production moves out-of-state, so there appears to be a reduction in California's emissions, but the production and

[54] Bushnell, James. Economic Modeling and Environmental Policy Choice. PowerPoint. Department of Economics, University of California, Davis. https://www.arb.ca.gov/cc/scopingplan/meetings/110716/bushnellpresentation.pdf

emissions have just moved elsewhere. This loss in production may be associated with loss in jobs and decreases in the State's gross domestic product (GDP) and could potentially increase global GHG emissions if the production moves to a less efficient facility outside of California.

- **Develop greenhouse gas reduction programs that can be readily exported to other jurisdictions.** Currently, California's Cap-and-Trade Program is linked with Québec's program and is proposing to link with Ontario's cap-and-trade program. At the same time, California's ambitious policies such as the RPS and LCFS have resulted in other regions adopting similar programs.
- **Invest in disadvantaged and low-Income communities, and low-income households.** Currently, Cap-and-Trade auction proceeds from the sale of State-owned allowances are appropriated for a variety of programs to reduce GHGs, which lead to job creation and economic development. A minimum of 35 percent of the proceeds are to be invested in projects to benefit disadvantaged communities, low-income communities, and low-income households. It is important to understand if the strategy will require or result in funding to support GHG reductions.
- **Avoid or minimize the impacts of climate change on public health by continuing reductions in GHGs.** Climate change has the potential to significantly impact public health, including increases in heat illness and death, air pollution-related exacerbation of cardiovascular and respiratory diseases, injury and loss of life due to severe storms and flooding, increased vector-borne and water-borne diseases, and stress and mental trauma due to extreme weather-related catastrophes.
- **Provide compliance flexibility.** Flexibility is important as it allows each regulated entity the ability to pursue its own path toward compliance in a way that works best for its business model. Flexibility also acknowledges that regulatory agencies may not have a complete picture of all available low-cost compliance mechanisms or opportunities even across the same sector. In addition, under AB 32 and AB 197, the strategy to reduce GHGs requires consideration of cost-effectiveness, which compliance flexibility provides.
- **Support the Clean Power Plan and other federal climate programs.** The Clean Power Plan is the most prominent federal climate regulation applicable to stationary sources, and California will continue to support aggressive federal action, as well as to defend existing programs like the Clean Power Plan. California power plants are expected to be within their limits as set forth by the State's draft compliance plan. However, the State still needs a mechanism to ensure the emissions for the covered electricity generating plants do not exceed the federal limits. This mechanism must be federally enforceable with regard to the affected power plants, and limit their emissions in accordance with the federal limit.

Table ll-4 provides an assessment of the Proposed Plan compared to the criteria provided above, while listing which specific policies and measures help to meet the criteria. This assessment is based on CARB staff evaluation as well as the analyses described in Chapter lll.

Table II-4. Policy Assessment of the Proposed Plan

Criteria	Details
Ability to Reduce GHGs to Meet the 2030 Target	• Incorporates existing and new commitments to reduce emissions from all sectors • The Cap-and-Trade Program scales to ensure reductions are achieved, even if other policies do not achieve them. This is particularly critical given the uncertainty inherent in both CARB's emission forecast and its estimate of future regulations.
Air Quality Co-Benefits	• Reduced fossil fuel use and increased electrification from policies such as the Mobile Source Strategy, Low Carbon Fuel Standard, Renewables Portfolio Standard, energy efficiency, land conservation, and refinery measure will likely reduce criteria pollutants and toxic air contaminants. • The Cap-and-Trade Program will ensure GHG emission reductions within California that may reduce criteria pollutants and toxic air contaminants.
Prioritize Rules and Regulations for Direct Emission Reductions	• Advanced Clean Cars regulations require reduction in the light-duty vehicle sector. • Low Carbon Fuel Standard requires reductions in light-duty and heavy-duty transportation. • SB 350, the Renewables Portfolio Standard, and energy efficiency will reduce the need for fossil power generation. • Refinery regulations require reductions in the industrial sector. • The Cap-and-Trade regulation constrains and reduces emissions across approximately 80 percent of California GHG emissions. • SB 1383 and the Short-lived Climate Pollutant Reduction Strategy require reductions in agricultural sector.
Potential to Protect Against Emissions Leakage	• Free allocation to minimize leakage, where supported by research.

Support the development of integrated and cost-effective regional, national, and international GHG reduction programs	• Supports existing and future linkages, allows for larger GHG emissions reductions worldwide through collaborative regional efforts. • Provides leadership on how to integrate short-lived climate pollutants into the broader climate mitigation program.
Funding	• Continue to fund programs for disadvantaged communities and local transit projects through the Greenhouse Gas Reduction Fund.
Public Health Benefit	• Reduces GHGs and provides leadership nationally and internationally for climate action. • Provides funding for programs such as home weatherization focused on disadvantaged communities, to mitigate potential cost impacts.
Compliance Flexibility and Cost-Effective	• Regulated sources self-identify and implement some GHG emissions reductions actions, beyond those already required to comply with additional prescriptive measures.
Support the Clean Power Plan and federal climate programs	• Post-2020 Cap-and-Trade Program can be used to comply with the Clean Power Plan.

D. Evaluation of Scoping Plan Alternatives

During the development of the Proposed Plan, stakeholders suggested alternative scenarios to achieve the 2030 target. While countless scenarios could potentially be developed and evaluated, the four below were considered, as they were most often included in comments by stakeholders and they bracket the range of potential scenarios. Several of these alternative scenarios were also evaluated in the Initial AB 32 Scoping Plan in 2008 (All Regulations, Carbon Tax).[55] Since the adoption of the Initial AB 32 Scoping Plan, some of the alternative scenarios have been implemented or contemplated by other jurisdictions, which has helped in the analysis and the development of this plan. This section provides a description and assessment of the alternatives against the policy criteria provided above. These assessments are based on CARB staff's evaluation and the analyses in Chapter lll.

1. Alternative 1: No Cap-and-Trade

Alternative 1 includes the known commitments described in Section A of this chapter plus a 30 percent reduction in GHG emissions in the refinery sector, but it does not include a post-2020 Cap-and-Trade Program. To achieve the 2030 target without the Cap-and-Trade Program, significant additional actions beyond the known commitments would have to be put in place to achieve the 2030 target, many of which may currently have implementation barriers. For example, the RPS target of 50 percent would need to be increased to 60 percent or greater, and incentive programs would need statutory authority.

The enhancements to the known commitments and new policies and measures are illustrative of the additional type of action that would be needed in this alternative in the absence of a Cap-and-Trade Program, but they are not necessarily the exact suite of policies or measures that would be selected in the absence of a Cap-and-Trade Program. It is important to note that many of the specific polices and measures included in the modeling for this scenario may have technology, cost, or statutory barriers that may prevent implementation from occurring at this time. The modeled scenario for this alternative provides an illustrative example of how a No Cap-and-Trade alternative could be structured. Additional details of the modeling for this alternative are included in Appendix D. The bullets below summarize additional actions needed beyond the proposed strategy without a cap-and-trade program:

- Enhanced RPS, energy efficiency, LCFS, and refinery measure.
- New GHG prescriptive regulations for industry requiring a 25 percent reduction in the sector by 2030.
- Enhanced GHG prescriptive regulations for refineries requiring a 30 percent reduction in the sector by 2030.
- A low-emission diesel standard.

[55] ARB. 2013. Initial AB 32 Climate Change Scoping Plan Document. https://www.arb.ca.gov/cc/scopingplan/document/scopingplandocument.htm

- Additional deployment of ZEVs.
- Incentive programs for early retirement of vehicles and heating, ventilation, and air conditioning systems.
- Increased VMT reductions.
- Increased electrification of the residential sector.
- Increased utilization of renewable natural gas.

Alternative 1 demonstrates the suite of specific measures and regulations that would need to be designed and implemented to achieve the 2030 target without the Cap-and-Trade Program, including establishing new incentive programs for early replacement of vehicles and other equipment. The modeling also assumes that all the policies and measures could be implemented and would perform as expected, which is highly uncertain. Many of the measures in this alternative face technology and cost barriers that must be overcome to ensure the reductions begin as soon as possible. If any measures are unable to be implemented or fail to perform, as needed, new measures would need to be identified, designed, and implemented. The time required to design and implement new measures could impede the State's ability to achieve its 2030 target. The modeling for the Proposed Scoping Plan Scenario already acknowledges some uncertainty for the known commitments; any enhancements called for in this alternative to these policies and measures would further increase the uncertainty of their ability to achieve the required GHG reductions. This alternative would require additional statutory authority and funding to implement the incentive programs. No funding would be generated for GGRF programs, including those in disadvantaged communities. While this alternative could also support air quality co-benefits and public health co-benefits, it has fewer options for mitigating emissions leakage, limited opportunities for linkages, and limited compliance flexibility. This alternative would not generate any funds for GGRF programs. Under Alternative 1, the State would also need to identify a new mechanism to demonstrate compliance with the Clean Power Plan.

2. **Alternative 2: Carbon Tax**

Alternative 2 includes the known commitments described in Section A of this chapter, the 20 percent reduction in GHG emissions at refineries, and a carbon tax in lieu of the post-2020 Cap-and-Trade Program.

A cap-and-trade program and a carbon tax are both carbon pricing mechanisms, but there are important differences. A cap-and-trade program sets an emission cap so that the maximum allowable GHG emission level is known and covered entities will have to reduce GHG emissions. With a carbon tax, there is no mechanism to limit the actual amount of GHG emissions either at a single source or in the aggregate, and a carbon tax requires entities to pay for all of their GHG emissions directly to the State. In other words, a cap-and-trade program provides environmental certainty while a carbon tax provides some carbon price certainty. There is no emissions limit with a carbon tax.

Alternative 2 only achieves the 2030 GHG target if we set the right price—a difficult task to do. A set carbon tax may not actually represent the actual cost of control for the

covered sectors. If we set the price too high, we have made the program unnecessarily expensive, and if we set the price too low, we will not achieve enough GHG reductions to meet the target. An approach to better ensure the GHG target is met is through a flexible tax that can be adjusted annually as part of the GHG emission inventory process. If the emission reductions are insufficient, the tax would be increased the following year to induce the needed GHG reductions. However, this approach is complex and is at odds with the carbon price certainty that many have advocated for as part of a carbon tax option.

This alternative would provide compliance flexibility, as it does not mandate specific actions, and it provides a funding source that could be used to fund GGRF programs or other programs. Moreover, this alternative could provide air-quality benefits, public health benefits, and direct emission reductions if the carbon tax is set appropriately to reduce GHGs. However, there is no obvious way to address trade exposure and to protect against emissions leakage as required under AB 32. One potential strategy to mitigate emissions leakage may be to exempt trade-exposed sectors from the carbon tax, but that would shift the burden to the sectors still subject to the tax and would pick "winners" across sectors as some industries may face a carbon cost and others may not. Any such exemptions would need to consider the role any exempt sector is expected to play in the long run, as supporting high carbon intensive or fossil fuel industry may not align well with the State's long-term climate goals. Alternative 2 would also forgo any existing and future linkages along the lines of those that exist with the current Cap-and-Trade Program. The State also would need to identify a new mechanism to comply with the Clean Power Plan.

In addition, information is emerging regarding the efficacy of the carbon tax policy in British Columbia (BC), which has a jurisdictional goal of reducing its GHG emissions by at least 33 percent below 2007 levels by 2020.[56] British Columbia's current carbon tax is $30 CAD per metric ton of carbon. It has not increased since 2012, and BC's emissions have increased by 2.7 percent from 2011 through 2014.[57] A report provided to the BC government by the Climate Action Leadership team found the province will fail to meet its 2020 target.[58,59] A progress report issued by the BC government stated, "Some policies lose effectiveness over time if they are not updated. For example, the carbon tax impact effectively diminishes if the rate remains unchanged, as inflation dampens the price signal."[60] This highlights the importance of how a carbon tax value is set and may need to change over time, and introduces the potential for some uncertainty around political support for higher carbon tax values. And, if data come to light that such an existing carbon tax is not working to achieve the State's climate goals,

[56] British Columbia. Greenhouse Gas Reduction Targets Act. http://www2.gov.bc.ca/gov/content/environment/climate-change/policy-legislation-programs/climate-action-legislation#GGRTA
[57] British Columbia, Environmental Reporting BC. 2016. Sustainability. Trends in Greenhouse Gas Emissions in B.C. (1990–2014). http://www.env.gov.bc.ca/soe/indicators/sustainability/ghg-emissions.html
[58] British Columbia. Climate Leadership Team. http://www2.gov.bc.ca/gov/content/environment/climate-change/policy-legislation-programs/climate-leadership-team
[59] British Columbia. Climate Leadership Team. 2015. Recommendations to Government. October 31. http://engage.gov.bc.ca/climateleadership/files/2015/11/CLT-recommendations-to-government_Final.pdf
[60] British Columbia. 2014. Climate Action In British Columbia: 2014 Progress Report. http://www2.gov.bc.ca/assets/gov/environment/climate-change/policy-legislation-and-responses/2014-progress-to-targets.pdf

additional policies, such as prescriptive regulations, may need to be introduced, and they may need to be aggressive to make up for the time when reductions did not materialize as expected.

3. Alternative 3: All Cap-and-Trade

Alternative 3 is a variant of the Proposed Scoping Plan Scenario and would rely more heavily on the Cap-and-Trade Regulation. However, since the majority of this scenario is comprised of actions under the known commitments, with several in response to statutory requirements, there are only a limited number of policies and measures that can be removed. Alternative 3 is the Proposed Scoping Plan Scenario minus the 20 percent refinery sector measure and maintaining the LCFS stringency at a 10 percent reduction in carbon intensity through 2030.

This alternative meets the criteria outlined in Section C of this chapter similar to the staff proposal, with one exception. This alternative is not as responsive to the direction in AB 197, as it does not prioritize direct GHG reductions at large stationary sources. It may also limit progress in developing low carbon fuels, which will be needed in increasing quantities to meet 2030 and 2050 climate goals.

4. Alternative 4: Cap-and-Tax

Alternative 4 is a variant of Alternative 2 (Carbon Tax) with some features from the Proposed Scoping Plan Scenario. This alternative is designed to cap GHG emissions and incorporate carbon pricing through a tax. This alternative is structured to be the same as Alternative 2 with known commitments and a 20 percent refinery sector measure. Under this alternative, entities that would be covered by a post-2020 Cap-and-Trade Program would instead have an annual cap that declines each year from 2021 to 2030 for each covered entity. Each year, these entities would be required to reduce their emissions by the established annual cap decline and pay a tax to the State for each metric ton of GHGs they emit that year. There would be no trading mechanism in this alternative. This mechanism would be expected to deliver 191 $MMTCO_2e$ cumulative GHG emission reductions. Or, 221 $MMTCO_2e$ if the refinery measure is combined with the shortfall of 191 $MMTCO_2e$ and all stationary facilities currently under the cap are part of this policy.

The modeling for Alternative 1 provides some insights into the potential design elements for this alternative. Modeling for Alternative 1 already assumes a 30 percent reduction in the refinery sector by 2030, or annual cap decline of 3 percent. And, the modeling assumes a 25 percent reduction in the industrial and oil and gas sectors, or 2.5 percent cap decline between 2021 and 2030. Alternative 1 also includes enhancements to some known commitments that may not be feasible to achieve. Holding the known commitments to the stringency in the Proposed Scoping Plan Scenario would require the annual cap decline in the refinery, industrial, and oil and gas sectors to be increased beyond the 3 and 2.5 percent, respectively. Further, this alternative would not rely on a carbon price signal to drive the GHG reductions; rather, the carbon tax may functionally act as a payment for every metric ton of GHGs emitted, and the cap may be the actual

constraint on emissions. Without a trading mechanism, compliance flexibility is reduced. To this point, the state of Washington has adopted its Clean Air Rule that caps and requires reductions at their covered entities.[61] But, in the design of the rule, it became clear that not all covered entities could achieve the annual reductions of approximately 2 percent (lower cap decline than what California would need), and an offset and limited trading mechanism were added to the rule to provide compliance flexibility.

Under Alternative 4, direct GHG emissions reductions would occur at each covered entity and this alternative would provide a funding source for other actions, including climate investments in disadvantaged communities. By including a declining cap, GHG emissions reductions toward achieving the State's target are more certain if other measures deliver the anticipated reductions. This also may not be the most cost-effective way to meet the State's climate goals. This alternative would introduce two costs—(1) onsite investments for reductions at a higher cost or reductions in production, and (2) a carbon tax for actual emissions paid to the State—that must be absorbed by the covered entity or passed on to consumers. In the Cap-and-Trade Program, some allowances can be provided to help reduce the cost-pass through to consumers that may otherwise make the industry less competitive with other producers not subject to a carbon cost. Further, some sources may not be able to achieve a required percent reduction in GHGs each year, forcing them to cut production to meet their annual caps, potentially affecting jobs and the price of their products. This would negatively impact both the California economy and global GHG emissions. Goods that are currently produced in California would be produced elsewhere potentially reducing in-state employment. Assuming California residents still want buy these products, they would be produced out-of-state and imported in, potentially increasing GHG emissions. Under Alternative 4, there are limited mechanisms to address emissions leakage, which may increase under this scenario.

Developing such a program would require several years to design, as each large economic sector (energy, transportation, and industry) may need to have different annual reduction percentages based on the ability for that sector to achieve those reductions while minimizing for emissions leakage and avoiding high costs to consumers. Even within the industrial sector, there will need to be careful consideration of annual percentage reductions among industry. The Cap-and-Trade Program currently distinguishes between over 30 industrial sectors for purposes of free allowance allocation and minimizing emissions leakage. There would also be a need for extensive regulatory efforts to ensure that, without a hard cap on aggregate emissions, a host of separate facilities and sources achieve enough reductions to meet the 2030 target. This scenario may also result in fewer opportunities for linkages with subnational or national programs, since other jurisdictions have not adopted these types of programs. There would still be a need to identify a backstop measure under the Clean Power Plan if the power plants were not able to achieve the required reductions each year as identified in the State's compliance plan.

[61] http://www.ecy.wa.gov/climatechange/carbonlimit.htm

III. Evaluations

A. Existing Programs for Air Quality Improvement in California

For half a century, CARB has been a leader in measuring, evaluating, and reducing sources of air pollution. Its air pollution programs have been adapted for national programs and emulated in other countries. Significant progress has been made in reducing diesel particulate matter (PM) and many other hazardous air pollutants. CARB partners with air districts to address stationary emissions sources and adopts and implements State-level regulations to address sources of criteria and toxic air pollution, including mobile sources. The key air quality strategies being implemented by CARB include the following:

- **State Implementation Plans.**[62] Strategy and proposed control measures designed to achieve the emission reductions from mobile sources, fuels, stationary sources, and consumer products necessary to meet ozone and fine PM attainment deadlines established by the Clean Air Act.
- **Diesel Risk Reduction Plan.**[63] The plan recommends many control measures to reduce the risks associated with diesel PM and achieve a goal of 85 percent PM reduction by 2020. Diesel PM accounts for approximately 60 percent of the current estimated inhalation cancer risk for background ambient air.[64]
- **Sustainable Freight Action Plan.**[65] Strategy to improve freight efficiency, transition to zero emission technologies, and increase competitiveness of California's freight system.
- **AB 32 Scoping Plan.**[66] Comprehensive strategy to achieve the State's climate goals.
- **AB 1807.**[67] CARB is required to use certain criteria in prioritizing the identification and control of air toxics.
- **AB 2588 Air Toxics "Hot Spots" Program.**[68] The goals of the program are to collect emission data, identify facilities having localized impacts, ascertain health risks, notify nearby residents of significant risks, and to reduce those significant risks to acceptable levels.

To support efforts to advance the State's toxics program, the Office of Environmental Health Hazard Assessment (OEHHA) finalized a new health risk assessment methodology on March 6, 2015. [69] In light of this update, CARB is collaborating with air districts in the review of the existing toxics program under AB 2588 to strengthen the program.

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[62] ARB. 2016. California State Implementation Plans. https://www.arb.ca.gov/planning/sip/sip.htm
[63] ARB. 2000. Final Diesel Risk Reduction Plan with Appendices. https://www.arb.ca.gov/diesel/documents/rrpapp.htm
[64] ARB and California Air Pollution Control Officers Association. 2015. *Risk Management Guidance for Stationary Sources of Air Toxics.* July 23. https://www.arb.ca.gov/toxics/rma/rmgssat.pdf
[65] ARB. 2016. Sustainable Freight Transport. https://www.arb.ca.gov/gmp/sfti/sfti.htm
[66] ARB. 2016. AB 32 Scoping Plan. https://www.arb.ca.gov/cc/scopingplan/scopingplan.htm
[67] ARB. 2014. California Air Toxics Program – Background. https://www.arb.ca.gov/toxics/background.htm
[68] ARB. 2016. AB 2588 Air Toxics "Hot Spots" Program. https://www.arb.ca.gov/ab2588/ab2588.htm
[69] OEHHA. 2015. Notice of Adoption of Air Toxics Hot Spots Program Guidance Manual for the Preparation of Health Risk Assessments 2015. http://oehha.ca.gov/air/crnr/notice-adoption-air-toxics-hot-spots-program-guidance-manual-preparation-health-risk-0

While the efforts to date have made a large impact on criteria and toxic emissions, and emissions are expected to continue to decline, more needs to be done to achieve healthful air and reduce community exposure to air pollution, especially in disadvantaged communities. To that end, California is pursuing a multipronged approach to reduce air pollution and address community exposure. In addition to continuing the many programs and policies to improve air quality, the following efforts are critical to addressing the disadvantaged community concerns:

- Take additional action to reduce industrial source emissions, with a focus on near-source exposure through CARB and air district actions.
- Integrate emissions and program data for toxics, criteria pollutants, and GHGs.
- Develop direct State measures that address each of these emissions sources, such as the Mobile Source Strategy and Sustainable Freight Action Plan.
- Implement Adaptive Management to monitor for and address any unlikely increases in toxic or criteria pollutant emissions due to implementation of the Cap-and-Trade Program.
- Work with air districts to assess emission reduction opportunities.
- Continue the toxics review process underway in response to OEHHA's risk methodology update.
- Continue implementation and enforcement of diesel risk reduction measures.
- Improve emissions inventory and data transparency.

B. AB 197 Measure Analyses

This section provides the required AB 197 estimates for the measures evaluated in this Proposed Plan. These estimates provide information on the relative impacts of the evaluated measures when compared to each other. Understanding if a measure will increase or reduce criteria pollutants or toxic air contaminant emissions, or if increasing stringency at additional costs yields few additional GHG reductions, supports the design of a suite of policies that result in GHG reductions, air quality co-benefits, and cost-effective measures. To this end, AB 197 (Garcia, Chapter 250, Statutes of 2016) requires the following for each potential reduction measure evaluated in any scoping plan update:

- The range of projected GHG emissions reductions that result from the measure.
- The range of projected air pollution reductions that result from the measure.
- The cost-effectiveness, including avoided social costs, of the measure.

The next three sub-sections provide the required AB 197 estimates for the measures evaluated in this Proposed Plan. As the Proposed Plan was developed, it was important to understand if any of the proposed policies or measures would increase criteria pollutant or toxic air contaminant emissions. Note the important caveats around some of the estimates; they must be considered when using the information in the tables below for purposes other than as intended.

1. Estimated Emissions Reductions for Evaluated Measures

For many of the existing programs with known commitments, such as the Mobile Source Strategy, previous analyses provide emission factors or other methods for estimating the impacts required by AB 197. Where available, these values were used. In some cases, estimates are based on data from other sources, such as the California Public Utilities Commission (CPUC) Renewables Portfolio Standard Calculator. For newly proposed measures, such as the refinery measures, assumptions were required to estimate the values. Consequently, the estimates for the newly proposed measures have substantial uncertainty. The uncertainty in the impacts of these measures would be reduced as the measures are defined in greater detail during the regulatory processes that are undertaken to define and adopt the programs. For example, as a measure is developed in detail, ways to obtain additional co-pollutant reductions or avoid co-pollutant increases may be identified and evaluated.

Table Ill-1 provides the estimates for the measures evaluated during the development of the Proposed Plan. Based on the estimates below, the Proposed Plan will provide air quality benefits. The table also provides important context, limitations, and caveats about the values.

As shown, the table includes GHG, criteria pollutant, and diesel PM estimates. As mentioned above, diesel PM accounts for 60 percent of the current estimated inhalation cancer risk for background ambient air. CARB is evaluating which additional toxic air contaminants can be estimated for the potential measures below.

Table III-1. Ranges of Estimated GHG and Air Pollution Reductions by Policy or Measure in 2030

Important: These estimates assume a 1:1 relationship between changes in GHGs, criteria pollutants, and toxic air contaminant emissions, and it is unclear whether that is always the case. The values should not be considered estimates of absolute changes for other analytical purposes. The ranges are estimates that represent current assumptions of how programs may be implemented; actual impacts may vary depending on the design, implementation, and performance of the policies and measures. The table does not show interactions between measures, such as the relationship with increased transportation electrification and associated increase in energy demand for the electricity sector. **The measures in bold are included in the Proposed Plan.**

Measure	Range of GHG Reductions ($MMTCO_2$) *	Range of NOx Reductions (Tons/Day)	Range of VOC Reductions (Tons/Day)	Range of $PM_{2.5}$ Reductions (Tons/Day)	Range of Diesel PM Reductions (Tons/Day)
50% Renewables Portfolio Standard (RPS)	13–15	1.9–2.4	0.2–0.3	1.4–1.7	< 0.01
Mobile Sources CTF and Freight	12–14	64	6.0	1.1	6.8
18% Carbon Intensity Reduction Target for LCFS - Liquid Biofuels	~4	4.0–4.9	0.6–0.7	0.5–0.6	—
20% Refinery Measure	2–5	0.4–0.5	0.5–0.6	< 0.1	< 0.01
Short-Lived Climate Pollutant Strategy	17–35 (CO_2e 100-yr GWP)	—	—	—	< 0.01
10% of residential and commercial electric space heating, water heating, A/C, and refrigeration are assumed to be flexible by 2018	~2	0.3–0.4	< 0.1	0.2–0.3	(< 0.01)
60% RPS and additional 10 GW behind-the-meter solar PV*	~14	1.0–1.3	0.1–0.2	**	—

25% Carbon Intensity Reduction Target for LCFS and a Low-Emission Standard - Liquid Biofuels*	~5	3.8–4.7	0.8–1.0	< 0.1	—
30% Refinery*	1–3	0.2–0.3	0.2–0.3	< 0.1	< 0.01
25% Industry	2–7	0.5–0.6	0.6–.7	< 0.1	< 0.01
25% Oil and Gas	1–3	0.1–0.2	0.2–0.3	< 0.1	< 0.01
5% Increased Utilization of renewable natural gas (RNG) (core and non-core)	~2	0.3–0.4	0.4–0.5	< 0.1	0
Mobile Source Strategy (CTF) with Increased ZEVs in South Coast and early retirement of light-duty vehicles (LDVs) with more efficient LDVs*	5–8	7	20	< 0.1	3.8
2x additional achievable energy efficiency in the 2015 Integrated Energy Policy Report (IEPR)	6-8	0.3–0.4	0.4–0.6	< 0.1	< 0.01
2.5x additional achievable energy efficiency in the 2015 IEPR, electrification of buildings (heat pumps and res. electric stoves) and early retirement of heating, ventilation and air conditioning (HVAC)*	6-9	1.9–2.4	0.2–0.3	1.4–1.7	< 0.01
Cap-and-Trade Program	45–100	A	A	A	1.4–3.3
Carbon Tax	45–100	B	B	B	1.4–3.3

* Where enhancements have been made to a measure or policy, the ranges in emissions reductions are incremental to the original measure. For example, the ranges for the 60% RPS are incremental to the emissions ranges for the 50% RPS.
**Some measures do not show a significant change in 2030 when there is an incremental increase in measure stringency or when modeling uncertainty was factored.
~ Some measures do not show a significant change in the single year 2030 reductions when there is an incremental increase in measure stringency or when uncertainty was factored.

— CARB is evaluating how to best estimate these values.
Criteria and toxic values are shown in tons per day, as they are episodic emissions events with residence times of a few hours to days, unlike GHGs, which have atmospheric residence times of many decades.

A. Due to the inherent flexibility of the Cap-and-Trade Regulation, as well as the overlay of other complementary GHG reduction measures, the mix of compliance strategies that individual facilities may use is not known. However, based on current law and policies that control industrial and electricity generating sources of air pollution, and expected compliance responses, CARB believes that emissions increases at the statewide, regional, or local level due to the regulation are not likely. A more stringent post-2020 cap-and-trade program will provide an incentive for covered facilities to decrease GHG emissions and any related emissions of criteria and toxic pollutants. Please see CARB's Co-Pollutant Emissions Assessment for a more detailed evaluation of a cap-and-trade program and associated air emissions impacts: **https://www.arb.ca.gov/regact/2010/capandtrade10/capv6appp.pdf**

B. A carbon tax has the same inherent flexibility of a cap-and-trade program, with the distinction that without a cap, a carbon tax option may not result in any emissions reductions for GHGs or other air emissions. If a carbon tax resulted in the same amount of GHG reductions as the cap-and-trade measure, we would expect similar types of compliance responses and similar impacts to criteria and toxics emissions.

NOx = nitrogen oxides; VOC = volatile organic compound

2. Estimated Economic Benefits for Evaluated Measures

Consideration of the social costs of carbon is a requirement in AB 197, including evaluation of cost-effectiveness for measures within this Proposed Plan. The U.S. Environmental Protection Agency (U.S. EPA) describes the social costs of carbon as follows:

> *EPA and other federal agencies use the social cost of carbon (SC-CO_2) to estimate the climate benefits of rulemakings. The SC-CO_2 is an estimate of the economic damages associated with a small increase in carbon dioxide (CO_2) emissions, conventionally one metric ton, in a given year. This dollar figure also represents the value of damages avoided for a small emission reduction (i.e., the benefit of a CO_2 reduction).*
>
> *The SC-CO_2 is meant to be a comprehensive estimate of climate change damages and includes, among other things, changes in net agricultural productivity, human health, property damages from increased flood risk and changes in energy system costs, such as reduced costs for heating and increased costs for air conditioning. However, it does not currently include all important damages. The IPCC Fifth Assessment report observed that SC-CO_2 estimates omit various impacts that would likely increase damages. The models used to develop SC-CO_2 estimates do not currently include all of the important physical, ecological, and economic impacts of climate change recognized in the climate change literature because of a lack of precise information on the nature of damages and because the science incorporated into these models naturally lags behind the most recent research. Nonetheless, the SC-CO_2 is a useful measure to assess the benefits of CO_2 reductions.*[70]

There continues to be active discussion within government and academia about the role of SC-CO_2 in assessing regulations, quantifying avoided climate damages, and the monetizing values themselves. To date, federal agencies such as the U.S. EPA, Department of Energy, and Department of Transportation have used SC-CO_2 in evaluating regulations.

The IPCC has stated that SC-CO_2 estimates are likely underestimated due to the omission of significant impacts that cannot be accurately monetized.[71] In addition, the SC-CO_2 does not account for impacts related to changes in criteria pollutants or toxics resulting from GHG focused policies and programs.

The cost-effectiveness of regulations and policies represents the cost to control each unit of emissions, and is the traditional cost metric associated with emission control.

[70] U.S. Environmental Protection Agency. EPA Fact Sheet. Social Cost of Carbon. www3.epa.gov/climatechange/Downloads/EPAactivities/social-cost-carbon.pdf
[71] https://www.ipcc.ch/publications_and_data/ar4/wg3/en/ch3s3-5-3-3.html

$SC\text{-}CO_2$ allows California to begin to examine a different metric, the costs of no action, or the damages.

There may be technologies or policies that do not appear to be cost-effective when compared to the $SC\text{-}CO_2$ associated with the avoided GHG reductions. However, these actions may result in other benefits that are not reflected in the $SC\text{-}CO_2$, including diversification of the portfolio of transportation fuels (a goal outlined in the Low Carbon Fuel Standard) and reductions in criteria pollutant emissions from power plants (as in the Renewables Portfolio Standard). Regulatory mandates help to broaden the deployment of these technologies and address market failures. Policies may also reduce the cost of production and utilization of lower carbon technologies over time, helping the State achieve its climate goals and potentially providing other economic benefits such as clean economy jobs.

This Proposed Plan uses the $SC\text{-}CO_2$ to incorporate the concept of the avoided cost of economic damages due to climate change—including a range for the economic benefits that occur as a result of the avoided environmental damages that result from achieving the 2030 target. The State will continue to monitor and engage in discussions related to any updates to U.S. EPA's $SC\text{-}CO_2$ methods and values and initiate its own work to refine a $SC\text{-}CO_2$ method and values for California.

Table Ill-2 provides the ranges for the avoided value of economic damages in the year 2030. The U.S. EPA $SC\text{-}CO_2$ values in 2030 of $16 using the 5 percent discount rate, $50 using the 3 percent discount rate, and $73 using the 2.5 percent discount rate were translated into 2015 dollars and multiplied across the range of estimated reductions by measure in 2030 to estimate the value of climate benefits from each measure in that year.[72] Since all the measures are aimed at reducing GHGs, they all result in avoided economic damages. The Proposed Plan is a suite of policies developed to reduce GHGs to a specific level in 2030, and any alternative scenario that also achieves the 2030 target will have the same avoided economic damages for the single year 2030, which is equivalent to $7.6 billion using the 3 percent discount rate, and ranges from $2.4 to $11.0 billion using the 2.5 to 5 percent discount rates.

[72] The U.S. EPA $SC\text{-}CO_2$ values are in 2007 dollars. In 2015 dollars, $16, $50, and $73 in 2007 translates to about $18, $57, and $83, respectively, based on the Bureau of Labor Statistics CPI Inflation Calculator.

Table III-2. Estimated Climate Benefits (Avoided Economic Damages) by Policy or Measure in 2030

Measure (Measures in bold are included in the Proposed Plan)	Range of GHG Reductions ($MMTCO_2$*)	Range of Social Cost of Carbon $million USD (2015 dollars)
50% Renewables Portfolio Standard (RPS)	13–15	$230–$1,260
Mobile Sources CTF and Freight	12–14	$170–$1,200
18% Carbon Intensity Reduction Target for LCFS -Liquid Biofuels	~4	$55–$340
20% Refinery Measure	2–5	$55–$460
Short-Lived Climate Pollutant Strategy	17–35 (CO_2e)	n/a
10% of residential and commercial electric space heating, water heating, A/C, and refrigeration are assumed to be flexible by 2018	~2	$55–$170
60% RPS and additional 10 GW behind-the-meter solar PV*	~14	$230–$1,200
25% Carbon Intensity Reduction Target for LCFS and a Low-Emission Standard - Liquid Biofuels*	~5	$55–$460
30% Refinery*	1–3	$55–$285
25% Industry	2–7	$55–$630
25% Oil and Gas	1–3	$55–$285
5% Increased Utilization of RNG (core and non-core)	~2	$55–$170
Mobile Source Strategy (CTF) with Increased ZEVs in South Coast and early retirement of LDVs with more efficient LDVs*	5–8	$55–$685
2x additional achievable energy efficiency in the 2015 IEPR	6–8	$115–$685
2.5x additional achievable energy efficiency in the 2015 IEPR, electrification of buildings (heat pumps and res. electric stoves) and early retirement of HVAC*	6–9	$115–$800
Cap-and-Trade Program	45–100	$800–$8,400
Carbon Tax	45–100	$800–$8,400
Proposed Scenario	**132.4**	**$2,400-$11,000**

Note: The SC-CO_2 ranges are representative of the relative values across the measures evaluated in the development of this scoping plan. They should be considered in the context of the uncertainty in the estimated GHG reductions in 2030 and the U.S. EPA definition of the SC-CO_2 and what the values represent over the course of a single year.

*Where enhancements have been made to a measure or policy, the ranges in emissions reductions are incremental to the original measure. For example, the ranges for the 60% RPS are incremental to the emissions ranges for the 50% RPS.

**All values have been rounded.
~Some measures do not show a significant change in 2030 when there is an incremental increase in measure stringency or when modeling uncertainty was factored.

3. Estimated Cost Per Metric Ton by Measure

AB 197 also requires an estimation of the cost-effectiveness of the potential measures evaluated for the Proposed Plan. The values provided in Table Ill-3 are estimates of the cost per metric ton of estimated reductions for each measure in 2030. These estimates do not reflect the costs or GHG reductions of measures across all years, but focus solely on 2030. Depending on the measure, there will be costs or savings per metric ton of GHGs reduced. The costs represent the incremental costs to achieve the GHG reductions beyond the Reference scenario (BAU). While it is important to understand the relative cost effectiveness of measures in the table below, the economic analysis presented later in this chapter provides a more comprehensive analysis of how the Proposed Plan and alternative scenarios affect the State's economy and jobs.

CARB will expand this analysis to include an evaluation of the cost per metric ton based on the net present value of the cumulative GHG emissions reductions and costs for each potential measure from 2021 through 2050, in order to capture the fuel and GHG savings over the full economic lifetime of investments made to meet the 2030 GHG goal.

Table lll-3 presents one way of estimating the cost (or savings) per tonne of CO_2e reduced for each of the measures in the Proposed Scoping Plan Scenario and the Alternative 1 scenario. The measures selected reflect many factors beyond the cost per tonne of an individual measure, including existing laws and policies, implementation feasibility, fuel diversity and technology transformation goals, as well as health and other benefits to California. These considerations are not reflected in the metric below.

Furthermore, many of the measures interact with other measures, making it analytically difficult to isolate the cost and GHG savings of an individual measure. For example, renewable electricity impacts the cost and GHG savings associated with electric vehicles. Likewise, electric vehicles impact the value of other flexible loads to the system, and the cost of meeting the low-carbon fuel standard directly depends on the success of other transportation measures, just to name a few examples.

For most of the measures shown in Table lll-3, the 2030 cost per tonne metric is isolated from the other measures by performing a series of sensitivity model runs in the California PATHWAYS model. This cost per tonne metric is calculated as the difference in the 2030 annualized cost (or savings) of the PATHWAYS Scoping Plan (or Alternative 1) scenario as compared to the annualized cost of the Scoping Plan (or Alternative 1) scenario ***excluding*** that particular measure. This cost (or savings) delta is divided by the difference in 2030 GHG emissions in the scenario as compared to the scenario ***excluding*** that particular measure.

By removing each measure in isolation from the rest of the measures in the scenario, this approach results in an estimate of the annual incremental average cost (or cost savings) per tonne of the measure, relative to the Proposed Scoping Plan (or Alterative 1) scenario.

Costs that represent transfers within the state, such as incentive payments for early retirement of equipment, are not included in this California total cost metric. The cost ranges shown below represent some of the uncertainty inherent in estimating this metric. The details of how the ranges for each measure were estimated are described in the footnotes below. All cost estimates have been rounded representing further uncertainty in individual values.

It is important to note that this cost per tonne metric does not represent an expected market price value for carbon mitigation associated with these measures. In addition, since the table below reports a single year (2030) snap-shot of costs and savings, it does not capture the fuel savings or GHG savings associated with the full economic lifetime of measures that are implemented in 2030, but whose impacts extend beyond 2030, nor does it capture the climate or health benefits of the GHG mitigation measures.

For the measures where other sources beyond the PATHWAYS model are used to develop estimates of the cost per tonne, this is noted in the table below.

Table III-3. Estimated 2030 Cost Per Metric Ton by Measure

Important: As individual measures are designed and implemented they will be subject to further evaluation and refinement and public review, which may result in different findings than presented below. The ranges are estimates that represent current assumptions of how programs may be implemented and may vary greatly depending on the design, implementation, and performance of the policies and measures. **Measures in bold text are included in the Proposed Plan.**

Measure	Cost/metric ton in 2030*
50% Renewables Portfolio Standard (RPS) [a]	$100 to $300
Mobile Sources CFT and Freight [b]	<$50
Liquid Biofuels (18% Carbon Intensity Reduction Target for LCFS) [c]	$250
20% Refinery Measure [d]	$70 to $200
Short-Lived Climate Pollutant Strategy	TBD
10% of residential and commercial electric space heating, water heating, A/C and refrigeration are assumed to be flexible by 2018 [e]	-$500 to -$300
60% RPS and additional 10 GW behind-the-meter solar PV [a]	$300 to $450
Liquid Biofuels (25% Carbon Intensity Reduction Target for LCFS and a Low-Emission Diesel Standard)[b]	$400
30% Refinery [d]	$70 to $200
25% Industry [d]	$70 to $200
25% Oil and Gas [d]	$70 to $200
5% Increased Utilization of renewable natural gas - core and non-core [f]	$300 to $1500
Mobile Source Strategy (CFT) with Increased ZEVs in South Coast & additional reductions in VMT and energy demand & early retirement of LDVs with more efficient LDVs [b]	-$150 to $200
2x additional achievable energy efficiency in the 2015 IEPR [g]	-$550 to -$300
2.5x additional achievable energy efficiency in the 2015 IEPR, electrification of buildings (heat pumps & res. electric stoves) and early retirement of HVAC [g]	$100 to $200
Cap-and-Trade Program [d]	$25 to $85
Carbon Tax [d]	$50 (2007 dollars)

Where enhancements have been made to a measure or policy the cost per tonnes are incremental to the original measure. For example, the cost per tonne for the 60% RPS are incremental to the costs per tonne for the 50% RPS.

[a] Cost estimate is based on PATHWAYS sensitivity analysis as described in the main text. The lower cost ranges are based on the EIA AEO's high oil and natural gas price forecast and a 20% reduction in the capital cost of wind and solar electricity generation relative to the base assumptions. The higher cost ranges are based on the EIA AEO's low oil and natural gas price forecast.
[b] Cost estimate is based on PATHWAYS sensitivity analysis as described in the main text. The lower cost ranges are based on the EIA AEO's high oil price forecast. The higher cost ranges are based on the EIA AEO's low oil price forecast.
[c] Liquid biofuel values are calculated as the average unsubsidized cost of biofuels supplied above that of an equivalent volume of fossil fuels. These values do not reflect impacts from other biofuel policies, such as the Renewable Fuel Standard or production tax credits, that are partially supported by fuel purchasers/taxpayers outside of California. Therefore, these values do not represent LCFS program costs or potential LCFS credit prices.
[d] **https://www.arb.ca.gov/regact/2016/capandtrade16/appc.pdf**
[e] Cost estimate is based on PATHWAYS sensitivity analysis as described in the main text. The lower cost range is based on an assumption that flexible loads can be implemented through retail rate design without additional capital expenditures; the higher cost range assumes that the cost of flexible loads is the same as the cost per ton of other building energy efficiency measures.
[f] Cost estimate is based on PATHWAYS sensitivity analysis as described in the main text. The **low**er **cost** range assumes **biogas in pipeline, using mo**deled delivered prices for biogas. The higher cost range assumes renewable natural gas is provided by **hydr**ogen generated from flexible grid electrolysis**.**

[g] Cost estimate is based on PATHWAYS sensitivity analysis as described in the main text. The lower cost range is based on the EIA's **high** natural gas **price** forecast and **higher electricity price**s**.** The **high**er **cost** range is based on the EIA's **low** natural gas **price** forecast and **lower electricity price**s**.** The cost per tonne does not represent the results of the CPUC's or CEC's standard cost-effectiveness evaluation tests.

C. Economic Analyses

1. Economic Impacts

The following section outlines the economic impact of the Proposed Plan relative to the business-as-usual Reference scenario. Additional detail on the economic analysis, including modeling details and the estimated economic impact of alternative scenarios is presented in Appendix E.

The Proposed Plan outlines a path to achieve the SB 32 target that requires less reliance on fossil fuels and increased investment in low carbon fuels and clean energy technologies. Through this shift, California can lead the world in developing the technologies needed to reduce the global risks of climate change. Innovation in low-carbon technologies will open growth opportunities for investors and businesses in California. As modeled, the analysis in this 2030 Target Scoping Plan suggests that the

cost of transitioning to this lower carbon economy are small, even without counting the potential opportunities for new industries and innovation in California. Under the Proposed Plan, the California economy, employment, and personal income will continue to grow as California businesses and consumers make clean energy investments and improve efficiency and productivity to reduce energy costs.

Overview of Economic Modeling

Two models are used to estimate the economic impact of the Proposed Plan and California's continued clean energy transition: (1) the California PATHWAYS model, and (2) the Regional Economic Models, Inc. (REMI) Policy Insight Plus model. The California PATHWAYS model estimates the direct costs and GHG emission reductions of implementing the prescriptive (or non-Cap-and-Trade) measures in the Proposed Plan relative to the BAU scenario.[73] Direct costs are the sum of the incremental changes in capital expenditures and fuel expenditures, including fuel savings for reduced energy use from efficiency measures. In most cases, reducing GHG emissions requires the use of more expensive equipment that can be operated using less fuel. In the Proposed Plan, the prescriptive measures modeled in PATHWAYS account for a portion of the GHG reductions required to meet the 2030 target. The remaining reductions are delivered through the Cap-and-Trade Program (as outlined in Figure III-2). The direct costs associated with the Cap-and-Trade Program are calculated outside of PATHWAYS based on an assumed range of Cap-and-Trade allowance prices from 2021 through 2030.

To estimate the future costs of the Proposed Plan, this economic analysis necessarily creates a hypothetical future California that is essentially identical to today, adjusted for currently existing climate policy as well as projected economic and population growth through 2030. The analysis cannot predict the types of innovation that will create efficiencies nor can it fully account for the significant economic benefits associated with reducing emissions. Rather, the economic modeling is conducted by estimating incremental capital and clean fuel costs of measures and assigning those costs to certain sectors within this hypothetical future.

The macroeconomic impacts of the Proposed Plan on the California economy were modeled using the REMI model with output from California PATHWAYS and estimated Cap-and-Trade Program costs as inputs. Additional methodological detail is presented in Appendix E.[74]

Estimated Cost of Prescriptive Measures

As described above, the Proposed Plan combines new measures addressing legislative mandates and the extension of existing measures, including a comprehensive cap on overall GHG emissions from the State's largest sources of pollution. The PATHWAYS model calculates costs and GHG emission reductions associated with the prescriptive measures in the Proposed Plan. Changes in energy use and capital investment are calculated in PATHWAYS and represent the estimated cost of achieving an estimated

[73] The PATHWAYS modeling is described in Chapter III, and additional detail is presented in Appendix D.

[74] Additional modeling details are available at the REMI PI+ webpage: http://www.remi.com/products/pi.

50 to 70 percent of the cumulative GHG reductions required to reach the SB 32 target between 2021 and 2030. The Cap-and-Trade Program delivers any remaining reductions, as shown in Figure III-2.

Table III-4 outlines the cost of prescriptive measures by sector in 2030, compared to the Reference scenario, as calculated in PATHWAYS. Estimated capital costs of equipment are levelized over the life of the equipment using a 10 percent discount rate and fuel costs are calculated on an annual basis.[75] The costs in Table III-4 are disaggregated into capital costs and fuel costs, which includes gasoline, diesel, biofuels, natural gas, electricity and other fuels.[76] Table III-4 assumes that all prescriptive measures deliver anticipated GHG reductions, and does not include any uncertainty in GHG reductions or cost.[77] The impact of uncertainty in GHG reductions is explored in more detail in Chapter III and in Appendices D and E, which include additional detail on measure, cost, and Reference scenario uncertainty.

The prescriptive measures result in incremental capital investments of $5.1 billion per year in 2030, but these annual capital costs are nearly offset by annual fuel savings of $4.1 billion in 2030. The incremental net cost of prescriptive measures in the Proposed Plan is estimated at $1 billion in 2030, which represents 0.03 percent of the California economy in 2030. Residential and commercial sectors are anticipated to see net savings in 2030 as the fuel savings vastly outweigh the annual capital investment. Agriculture and transportation sectors will see a net cost increase from implementation of the prescriptive measures. The transportation sector sees higher capital costs due to the purchase of more efficient equipment and a reduction in fuel costs due to reduced vehicle miles traveled, more efficient equipment, and fuel-switching from fossil to electric fuels, relative to the Reference scenario. In the agriculture sector, capital expenditures are due to investments in more efficient lighting and the mitigation of agricultural methane and nitrogen oxides. Agricultural fuel costs increase due to higher electricity and liquid biofuel costs.

Table III-4. Change in PATHWAYS Sector Costs in 2030 Relative to the Reference Scenario (Billion $2015)[78]

End Use Sector[79]	Levelized Capital Cost	Fuel Cost	Total Annual Cost
Residential	$0.1	-$0.8	-$0.7
Commercial	$0.5	-$0.9	-$0.4

[75] PATHWAYS costs are calculated in real $2012. For this analysis, all costs are reported in $2015. The PATHWAYS costs are inflated using the Bureau of Economic Analysis (BEA) Table 1.1.4 available at: https://bea.gov/national/pdf/dpga.pdf.
[76] Additional information on the fuels included in PATHWAYS is available at: https://www.arb.ca.gov/cc/scopingplan/meetings/1142016/e3pathways.pdf.
[77] More information on the inputs to the California PATHWAYS model is available at: https://www.arb.ca.gov/cc/scopingplan/scoping_plan_scenario_description2016-12-01.pdf.
[78] PATHWAYS costs reported in $2012 are inflated to $2015 using the Bureau of Economic Analysis (BEA) Table 1.1.4 available at: https://bea.gov/national/pdf/dpga.pdf
[79] Information on the end use sectors are available in the California PATHWAYS documentation available at: https://www.arb.ca.gov/cc/scopingplan/meetings/1142016/technicalappendix.pdf. This documentation is being updated for this 2030 Target Scoping Plan analysis.

Transportation	$3.7	-$3.2	$0.5
Industrial	$0.3	$0.2	$0.4
Oil and Gas Extraction	$0.0	$0.1	$0.1
Petroleum Refining	$0.1	-$0.2	$0.0
Agriculture	$0.3	$0.5	$0.8
TCU (Transportation Communications and Utilities)	$0.1	$0.2	$0.3
Total	**$5.1**	**-$4.1**	**$1.0**

Note that table values may not add due to rounding.

Estimated Cost of the Cap-and-Trade Program

The direct cost of achieving GHG reductions through the Cap-and-Trade Program is estimated outside of PATHWAYS. The Cap-and-Trade Program sets an economy-wide GHG emissions cap and gives firms the flexibility to choose the lowest-cost approach to reduce emissions. As with the prescriptive measures, the direct costs of any single specific GHG reduction activity under the Cap-and-Trade Program is subject to a large degree of uncertainty. However, as Cap-and-Trade allows covered entities to pursue the reduction options that emerge as the most efficient, overall abatement costs can be bounded by the allowance price. Covered entities should pursue reduction actions with costs less than or equal to the allowance price. An upper bound on the compliance costs under the Cap-and-Trade Program can be therefore be estimated by multiplying the range of anticipated allowance prices by the anticipated GHG reductions needed (in conjunction with the reductions achieved through the prescriptive measures) to achieve the SB 32 target.

A large number of factors influence the allowance price, including the ease of substitution by firms to low carbon production methods, consumer price response, the pace of technological progress, and impacts to the price of fuel. Other policy factors that also affect the allowance price include the return of auction proceeds from the sale of State-owned allowances and linkage with other jurisdictions.

Flexibility allows the Cap-and-Trade allowance price to adjust to changes in supply and demand while a firm cap ensures GHG reductions are achieved. This analysis includes a range of allowance prices bounded by the Cap-and-Trade auction floor price (C+T Floor Price) which represents the minimum sales price for allowances sold at auction and the Allowance Price Containment Reserve Price (C+T Reserve Price), which represents the price at which an additional pool of allowances is made available and is the highest anticipated price under the Program. Table III-5 outlines the projected allowance prices used in this analysis.

Table III-5. Estimated Range of Cap-and-Trade Allowance Price 2020–2030

($2015)	2020	2025	2030
C+T Floor Price	$15.4	$19.7	$25.2
C+T Reserve Price	$72.1	$73.0	$78.4

Uncertainty in the GHG reduction potential of prescriptive measures in the Proposed Plan can affect the cost of achieving the 2030 target. The aggregate emissions cap of the Cap-and-Trade Program ensures that the 2030 target will be met—irrespective of the GHG emissions realized through prescriptive measures. If GHG reductions anticipated under prescriptive measures do not materialize, the Cap-and-Trade Program will be responsible for a larger share of the total emissions reductions. Under that scenario, the demand for Cap-and-Trade allowances may rise, resulting in an increase in allowance price. While the Cap-and-Trade allowance price may rise, it is highly unlikely that it will rise above the C+T Reserve price, given the program design. If prescriptive measures deliver anticipated GHG reductions, demand for allowances will be low, depressing the price of allowances. However, the C+T Floor Price represents the lowest price at which allowances can be sold at auction.

Table III-6 presents the estimated direct cost estimates for GHG reductions achieved through the Cap-and-Trade Program in 2030. These costs represent the lower and upper bounds of the cost of reducing GHG emissions to achieve the SB 32 target under the Proposed Plan. The estimated direct costs range from $1.2 to $3.6 billion dollars (in $2015), depending on the allowance price in 2030. This range highlights the allowance price uncertainty that is a trade-off to the GHG reduction certainty provided by the Cap-and-Trade Program. The estimated cost of GHG reductions is calculated by multiplying the allowance price by the GHG emission reductions required to achieve the SB 32 target.

Sensitivity Analysis

In addition to uncertainty in the Cap-and-Trade allowance price and uncertainty in the GHG reductions achieved through the prescriptive measures, there is uncertainty in the GHG emissions that will occur under the Reference scenario, as presented in Figure II-1. There is also uncertainty in costs embedded within the Reference scenario including the price of oil, other energy costs, and technology costs.

The PATHWAYS incremental cost results are also sensitive to the fossil fuel price assumptions. Altering the fuel price trajectory in the Reference scenario directly impacts the incremental cost of achieving GHG reductions in the Proposed Plan, as costs are relative to the Reference scenario.

The PATHWAYS scenarios use fossil fuel price projections from the Annual Energy Outlook (AEO) 2015 reference case.[80] To estimate the impact of changes in future fuel prices on the estimated incremental cost of the Proposed Plan two sensitivities were conducted. In the low fuel price sensitivity, the AEO low oil and natural gas price case is used to project the future cost of fuels in the Reference scenario. The cost of the Proposed Plan, relative to the reference case, increases under these conditions, since fuel savings are less valuable when fuel prices are low. A second sensitivity shows that high future oil and natural gas prices (as projected in the AEO high oil price case) reduce the net cost of the Proposed Plan, relative to the Reference scenario. This is because avoided fuel savings are more valuable when fuel prices are high. Table III-6 outlines the costs and savings from the Proposed Plan (both prescriptive measures and cap-and-trade) under the high and low fuel price sensitivities.

The price of oil and natural gas affects the value of fuel savings, which are estimated to be significant using AEO reference oil and natural gas prices (presented in Table III-4). Under the low fuel price sensitivity, the net incremental cost of prescriptive measures is $4 billion in 2030. Under the high fuel price sensitivity, the prescriptive measures result in net *savings of* $5 billion in 2030. Table III-6 also shows that these price uncertainties are captured within the analyzed range of allowance prices. As described above, changes in fuel prices may affect the price of Cap-and-Trade allowances, but the price is highly unlikely to go outside the range of prices bounded by the C+T Floor Price and C+T Reserve Price. The final column in Table III-6 presents the estimated direct cost of the Proposed Plan, including both the prescriptive measures and a range of estimated costs to achieve GHG reductions under the Cap-and-Trade Program for varying projections of future fuel prices. The total cost, reflecting fuel and allowance price uncertainty, ranges from an annual savings to California of $3.8 billion to an annual cost of $7.6 billion. The net climate benefits, as estimated by the SC-CO_2, outweigh these direct costs.[81]

Table III-6. Estimates of Direct Cost and Climate Benefits in 2030 Relative to the Reference Scenario and Including Fuel Price Sensitivity (Billion $2015)

Scenario	Prescriptive Measures	C+T Floor Price	C+T Reserve Price	2030 Total Cost
Proposed Plan	$1.0	$1.2	$3.6	$2.2 to $4.6
Low Fuel Price Sensitivity	$4.0	$1.2	$3.6	$5.2 to $7.6
High Fuel Price Sensitivity	-$5.0	$1.2	$3.6	-$3.8 to -$1.4
Range of Climate Benefits (SC-CO_2)				$2.4 to $11.0

[80] The high and low fuel price sensitivity ranges are derived from the AEO 2016 reference case, and are applied as ratios to the base case fuel price assumptions. The AEO 2015 report is available at: http://www.eia.gov/outlooks/aeo/pdf/0383(2015).pdf and the AEO 2016 report is available for download at: http://www.eia.gov/outlooks/aeo/pdf/0383(2016).pdf.

[81] Climate benefits are estimated using the Social Cost of Carbon in 2030 across the range of discount rates from 2.5 to 5 percent. All values are reported in $2015. Additional information on the Social Cost of Carbon is available at: https://www3.epa.gov/climatechange/Downloads/EPAactivities/social-cost-carbon.pdf.

Fuel price sensitivity is directly modeled in PATHWAYS, resulting in a range of impacts from prescriptive measures. The range of costs labeled "2030 Total Cost" includes the cost of prescriptive measures estimated in PATHWAYS and the impact of the Cap and-Trade Program calculated at the C+T Floor Price (the lower bounds) and the C+T Reserve Price (the upper bounds).

Macroeconomic Impacts

The macroeconomic impacts of the Proposed Plan are estimated using the REMI model. Annual capital and fuel costs (for example, the costs in Table III-4) are estimated using PATHWAYS and input into the REMI model to estimate the impact of the Proposed Plan on the California economy each year relative to GDP, which is often used as a proxy for economic growth, as well as employment, personal income, and changes in output by sector and consumer spending. Table III-7 presents key macroeconomic impacts of implementing the Proposed Plan, based on the range of anticipated allowance prices. In 2030, under the Proposed Plan, growth across the indicators is about one-half of one percent less than the Reference scenario. The results in Table III-7 include not only the estimated direct cost of the Cap-and-Trade Program, but also the return of allowance value from the auction of Cap-and-Trade allowances to California and consumers. See Appendix E for more detail on the modeling of the return of allowance value under the Cap-and-Trade Program in REMI. The Cap-and-Trade Program is modeled in REMI as an increase in production cost to sectors based on estimated future GHG emissions and anticipated free allowance allocation. If a sector is expected to receive free allocation of allowances, the value of those free allowances is not modeled as a cost in REMI. The analysis does include the estimated benefit to sectors due to the proceeds from the auction of cap-and-trade allowances and assumes that each year $2 billion of proceeds from the auction of State-owned cap-and-trade allowances are distributed to the economic sectors currently receiving GGRF appropriations. These funds work to achieve further GHG reductions in California, lower the cost of reducing GHG emissions to businesses, and protect disadvantaged communities. Any remaining auction proceeds after the distribution of $2 billion through GGRF sectors are distributed evenly to consumers in California as a dividend. The estimated costs in Table III-7 include the cost of the GHG reductions to sectors, as well as the benefit of a portion of those costs disbursed through the GGRF and as a dividend to consumers, as detailed in Appendix E.

Table III-7. Macroeconomic Indicators in 2030 Under Base Fuel Price Assumptions

	Reference Scenario (2030)	Proposed Plan (2030)	Percentage Change Relative to Reference Scenario
California GDP (Billion $2015)	$3,439	$3,428 to $3,419	-0.3% to -0.6%
Employment (Thousand Jobs)	23,522	23,460 to 23,422	-0.3% to -0.4%
Personal Income (Billion $2015)	$3,010	$3,004 to $3,006	-0.2% to -0.1%

Table III-7 was estimated using the REMI model. The range of costs for the Proposed Plan represents the impact of achieving the SB 32 target through prescriptive measures and the Cap-and-Trade Program at the C+T Floor Price (the lower bounds) and the C+T Reserve Price (the upper bounds).

It is important to put the results of Table III-7 into context. First, reducing GHG emissions 40 percent below 1990 levels under the Proposed Plan will lead to avoided social damages from climate change on the order of $2.4 to $11 billion, as estimated using the SC-CO_2, as well as additional potential savings from reductions in air pollution and petroleum dependence. These impacts are not included in this economic analysis. Second, in 2030, the California economy is projected to grow to $3.4 trillion, an average growth rate of 2.2 percent per year from 2020 to 2030. Even without including the potentially significant economic benefits of emissions reductions in the Proposed Plan, implementation of the Plan is not estimated to change the annual GDP growth across the range of allowance prices. Based on this analysis, in 2030 the California economy will take only three months longer to get to the GDP anticipated in the Reference scenario.

Determining employment changes as a result of policies is challenging to model, due to a range of uncertainties and global trends that will influence the California economy, regardless of implementation of the Proposed Plan. The global economy is seeing a shift toward automation and mechanization, which may lead to slowing of employment across some industries globally, irrespective of California's energy and low carbon investments. In California, employment is projected to reach 23.5 million jobs in 2030. In this analysis, implementing the Proposed Plan would change that growth of employment by less than half of 1 percent.

Estimated personal income in California is relatively unchanged under the Proposed Plan relative to the Reference scenario. Considering the uncertainty in the modeling, modest changes in the growth of personal income are not different from zero, which suggests that meeting the SB 32 target will not change the growth of personal income relative to the Reference scenario.

When analyzing the estimated macroeconomic impacts, it is important to remember that

a major substitution of electricity and capital away from fossil fuels is anticipated to have a very small effect on California GDP, employment, and personal income—less than 1 percent relative to the Reference scenario in 2030. The economic impacts indicate that shifting money and investment away from fossil fuels and to clean energy is likely to have a negligible effect on the California economy. Additionally, it is certain that innovation will continue as new technologies are developed and implemented. While this analysis projects the costs and GHG reductions of current technologies over time, it does not capture the impact of new technologies that may shift the economy and California in unanticipated ways or benefits related to changes in air pollution and impacts on human health, avoided environmental damages, and impacts to natural and working lands. Thus, the results of this analysis very likely underestimate the benefits of shifting to a clean energy economy.

Consumer spending also shifts in response to implementation of the Proposed Plan relative to the Reference scenario. As presented in Table III-7, there is a negligible impact to consumer income, but small changes in income can alter the distribution of consumer spending among categories. In 2030, consumer spending is lower under the Proposed Plan than in the Reference scenario across all analyzed allowance prices. Consumers spend less on fuels, electricity, natural gas, and capital as a result of measures in the Proposed Plan that reduce demand, increase efficiency, and drive technological innovations. The estimated impact to California households is also modest in 2030, as outlined in Table III-8. In 2030, the average annual cost per household of the Proposed Plan ranges from $30 to $215 (labeled incremental cost in Table III-8), depending on the price of reductions under the Cap-and-Trade Program.[82] In 2030, as modeled in the Reference scenario, households will spend $3,533 on equipment and fuel.

Implementing the prescriptive measures in the Proposed Plan will change household fuel and equipment expenditures as is estimated to result in a $45 savings per household in 2030. The additional reductions needed to achieve the SB 32 target, obtained through the Cap-and-Trade Program, result in a cumulative annual cost of $30 to $215 to households in 2030, relative to the Reference scenario. The household impact of the Cap-and-Trade Program assumes that all costs of GHG reductions in the Cap-and-Trade Program are passed to consumers and therefore represents the upper bounds of the estimated household impact. It does not account for benefits from reduced climate impacts, health savings from reduced air pollution impacts, or lower petroleum dependence costs that might impact households.

While not significant, the range of household impacts represents changes in fuel expenditures and capital investment as a result of the prescriptive measures and Cap-and-Trade component of the Proposed Plan. As modeled, the household impact of the Proposed Plan comprises less than 1 percent of average household expenditures in 2030. To ensure that vulnerable populations and low-income households are not disproportionately affected by California's climate policy, CARB is taking steps to better quantify localized economic impacts and ensure that low-income households see

[82] Household projections were obtained from California Department of Finance. They are available at: http://www.dof.ca.gov/Forecasting/Demographics/projections/.

tangible benefits from the Proposed Plan. Researchers at the University of California, Los Angeles (UCLA) are currently working on a retrospective analysis that will estimate the impacts across California communities of the implementation of AB 32, which will help identify areas of focus as 2030 measures are developed. The Cap-and-Trade Program will also continue to provide benefit to disadvantaged communities through the disbursement of GGRF funds.

Table III-8. Estimated Annual Cost per Household in 2030

Scenario	2030 Annual Cost per Household
Reference Scenario	$3,500
Proposed Plan	$3,530 - $3,715
Incremental Cost of Plan Relative to Reference Scenario	$30-215

The investments made in implementing the Proposed Plan will have long-term benefits and present significant opportunities for California investors and businesses, as upfront capital investments will result in long-term fuel and energy efficiency savings, the benefits of which will continue into the future. The California economy will continue to grow under the Proposed Plan, but it will grow more resilient, more sustainable, and will be well positioned to reap the long-term benefits of lower carbon investments.

Estimating the Economic Impact on Disadvantaged Communities

As described above, and even with significant unquantified benefits, implementing the Proposed Plan is estimated to have a small impact on the Statewide California economy through 2030. However, shifting from fossil fuels can disproportionately affect specific geographic regions whose local economies rely on fossil fuel intensive industries. These regions can also include vulnerable populations and disadvantaged communities who may be disproportionately impacted by poor air quality and climate.

Achieving the SB 32 target will require sectors and regions to respond to the challenges and opportunities as California continues its transition to a clean energy economy. While the economic modeling does not show the impact to specific regions or populations, policy action at the State, regional, and local level can help to ensure that disadvantaged communities and vulnerable populations are able to benefit from technological innovation and the benefits of the clean energy economy.

This economic analysis will be revised prior to the final release of the 2030 Target Scoping Plan to include additional analyses including a regional impact analysis to estimate the distribution of economic impacts across regions of the State, including disadvantaged communities. In addition, there are currently three research contracts underway at CARB to quantify the impact of California's climate policy on regions and disadvantaged communities throughout California. As mentioned above, researchers from UCLA are estimating the improvements in health outcomes associated with AB 32, with a focus on disadvantaged communities. This research will be informed by input from technical advisory committees including a group focused on environmental justice.

There are also two studies currently underway to quantify the impact of GGRF funds. A UCLA contract focuses on quantifying job creation under GGRF in California, while a University of California, Berkeley, contract is constructing methodologies to assess the co-benefits of GGRF projects across California. These research efforts will provide a regional analysis of the impact of and benefits to specific communities and sectors to ensure that all Californians see economic benefits, in addition to clean air benefits, from the implementing the Proposed Plan.

D. Public Health

Addressing climate change could represent the greatest opportunity to improve public health in our time.[83] Many measures to reduce GHG emissions also have significant health co-benefits that can address climate change *and* improve the health and well-being of all populations across the State. Climate change is already affecting the health of communities.[84] Climate-related health impacts can include increased heat illness and death, increases in air pollution-related exacerbation of cardiovascular and respiratory diseases, injury and loss of life due to severe storms and flooding, increased vector-borne and water-borne diseases, and stress and mental trauma due to extreme weather-related catastrophes.[85] The urgency of action to address the impacts already being felt from a changing climate and the threats in coming decades provides an unprecedented opportunity for California's leadership in climate action to reduce GHG emissions and create healthy, equitable, and resilient communities where all people thrive. This section discusses the link between climate change and public health. It does not analyze the specific measures included in the strategy but provides context for assessing the potential measures and scenarios.

Achieving Health Equity through Climate Action

Many populations in California face *health inequities,* or unfair and unjust health differences between population groups that are systemic and avoidable.[86] Differences in environmental and socioeconomic determinants of health result in these health inequities. Those facing the greatest health inequities include low-income individuals and households, the very young and the very old, communities of color, and those who have been marginalized or discriminated against based on gender or race/ethnicity.[87] It is these very same populations, along with those suffering existing health conditions and certain populations of workers (e.g., outdoor workers), that climate change will most disproportionately impact.[88] The inequitable distribution of social, political, and economic power results in health inequities, while perpetuating systems (e.g.,

[83] Watts, N., W. N. Adger, P. Agnolucci, et al. 2015. "Health and climate change: Policy responses to protect public health." *The Lancet* 386, 1861–1914.
[84] USGCRP. 2016. *The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment.* Crimmins, A., J. Balbus, J. L. Gamble, C. B. Beard, J. E. Bell, D. Dodgen, R. J. Eisen, N. Fann, M. D. Hawkins, S. C. Herring, L. Jantarasami, D. M. Mills, S. Saha, M. C. Sarofim, J. Trtanj, and L. Ziska, Eds. U.S. Global Change Research Program, Washington, D.C., 312 pp.
[85] Ibid.
[86] Whitehead, M. 1992. "The concepts and principles of equity and health." *International Journal of Health Services* 22(3), 429–445.
[87] California Department of Public Health (CDPH). 2015. *The Portrait of Promise: The California Statewide Plan to Promote Health and Mental Health Equity.* A Report to the Legislature and the People of California by the Office of Health Equity. Sacramento, CA: California Department of Public Health, Office of Health Equity.
[88] Shonkoff, S., R. Morello-Frosch, M. Pastor, and J. Sadd. 2011. "The climate gap: Environmental health and equity implications of climate change and mitigation policies in California—a review of the literature." *Climatic Change* 109 (Suppl 1):S485–S503.

economic, transportation, land use, etc.) drive GHG emissions. As a result, communities face inequitable living conditions. For example, low-income communities of color tend to live in more polluted areas and face climate change impacts that can compound and exacerbate existing sensitivities and vulnerabilities.[89,90] Fair and healthy climate action requires that the inequities that create and intensify community vulnerabilities be addressed. The capacity for climate resilience is significantly driven by living conditions and the forces that shape them, such as income, education, housing, transportation, environmental quality, and access to services. Thus, strategies such as alleviating poverty, increasing access to opportunity, improving living conditions, and reducing health and social inequities will result in more climate-resilient communities. In fact, there are already many "no-regret" climate mitigation and adaptation measures available (discussed below) that can reduce health burdens, increase community resilience, and address social inequities.[91] Focusing efforts to achieve health equity can thus lead to significant progress in addressing human-caused climate change.

Potential Health Impacts of Climate Change Mitigation Measures

Socioeconomic Factors: Income, Poverty, and Wealth

Economic factors, such as income, poverty, and wealth, are collectively one of the largest determinants of health. As such, climate mitigation measures that yield economic benefits can improve population health significantly, especially if the economic benefits are directed to those most vulnerable and disadvantaged (including those living in poverty) who often face the most health challenges. From the poorest to richest ends of the income spectrum, higher income is associated with greater longevity in the United States.[92,93,94] The gap in life expectancy between the richest 1 percent and poorest 1 percent of Americans was almost 15 years for men in 2014, and about 10 years for women.[95] Early death among those living in poverty is not a result of those with higher incomes having better access to quality health care.[96] Only about 10–20 percent of a person's health status is accounted for by health care (and 20– 30 percent attributed to genetics), while the remainder is attributed to the social determinants of health. These include environmental quality, social and economic circumstances, and the social, media, policy, economic, retail, and built environments—all of which in turn shape stress levels and behaviors, including smoking, diet, and exercise.[97,98,99,100,101,102,103,104,105,106,107] In fact, where people live, work, learn, and play

[89] Ibid.
[90] Rudolph, L. and S. Gould. 2015. "Climate change and health inequities: A framework for action." *Annals of Global Health* 81:3, 432–444.
[91] Watts N, Adger WN, Agnolucci P, et al. 2015. Health and climate change: policy responses to protect public health. Lancet: 386, 1861-1914
[92] Chetty, R., M. Stepner, S. Abraham, et al. 2016. "The Association Between Income and Life Expectancy in the United States, 2001–2014." *JAMA* Published online April 10, 2016. doi:10.1001/jama.2016.4226.
[93] Marmot, M., S. Friel, R. Bell, et al. 2008. "Closing the gap in a generation: Health equity through action on the social determinants of health." *The Lancet* 372, 9650: 1661–1669.
[94] Woolf, S. H., and P. Braveman. 2011. "Where health disparities begin: The role of social and economic determinants—and why current policies may make matters worse." *Health Affairs* (Millwood) 30(10), 1852–1859.
[95] Chetty R, Stepner M, Abraham S, et al. 2016. The Association between Income and Life Expectancy in the United States, 2001-2014. JAMA. Published online April 10, 2016. doi:10.1001/jama.2016.4226
[96] Ibid.
[97] DHHS, Public Health Service. 1980. *Ten leading causes of death in the United States.* Atlanta, GA: Bureau of State Services.
[98] McGinnis, J., and W. Foege. 1993. "Actual causes of death in the United States." *JAMA* 270(18), 2207–2212.

is often a stronger predictor of life expectancy than their genetic and biological makeup.[108] The World Health Organization's Commission on the Social Determinants of Health concluded that the poor health of poor people, and the social gradient in health, are caused by the unequal distribution of power, income, goods, and services resulting from poor social policies and programs, unfair economic arrangements, and bad politics.[109] Thus, improving the conditions of daily life and tackling the inequitable distribution of power, money, and resources can remedy inequitable health outcomes.[110] Simply put, the more evenly distributed the wealth, the healthier a society is.[111]

The *wealth-health gradient* has significant implications for the Proposed Plan. State climate legislation and policies require prioritizing GHG reduction strategies that serve vulnerable populations and improve well-being for disadvantaged communities. As such, strategies that improve the financial security of communities facing disadvantage while reducing GHG emissions are win-win strategies. These include providing funds or services for GHG reduction programs (e.g., weatherization, energy efficiency, renewable energy, ZEVs, transit, housing, and others) to low-income individuals and households to help them reduce costs. Among the poorest 25 percent of people, per capita government expenditures are strongly associated with longer life spans.[112] Successful strategies California has already implemented to assure the poor do not pay higher costs for societal GHG reductions include low-income energy discount programs, in combination with direct climate credits, and policies and programs that help Californians reduce electricity, natural gas, and gasoline consumption.[113] More such strategies could be pursued. To tackle the inequitable distribution of power that leads to disparate health outcomes, agencies can first assure they have robust structures for civic engagement so that people facing health inequities can themselves participate in decision-making about solutions. Whether it is absolute poverty or relative deprivation

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[99] Lantz, P. et al. 1998. "Socioeconomic factors, health behaviors, and mortality: Results from a nationally representative prospective study of US adults." *JAMA* 279(21), 1703–1708.
[100] McGinnis, J. et al. 2002. "The case for more active policy attention to health promotion." *Health Affairs* 21(2), 78–93.
[101] Mokdad, A. et al. 2004. "Actual causes of death in the United States, 2000." *JAMA* 291(10), 1238–1245.
[102] Danaei, G. et al. 2009. "The preventable causes of death in the United States: Comparative risk assessment of dietary, lifestyle, and metabolic risk factors." *PLoS Medicine* 6(4), e1000058.
[103] World Health Organization (WHO). 2009. *Global health risks: Mortality and burden of disease attributable to selected major risks.* Geneva: WHO.
[104] Booske, B. et al. 2010. Different perspectives for assigning weights to determinants of health. County Health Rankings Working Paper. Madison, WI: University of Wisconsin Population Health Institute.
[105] Stringhini, S. et al. 2010. "Association of socioeconomic position with health behaviors and mortality." *JAMA* 303(12), 1159–1166.
[106] Thoits, P. 2010. "Stress and health: Major findings and policy implications." *Journal of Health and Social Behavior* 51 Suppl, S41–53.
[107] McGovern, L., G. Miller and P. Highes-Cromwick. 2014. "Health policy brief: The relative contribution of multiple determinants to health outcomes." *Health Affairs*
[108] Iton, A. 2006. Tackling the root causes of health disparities through community capacity building. In: Hofrichter R, ed. *Tackling Health Inequities Through Public Health Practice: A Handbook for Action.* Washington, D.C., and Lansing, MI: National Association of County and City Health Officials and Ingham County Health Department; 116–136.
[109] Marmot M, Friel S, Bell R, et al. 2008. Closing the gap in a generation: health equity through action on the social determinants of health. The Lancet , Volume 372 , Issue 9650, 1661 – 1669
[110] Ibid.
[111] Smith, R. 1996. "The big idea." *British Medical Journal* 312:April 20th, Editor's choice.
[112] Chetty R, Stepner M, Abraham S, et al. 2016. The Association between Income and Life Expectancy in the United States, 2001-2014. JAMA. Published online April 10, 2016. doi:10.1001/jama.2016.4226
[113] Gattaciecca, J., C. Callahan, and J. R. DeShazo. 2016. *Protecting the most vulnerable: A financial analysis of Cap-and-Trade's impact on households in disadvantaged communities across California.* UCLA Luskin School of Public Affairs: Los Angeles, CA. Available at: http://innovation.luskin.ucla.edu/content/protecting-most-vulnerable. Accessed April 22, 2016.

that leads to poor health, investments and policies that both lift up the poor and reduce wealth disparities will address the multiple problems of climate change mitigation, adaptation, and health inequities.

Employment

Employment status impacts human health in many ways. Poor health outcomes of unemployment include premature death, self-rated ill-health (a strong predictor of poor health outcomes), and mental illness.[114,115,116,117] Economic strain related to unemployment can impact mental health and trigger stress that is linked to other health conditions.[118,119] Populations of color are overrepresented in the unemployment and under-employment ranks, which likely contributes to racial health inequities. In 2014, 14.7 percent of African-Americans, 12.1 percent of American Indians and Alaska Natives, and 9.8 percent of Latinos were unemployed, compared to 7.9 percent of Whites.[120] In addition to providing income, the work experience has health consequences. There is a *work status–health gradient* similar to the wealth–health gradient. Workers with lower occupational status have a higher risk of death,[121] increased blood pressure,[122] and more heart attacks.[123,124] Higher status workers often have a greater sense of autonomy, control over their work, and predictability, compared to lower status workers, whose lack of control and predictability translates to stress that shortens their lives.[125] Nonstandard working arrangements such as part-time, seasonal, shift, contract, or informal sector work have been linked to greater psychological distress and poorer physical health.[126,127] Women are heavily overrepresented in nonstandard work, as are people of color and people with low levels of education.[128,129]

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[114] Krueger, P., and S. Burgard. 2011. Income, occupations and work. In: Rogers R, Crimmins E, eds. *International Handbook of Adult Mortality.* New York: Springer: 263–288.

[115] Rogers, R., R. Hummer, and C. Nam. 2000. *Living and Dying in the USA. Behavioral, health, and social differentials of adult mortality.* New York, NY: Academic.

[116] Ross, C. and J. Mirowsky. 1995. "Does employment affect health?" J*ournal of Health and Social Behavior* 36(3):230–243.

[117] Burgard, S., and K. Lin. 2013. "Bad jobs, bad health? How work and working conditions contribute to health disparities." *Am Behav Sci* 57(8).

[118] Price, R., D. Friedland, J. Choi, and R. Caplan. 1998. Job-loss and work transitions in a time of global economic change.

[119] Price, R., J. Choi, and A. Vinokur. 2002. "Links in the chain of adversity following job loss: How financial strain and loss of personal control lead to depression, impaired functioning, and poor health." *Journal of Occupational Health Psychology* 7(4), 302.

[120] U.S. Census Bureau. 2014. American Community Survey 1-Year Estimates. http://www2.census.gov/programs-surveys/acs/summary_file/2014/data/. Last updated August 31, 2015. Accessed April 20, 2016.

[121] Rogers R, Hummer R, and Nam C. 2000. Living and Dying in the USA. Behavioral, health, and social differentials of adult mortality. New York, NY: Academic

[122] Colhoun, H., H. Hemingway, and N. Poulter. 1998. "Socio-economic status and blood pressure: An overview analysis." *Journal of Human Hypertension* 12(2).

[123] Möller, J., T. Theorell, U. De Faire, A. Ahlbom, and J. Hallqvist. 2005. "Work related stressful life events and the risk of myocardial infarction. Case-control and case-crossover analyses within the Stockholm heart epidemiology programme (SHEEP)." *Journal of Epidemiology and Community Health* 59(1), 23–30.

[124] Burgard S, Lin K. 2013. Bad jobs, bad health? How work and working conditions contribute to health disparities. Am Behav Sci: 57(8).

[125] Marmot, M., G. Rose, M. Shipley, and P. Hamilton. 1978. "Employment grade and coronary heart disease in British civil servants." *Journal of Epidemiology and Community Health* 32(4), 244–249.

[126] Dooley, D., and J. Prause. 2004. Settling down: Psychological depression and underemployment. The social costs of underemployment, 134-157. In: Dooley, D. and J. Prause. *The Social Costs of Underemployment: Inadequate Employment as Disguised Unemployment.*

[127] Virtanen, M., M. Kivimäki, M. Joensuu, P. Virtanen, M. Elovainio, and J. Vahtera. 2005. "Temporary employment and health: A review." *International Journal of Epidemiology* 34(3): 610–622.

[128] Nollen, S. 1996. "Negative aspects of temporary employment." *Journal of Labor Research* 17(4): 567–582.

[129] Burgard S, Lin K. 2013. Bad jobs, bad health? How work and working conditions contribute to health disparities. Am Behav Sci: 57(8)

The implementation of California's climate change goals provides great opportunity to not only improve the habitability of the planet, but also to increase economic vitality, employ historically disadvantaged people in secure jobs, and improve the health of the population. Measures in the Proposed Plan that aim to reduce greenhouse gases can simultaneously improve health and social equity by prioritizing or requiring that: (1) infrastructure projects using public funds pay living wages, provide quality benefits to all employees, and minimize nonstandard work; (2) locals are hired as much as is feasible; (3) preference is given for women-owned and minority-owned businesses; (4) employers receiving public funds assess and reduce work stress and lack of workplace control; (5) projects benefiting from State climate investments prioritize hiring from historically hard-to-employ groups, such as youth (especially youth of color), formerly incarcerated people, and people with physical or mental illness; and (6) training is provided to these same groups to work in jobs in sectors that will support a sustainable economy.

Communications Supporting Climate Change Behaviors and Policies

California's leadership on GHG reduction is exceptional. However, climate mitigation goals are often treated independently by sector, and the public does not see a unified message that changes must take place on every level in every sector to preserve human health and well-being. Climate strategy could be supported by public communications campaigns that link sectors and present a message of the need for bold action, along with the benefits that action can yield. Mass media communications and social marketing campaigns can help shift social and cultural norms toward sustainable and healthy practices. Messaging about the co-benefits of climate change policies in improving health and well-being can lead to increased community and decision-maker support among vulnerable groups for policies and measures outlined in the Proposed Plan.

Community Engagement Leads to Robust, Lasting, and Effective Climate Policies

For California's climate change policies to be supported by the public and be implemented with enthusiasm, they must be developed through ample, genuine opportunities for community members to discuss and provide input. Californians' contributions to the policy arena strengthen the end products and assist in their implementation and enforcement.

Efforts to mitigate climate change through policy, environmental, and systems change present considerable opportunities to promote sustainable, healthy, resilient, and equitable communities. The measures in the Proposed Plan, and the way they are implemented, can help create living conditions that facilitate physical activity; encourage public transit use; provide access to affordable, fresh, and nutritious foods; protect the natural systems on which human health depends; spur economic development; provide safe, affordable, and energy-efficient housing; enable access to jobs; and increase social cohesion and civic engagement. These climate change mitigation measures can improve overall population health, as well as material conditions, access to opportunity, and health and well-being in communities facing health inequities. Approaching the policy solutions outlined in the Proposed Plan with a health and equity lens can

ultimately help lead to a California in which all current and future generations of Californians can benefit and thrive.

E. Environmental Analysis

CARB, as the lead agency for the Proposed 2030 Target Scoping Plan, prepared a Draft Environmental Analysis (EA) in accordance with the requirements of the California Environmental Quality Act (CEQA) and CARB's regulatory program certified by the Secretary of Natural Resources (California Code of Regulation, title 17, sections 60006–60008; California Code of Regulation, title 14, section 15251, subdivision (d)). The resource areas from the CEQA Guidelines Environmental Checklist were used as a framework for a programmatic environmental analysis of the reasonably foreseeable compliance responses resulting from implementation of the proposed measures discussed in the Proposed Plan. The Draft EA provides an analysis of both the beneficial and adverse impacts and feasible mitigation measures for the reasonably foreseeable compliance responses associated with the proposed measures. Collectively, the Draft EA concluded that implementation of these actions could result in the following short-term and long-term beneficial and adverse impacts:

- Beneficial long-term impacts to air quality, energy demand and greenhouse gas emissions.
- Less than significant impacts to air quality, energy demand, resources related to land use planning, mineral resources, population and housing, public services, and recreational services.
- Potentially significant and unavoidable adverse impacts to aesthetics, agriculture and forest resources, air quality, biological resources, cultural resources, geology and soils, hazards and hazardous materials, hydrology and water quality, resources related to land use planning, noise, recreational services, transportation/traffic, and utilities and service systems.

The potentially significant and unavoidable adverse impacts are primarily related to short-term construction-related activities, which explains why some resource areas are identified above as having both less-than-significant impacts and potentially significant impacts. Please refer to the Draft EA in Appendix F for further details.

CARB will prepare written responses to all comments received on the Draft EA, which will be presented to the Board for consideration along with the Final EA.

IV. Key Sectors

Climate change mitigation policies must be considered in the context of the sector's contribution to the State's total GHGs, while also considering any co-benefits for criteria pollutant and toxic air contaminant reductions. The transportation, electricity (in-state and imported), and industrial sectors are the largest contributors to the GHG inventory and present the largest opportunities for GHG reductions. However, to ensure decarbonization across the entire economy and to meet our 2030 GHG target, policies must be considered for other sectors. Policies that support energy efficiency, alternative fuels, and renewable power also can provide co-benefits for both criteria and toxic air pollutants.

Any specific policies identified within the Final Plan that will ultimately be considered by the Board or other State agencies for adoption will be subject to subsequent analytical and public processes to develop and identify the full requirements and process for implementation. For example, a change in the LCFS Carbon Intensity (CI) target would only take effect after a subsequent rulemaking for that regulation that would include its own public process and environmental, economic, and public health analyses. Many policies for reducing emissions toward the 2030 target are already known. For instance, the increased RPS, energy efficiency requirements, and various transportation plans will go far in reducing GHGs toward achieving the 2030 target, while delivering reductions in criteria and toxic air pollutants. This Proposed Plan identifies these and additional policies or program enhancements we will need to achieve remaining GHG reductions in a complementary, flexible, and cost-effective manner to meet the 2030 target. These policies should continue to encourage reductions beyond 2030 to keep us on track to stabilize the climate. Policies that ensure economy-wide investment decisions that incorporate consideration of GHG emissions are particularly important.

As we pursue GHG reduction targets, we must acknowledge the integrated nature of our built and natural environments, and cross-sector impacts of policy choices. Some strategies do not fit neatly into one sector category, such as Green Buildings, which cross the energy, transportation, water, waste, and land use sectors. Green building regulations and programs offer complementary opportunities to address the direct and indirect effects of buildings on the environment by incorporating strategies to minimize overall energy use, water use, waste generation, and transportation impacts. The Governor's Green Buildings Executive Order B-18-12 for State buildings and the California Green Building Standards (CALGreen) Code[130] are key state initiatives supporting emission reductions associated with buildings, and some local governments are taking action by adopting "beyond code" green building standards. Looking forward, there is a need to establish a path toward transitioning to zero net carbon buildings, which will be the next generation of buildings that can contribute significantly to achieving long-term climate goals. Recent research activities have provided results to better quantify GHG emission reductions of green buildings, and additional research

[130] The authority to update and implement the CALGreen Code is the responsibility of several State agencies identified in California Building Standards Law.

activities need to continue to expand their focus to support technical feasibility evaluations and implementation.

Each of the policies directed at the built environment must be considered in the broader context of the high-level goals for other sectors, including the Natural and Working Lands sector. For example, policies that support natural and working lands can reduce emissions and sequester carbon, while also providing ecosystem benefits such as better water quality, increased water yield, soil health, reduced erosion, and habitat connectivity. These policies and co-benefits will be considered as part of the integrated strategy outlined above. Table lV-1 provides examples of the cross-sector interactions between and among the main sectors analyzed for the Proposed Plan that are discussed in this chapter (Energy, Transportation, Industry, Water, Waste Management, and Natural and Working Lands), and which are discussed in this chapter.

This chapter recognizes these interactions and relates these broad strategic options to the specific additional programs recommended in Chapter ll of this document. Accordingly, Chapter lV provides an overview of each sector's contributions to the State's GHG emissions, a description of both ongoing and proposed programs and policies to meet the 2030 target, and additional climate policy steps that could be considered in the future. The wide array of complementary and supporting measures being contemplated or undertaken across State government are detailed here. The broad view of State action described in this chapter thus provides context for the narrower set of measures discussed in detail in Chapter ll of this Proposed Plan. It is these measures in Chapter ll that CARB staff has identified as specific actions to meet the 2030 target in SB 32.

The following phrases have specific meanings in this discussion of the policy landscape: "Ongoing and Proposed Measures" refers to programs and policies that are either ongoing existing efforts, or efforts required by statute or about to begin. These measures include those identified as necessary specific actions to meet the 2030 GHG target, and which are set apart and described in greater detail in Chapter ll. "Sector Measures" listed also include cross-cutting measures that affect many entities in the sector; some of these are also identified in Chapter ll. "Potential Additional Actions" are not being proposed as part of the specific strategy to achieve the 2030 target in this Proposed Plan. However, this Proposed Plan aims to spur thinking and exploration of innovative new technologies and polices that may help the State achieve its long-term climate goals. Some of these items may not ever be formally proposed, but they are included here because CARB, other agencies, and stakeholders believe their potential should be explored with stakeholders in coming years.

Table IV-1. Cross-Sector Relationships

Sector	Example Interactions with Other Sectors
 Energy	 Hydroelectric power, cooling, cleaning, waste water treatment plant (WWTP) bioenergy  Vehicle-to-grid power; electricity supply to vehicle charging infrastructure  Biomass feedstock for bioenergy, land for utility-scale renewable energy (solar, wind)  Agricultural waste and manure feedstocks for bioenergy  Organic waste for bioenergy
 Transportation	 Electric vehicles, natural gas vehicles, transit/rail; more compact development patterns that reduce vehicle miles traveled (VMT) also demand less energy per capita  More compact development patterns that reduce VMT also demand less water per capita and reduce conversion of natural and working lands  Reducing VMT also reduces energy demands necessary for producing and distributing fuels and vehicles and construction and maintenance of roads  Biomass feedstock for biofuels  Agricultural waste and manure feedstocks for biofuels  Organic waste for biofuels  Greenfield suburban development on natural and working lands leads to increased VMT
 Industry	 Potential to electrify fossil natural gas equipment, substitution of fossil-based energy with renewable energy  Greenfield urban development impacts

Water	Energy consumption for water pumping, treatment, heating; resource for cooling, cleaning; WWTP bioenergy Use of compost to help with water retention / conservation / drought mitigation Land conservation results in healthier watersheds by reducing polluted runoff, allowing groundwater recharge, and maintaining properly functioning ecosystems
Waste Management	Composting, anaerobic digestion, and wastewater treatment plant capacity to help process organic waste diverted from landfills Compost for carbon sequestration, erosion control in fire-ravaged lands, water conservation, and healthy soils Replacing virgin materials with recycled materials associated with goods production; enhanced producer responsibility reduces energy impacts of consumption Efficient packaging materials reduces energy consumption and transportation fuel use
Agriculture	Crop production, manure management; WWTP biosolids for soil amendments Agricultural waste and manure feedstocks for bioenergy Compost production in support of Healthy Soils Initiative
Natural and Working Lands	Healthy forestlands provide wood and other forest products Restoring coastal and sub-tidal areas improves habitat for commercial and other fisheries. Sustainable management can provide biomass for electricity. Sustainable management can provide biomass for biofuels. Resilient natural and working lands provide habitat for species and functions to store water, recharge groundwater, naturally purify water, and moderate flooding. Forests are also a source of compost and other soil amendments Conservation and land protections help reduce VMT and increase stable carbon pools in soils and above-ground biomass.

A. Low Carbon Energy

The energy sector in California is composed of electricity and natural gas infrastructure, which brings electricity and natural gas to homes, businesses, and industry. This vast system is critical to California's economy and public well-being, and pivotal to reducing its GHG emissions.

Historically, power plants generated electricity largely by combusting fossil fuels. In the 1970s and early 1980s, a significant portion of California's power supply came from coal and petroleum resources. To reduce air pollution and promote fuel diversity, the State has shifted away from these resources to natural gas, renewable energy, and energy efficiency programs, resulting in significant GHG emissions reductions. Emissions from the electricity sector are currently approximately 20 percent below 1990 levels and are well on their way to achieving deeper emissions cuts by 2030. Since 2008, renewable generation almost doubled, coal generation was reduced by more than half, and GHG emissions were reduced by a quarter.

Carbon dioxide is the primary GHG associated with the electricity and natural gas systems. The electricity sector, which is composed of in-state generation and imported power to serve California load, has made great strides to help California achieve its climate change objectives. Renewable energy has shown tremendous growth, with capacity from large-scale solar, wind, geothermal, hydropower, and biomass power plants growing from 6,600 megawatts (MW) in 2010 to nearly 14,300 MW in 2015.[131,132]

Renewable energy adoption in California has been promoted through the RPS and several funding mechanisms, such as the California Solar Initiative (CSI) programs, Self-Generation Incentive Program (SGIP), Net-Energy Metering (NEM), and federal tax credits. These mandates and incentives have spurred both utility-scale and small-scale customer-developed renewable energy projects.

SB 350 requires large publicly owned utilities and all load-serving entities under the jurisdiction of the California Public Utilities Commission (CPUC) to file integrated resource plans (IRPs) with the California Energy Commission (CEC) and CPUC, respectively. Through their IRPs, filing entities will demonstrate how they will meet the electricity sector's share of the State's 2030 GHG reduction target while ensuring reliability in a cost-effective manner. The CEC and CPUC are currently developing the guidelines that publicly owned utilities and load-serving entities will follow to prepare and submit IRPs. The Proposed Plan is expected to provide information to help establish the range of GHG reductions required for the electricity sector, and those numbers will be translated into planning target ranges in the IRP process. The IRP process will grant retail electricity sellers in California some flexibility to determine the

[131] Large-scale means 20 MW or larger capacity.
[132] California Energy Commission. 2016. Tracking Progress. Renewable Energy – Overview. www.energy.ca.gov/renewables/trackingprogress/documents/renewable.pdf

optimal way to reduce GHG emissions, based on the IRP Reference System Plan,[133] to achieve the electricity sector's share of the 2030 goal.

Energy efficiency is another key component to reducing energy sector GHG emissions, and it will be another consideration in each agency's IRP process. Utilities have been offering energy efficiency programs, such as incentives, to California customers for decades, and CEC has continually updated building and appliance standards. In the context of IRPs, utility-ratepayer-funded energy efficiency programs will likely continue to play an important role in reducing GHG emissions in the electricity sector.

SB 350 requires CEC and CPUC to establish annual targets for statewide energy efficiency savings and demand reduction that will achieve a cumulative doubling of statewide energy efficiency savings in electricity and natural gas end uses by 2030. These targets can be achieved through appliance and building energy efficiency standards; utility incentive, rebate, and technical assistance programs; third-party delivered energy efficiency programs; and other programs. Achieving greater efficiency savings in existing buildings, as directed by Governor Brown in his 2015 inaugural speech, will be essential to meet the goal of doubling energy efficiency savings. In September 2015, CEC adopted the Existing Buildings Energy Efficiency Action Draft Plan, which is designed to provide foundational support and strategies to enable scaling of energy efficiency in the built environment. Pursuant to SB 350, CEC published an updated Existing Buildings Energy Efficiency Action Plan prior to January 2017. More than $10 billion in private capital investment will be needed to double statewide efficiency savings in California.[134] Energy efficiency programs are one part of the broader green buildings strategy, which incorporates additional measures to minimize water use, waste generation, and transportation impacts.

Fossil-fuel-based natural gas is a significant fuel source for both in-State electricity generation and electricity imported into California. It is also used in transportation applications and in residential, commercial, industrial, and agricultural sector end uses. Greenhouse gas emissions from combustion of fossil natural gas decreased from 134.71 $MMTCO_2e$ in 2000 to 127.73 $MMTCO_2e$ in 2014, while natural gas pipeline fugitive emissions were estimated to be 4.0 $MMTCO_2e$ in 2014 and have been nearly unchanged since 2000.[135] Greenhouse gas-reduction strategies should focus on efficiency, reducing leakage from well and pipelines, implementing the SLCP strategy, and studying the potential for renewable natural gas (RNG) fuel switching (i.e., renewable hydrogen blended with methane or biomethane).

Renewable natural gas volume has been increasing from approximately 1.5 million diesel gallon equivalent (dge) in 2011 to more than 68.5 million dge in 2015, and continued substitution of RNG for fossil natural gas would help California reduce its

[133] The Reference System Plan will be used in the IRP process to guide investment, resource acquisition, and programmatic decisions to reach the State's policy goals, in addition to informing the development of individual load serving entities IRPs.
[134] California Energy Commission. 2016. *Existing Building Energy Efficiency Action Plan.* page 61. Available at: http://docketpublic.energy.ca.gov/PublicDocuments/16-EBP-01/TN214801_20161214T155117_Existing_Building_Energy_Efficency_Plan_Update_Deceber_2016_Thi.pdf
[135] ARB. 2016. ARB's Emission Inventory Activities. www.arb.ca.gov/ei/ei.htm

dependence on fossil fuels. In addition, RNG can be sourced by recovering methane from landfills, livestock operations, and wastewater treatment facilities through the use of existing technologies, thereby also reducing methane emissions. The capture and productive use of renewable methane from these and other sources is consistent with requirements of SB 1383.

Collectively, renewable energy and energy efficiency measures can result in significant public health and climate benefits by displacing air pollution and GHG emissions from fossil-fuel based energy sources, as well as by reducing the health and environmental risks associated with the drilling, extraction, transportation, and storage of fossil fuels, especially for communities living near fossil-fuel based energy operations.[136]

As the energy sector continues to evolve and decarbonize, both the behavior of individual facilities and the design of the grid itself will change, with important distributional effects. Some power plants may operate more flexibly to balance renewables, emerging resources (including storage) will become more prevalent, and aging facilities may retire and be replaced. In turn, this may shift patterns of criteria pollutant emissions at these facilities. Because many existing power plants are in, or near, disadvantaged communities, it is of particular importance to ensure that this transition to a cleaner grid does not result in unintended negative impacts to these communities.

1. Looking to the Future

This section outlines the high-level objectives and goals to reduce GHGs in this sector.

Electricity Goals

- Achieve sector-wide and load-serving entity specific GHG reduction planning targets set by the State through Integrated Resource Planning.
- Reduce fossil fuel use.
- Reduce energy demand.

Natural Gas Goals

- Ensure safety of natural gas system.
- Decrease fugitive methane emissions.
- Reduce dependence on fossil natural gas.

2. Cross-Sector Interactions

The energy sector interacts with nearly all sectors of the economy. Siting of power plants (including solar and wind facilities) and transmission and distribution lines has impacts on land use in California—be it conversion of agricultural or natural and working lands, impacts to sensitive species and habitats, or implications to disadvantaged, vulnerable, and environmental justice communities. Additionally, more compact

[136] For a detailed analysis of public health implications and impacts of climate mitigation measures, please see Appendix J: Public Health Analysis (to be released in early 2017).

development patterns reduce per capita energy demands, while less-compact sprawl increases them. Further, efforts to reduce GHG emissions in the transportation sector include electrification. Some industrial sources also use electricity as a primary or auxiliary source of power for manufacturing. In the future, industrial facilities may electrify their systems instead of relying on natural gas. These activities will increase demand for this sector. In addition, water is used in various applications in the energy sector, ranging in intensity from cooling of turbines and other equipment at power plants to cleaning solar photovoltaic panels. Given California's historic drought, water use for the electricity sector is an important consideration for operation, maintenance, and construction activities.

Continued planning and coordination with federal, State, and local agencies, governments, tribes, and stakeholders will be crucial to minimizing environmental and health impacts from the energy sector, deploying new technologies, and identifying feedstocks.

3. Efforts to Reduce Greenhouse Gases

The measures below include some required and new potential measures to help achieve the State's 2030 target and to support the high-level objectives for this sector. Some measures may be designed to directly address GHG reductions, while others may result in GHG reductions as a co-benefit.

Ongoing and Proposed Measures – Electricity

- Per SB 350, with respect to Integrated Resource Plans, establish GHG planning targets for the electricity sector and each load-serving entity.
- Per SB 350, ensure meaningful GHG emission reductions by load-serving entities through Integrated Resource Planning.
- Per AB 197, prioritize direct reductions at large stationary sources, including power-generating facilities.
- Per SB 350, increase the RPS to 50 percent of retail sales by 2030 and ensure grid reliability.
- Per Governor Brown's Clean Energy Jobs Plan, increase development of distributed renewable generation.
- Continue to increase use of distributed renewable generation at State facilities where space allows.
- Increase retail customers' use of renewable energy through optional utility 100 percent renewable energy tariffs.
- Per SB 350, efforts to evaluate, develop, and deploy regionalization of the grid and integration of renewables via regionalization of the California Independent System Operator (CAISO) should continue while maintaining the accounting accuracy and rigor of California's greenhouse gas policies.
- Per SB 350, establish annual targets for statewide energy efficiency savings and demand reduction that will achieve a cumulative doubling of statewide energy efficiency savings in electricity and natural gas end uses by 2030.

- Per SB 350, conduct and publish studies on barriers to increasing access to renewable energy generation for low-income customers, energy efficiency and weatherization investments for low-income customers, and contracting opportunities for local small business in disadvantaged communities, as well as recommendations on how to achieve those goals.
- Continue implementation of the Regulations Establishing and Implementing a Greenhouse Gases Emission Performance Standard for Local Publicly Owned Electric Utilities as required by SB 1368 (Perata, Chapter 598, Statutes of 2006), which effectively prohibits electric utilities from making new long-term investments in high-GHG emitting resources such as coal power.
- Per AB 802, adopt the forthcoming CEC regulations governing building energy use data access, benchmarking, and public disclosure.
- Per AB 2868, encourage development of additional energy storage capacity on the transmission and distribution system.
- Per AB 758,[137] implement recommendations under State jurisdiction included in the AB 758 Action Plan developed by CEC.

Ongoing and Proposed Measures – Natural Gas

- Adopt the forthcoming CARB Proposed Regulation for Greenhouse Gas Emission Standards for Crude Oil and Natural Gas Facilities to reduce fugitive methane emissions from storage and distribution infrastructure.
- Per SB 1371, adopt improvements in investor-owned utility (IOU) natural gas systems to address methane leaks.
- Implement the SLCP Strategy to reduce natural gas leaks from oil and gas wells, pipelines, valves, and pumps to improve safety, avoid energy losses, and reduce methane emissions associated with natural gas use.
- Per SB 1383, adopt regulations to reduce methane emissions from livestock manure and dairy manure management operations by up to 40 percent below the dairy sector's and livestock sector's 2013 levels by 2030, including establishing energy infrastructure development and procurement policies needed to encourage dairy biomethane projects. The regulations will take effect on or after January 1, 2024.
- Per SB 887, initiate continuous monitoring at natural gas storage facilities and (by January 1, 2018) mechanical integrity testing regimes at gas storage wells, develop regulations for leak reporting, and require risk assessments of potential leaks for proposed new underground gas storage facilities.
- Per SB 1383, CEC will develop recommendations for the development and use of renewable gas as part of its 2017 Integrated Energy Policy Report (IEPR).
- Per Public Utilities (PU) Code 454.56, CPUC, in consultation with CEC, (1) identifies all potentially achievable cost-effective natural gas efficiency savings and establishes gas efficiency targets for the gas corporation to achieve, and (2) requires gas corporations to first meet unmet resource needs through available natural gas efficiency and demand reduction resources that are cost-

[137] AB 758 requires CEC, in collaboration with CPUC, to develop a comprehensive program to achieve greater energy efficiency in the State's existing buildings.

effective, reliable, and feasible (PU Codes 890–900 provide public goods charge funding authorization for these programs).
- Per SB 185 (De Leon, Chapter 605, Statutes of 2015), implement the requirement for the California Public Employees' Retirement System (CalPERS) and the California State Teachers' Retirement System (CalSTRS) to sell their holdings in coal-producing companies by June 1, 2017, and explore extending divestiture requirements for additional fossil-fuel assets.

Sector Measures
- Adopt a post 2020 Cap-and-Trade Program.
- Evaluate and implement additional policies and measures that support further reductions of emissions of criteria and toxics air pollutants from fossil power plants, especially plants located near disadvantaged communities.

Potential Additional Actions
The actions below have the potential to reduce GHGs and complement the measures and policies identified in Chapter ll. These are included to spur thinking and exploration of innovation that may help the State achieve its long-term climate goals. It is anticipated that there will be workshops and other stakeholder forums in the years following finalization of the Scoping Plan to explore these potential actions.

- Increase use of renewable energy through long-term agreements between customers and utilities (such as Sacramento Municipal Utility District Solar Shares).
- Develop clear and feasible rules needed for the development of electricity storage technologies.
- Adopt a zero net energy (ZNE) standard for residential buildings by 2018/2019, and for commercial buildings by 2030.
- Expand the State Low-Income Weatherization Program (LIWP) to continue to improve energy efficiency and weatherize existing residential buildings, particularly for low-income individuals and households.
- Decrease usage of fossil natural gas through a combination of energy efficiency programs, fuel switching, and the development and use of RNG in the residential, commercial, and industrial sectors.
- Accelerate the deployment of heat pumps.
- Consider enhanced energy efficiency (high efficiency air conditioners, light-emitting diode (LED) lamps, efficiency improvements in industrial process cooling and refrigeration, efficient street lighting).
- Promote programs to support third-party delivered energy efficiency projects.
- Per AB 33, consider large-scale electricity storage.
- Support more compact development patterns to promote reduced per capita energy demand (see the Transportation sector for specific policy recommendations).
- Establish target dates and pathways for a zero carbon building State policy.
    - Form a multi-agency and stakeholder working group to:

- Compile a literature review and evaluate research on zero carbon buildings;
- Propose a definition for zero carbon buildings; and
- Recommend target dates and pathways to implement policy.

B. Industry

California's robust economy, with the largest manufacturing sector in the United States, is supported by a variety of sub-industrial sectors, some of which include cement plants, refineries, food processors, paper products, wineries, steel plants, and industrial gas, entertainment, technology and software, aerospace, and defense companies. Together, industrial sources account for approximately 21 percent of the State's GHG emissions—almost equal to the amount of GHG emissions from the energy sector. Emissions in this sector are mainly due to fuel combustion and, in some industries, process-related emissions. Changes in this sector strongly correlate with changes in the overall economy. For example, housing and construction growth usually increases demand for cement. Moving toward a cleaner economy and ensuring we meet the statewide targets requires us to address GHG emissions in this sector, which has the potential to provide local co-benefits in criteria pollutant and toxic air contaminant reductions in immediate surrounding locations, especially in vulnerable communities. At the same time, we must ensure there is a smooth path to a cleaner future to support a resilient and robust economy with a strong job force, including training opportunities for workers in disadvantaged communities, while continuing to support economic growth in existing and new industries.

Greenhouse gas emissions in the Industrial sector have remained relatively flat for the last few years while the State's economy has continued to grow, meaning the GHG emissions to produce each dollar of gross standard product is decreasing. In 2015, this sector accounted for approximately 20 percent of the State's GDP. In 2015, California industry exported $165.4 billion in merchandise.[138] Policies to address GHG emission reductions must continue to balance the State's economic well-being with making progress toward achievement of the statewide limits.

As this sector is dominated by combustion-related emissions, policies and measures to supply cleaner fuels and more efficient technology are the key to reducing GHG emissions. Some sectors, such as cement and glass, also have significant process emissions, and there may be fewer opportunities to address those process emissions, as they are related to chemical reactions and processes to meet safety, product-specific, or regulatory standards for the final products. Another important aspect for this sector is its role as the State transitions to a cleaner future. Infrastructure, including existing facilities and new facilities, can support the production of new technology to bolster the State's efforts to address GHGs. For example, existing refineries have an opportunity to move away from fossil fuel production and switch to the production of biofuels and clean technology. Another example of a switch to a cleaner technology is

[138] U.S. Department of Commerce. International Trade Administration. 2016. California Exports, Jobs, & Foreign Investment. www.trade.gov/mas/ian/statereports/states/ca.pdf

Tesla's Fremont, California, facility that was a former General Motors and Toyota factory. As the State works to double energy efficiency in existing buildings, there will be an increased demand for efficient lighting fixtures, building insulation, low-e[139] coatings for existing windows, or new windows—goods which could be produced in California. Three predominant in-State paths to reducing GHG emissions for the Industrial sector are: fuel switching, energy efficiency improvements, or the relocation of production to outside the State. Carbon capture and sequestration also offers a potential new, long-term path for reducing GHGs for large stationary sources.

While fuel switching and energy efficiency are beneficial strategies, relocation of production to outside the State is disadvantageous for a couple of reasons. First, AB 32 requires the State's climate policies to minimize emissions leakage, and relocation would shift GHG emissions outside of the State, resulting in emissions leakage. Second, it could also reduce the availability of associated jobs and could impact a local tax base that supports local services such as public transportation, emergency response, and social services, as well as funding sources critical to protecting the natural environment and keeping it available for current and future generations.

Even while we continue to seek further GHG reductions in the sector, it is important to recognize the State has a long history of addressing health-based air pollutants in this sector. Many of the actions for addressing criteria pollutants and toxic air contaminants in the industrial sector are driven by California's local air district stationary source requirements to ensure progress toward achieving State and national ambient air quality standards. Some of those actions, such as use of Best Available Control Technology, have resulted in co-benefits in the form of GHG reductions. The State must continue to strengthen its existing criteria and toxic air pollutant programs and relationships with local air districts to ensure all Californians have healthy, clean air. This is especially true in disadvantaged communities.

AB 32 directed CARB to take several actions to address GHG emissions, such as early action measures, GHG reporting requirements for the largest GHG sources, and other measures. In response, the State adopted multiple measures and regulations, including regulations for high global warming potential (high-GWP) gases used in refrigeration systems and the semiconductor industry.[140] These regulations apply to specific GHGs and types of equipment that can be found across the economy. For example, high-GWP gases are found in refrigeration systems in large food processing plants and chemical and petrochemical facilities, among others.[141]

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[139] Low-e coatings reduce the emissivity, or heat transfer, from a window to improve its insulating properties.

[140] ARB. Refrigerant Management Program. www.arb.ca.gov/cc/rmp/rmp.htm

[141] The U.S. Environmental Protection Agency (U.S. EPA) has also enacted regulations to reduce hydrofluorocarbon (HFC) emissions by prohibiting high-GWP refrigerants in new retail food refrigeration equipment and in chillers used for large air-conditioning applications. On the international level, the European Union F-gas regulations went into effect January 1, 2015. Those regulations prohibit high-GWP HFCs in new equipment and require a gradual phasedown in the production and import of HFCs. A similar HFC phasedown that would take place globally was the subject of international negotiations during the Montreal Protocol meeting in Rwanda from October 10–14, 2016. Those negotiations resulted in an agreement that will phase down the use of HFCs and put the world on track to avoid nearly 0.5°C of warming by 2100.

The State has also adopted the first in the world economy-wide cap-and-trade program that applies to all large industrial GHG emitters, imported electricity, and fuel and natural gas suppliers. The Cap-and-Trade Program is a key element of California's GHG reduction strategy. The Cap-and-Trade Regulation establishes a declining limit on major sources of GHG emissions, and it creates a powerful economic incentive for major investment in cleaner, more efficient technologies. The Cap-and-Trade Program applies to emissions that cover about 80 percent of the State's GHG emissions. CARB creates allowances equal to the total amount of permissible emissions (i.e., the "cap") over a given compliance period. One allowance equals one metric ton of GHG emissions. Fewer allowances are created each year, thus the annual cap declines and statewide emissions are reduced over time. An increasing annual auction reserve (or floor) price for allowances and the reduction in annual allowance budgets creates a steady and sustained pressure for covered entities to reduce their GHGs. All covered entities in the Cap-and-Trade Program are still subject to the air quality permit limits for criteria and toxic air pollutants.

The Cap-and-Trade Program is designed to achieve the most cost-effective statewide GHG emission reductions; there are no individual or facility-specific GHG emission reduction requirements. Each entity covered by the Cap-and-Trade Regulation has a compliance obligation that is set by its GHG emissions over a compliance period, and entities are required to meet that compliance obligation by acquiring and surrendering allowances in an amount equal to their compliance obligation. Companies can also meet a limited portion of their compliance obligation by acquiring and surrendering offset credits, which are compliance instruments that are based on rigorously verified emission reductions that occur from projects outside the scope of the Cap-and-Trade Program. Like allowances, each offset credit is equal to one metric ton of GHG emissions. The program began in January 2013 and achieved a near 100 percent compliance rate for the first compliance period (2013–2014). Reported and verified emissions covered by the Cap-and-Trade Program have been below the cap throughout the first years of the Program.[142]

Allowances are issued by CARB and distributed by free allocation and by sale at auctions. CARB also provides for free allocation to some entities covered by the Program to address potential trade exposure due to the cost of compliance with the Program and address concerns of relocation of production out-of-state and resulting emissions leakage. Offset credits are issued by CARB to qualifying offset projects. Secondary markets exist where allowances and offset credits may be sold and traded among Cap-and-Trade Program participants. Facilities must submit allowances and offsets to match their annual GHG emissions. Facilities that emit more GHG emissions must surrender more allowances or offset credits, and facilities that can cut their emissions need to surrender fewer compliance instruments. Entities have flexibility to choose the lowest-cost approach to achieving program compliance; they may purchase allowances at auction, trade allowances and offset credits with others, take steps to reduce emissions at their own facilities, or utilize a combination of these approaches.

[142] ARB. 2016. Mandatory Greenhouse Gas Emissions Reporting. www.arb.ca.gov/cc/reporting/ghg-rep/ghg-rep.htm

Proceeds from the sale of State-owned allowances at auction are placed into the Greenhouse Gas Reduction Fund.

It is important to note that while the Cap-and-Trade Program is designed to reduce GHGs for the industrial sector, there are recommendations from the EJAC (or Committee) for the State to pursue more facility-specific GHG reduction measures to achieve potential local air quality co-benefits, and AB 197 directs CARB to prioritize direct reductions at large stationary sources. The Committee has expressed a strong preference to forgo the existing Cap-and-Trade Program and rely on prescriptive facility level regulations. It is also important to note that GHG, criteria pollutant, and toxic air contaminant trends are not always correlated. In some situations, criteria pollutants may actually be produced by actions such as destruction of methane through combustion devices or remain unchanged when fossil natural gas is displaced with renewable natural gas in large boilers. Regardless, there remains a need to develop or enhance existing measures to address criteria and toxic air pollutants as those pose local air quality health issues for communities adjacent to industrial sources. To address these specific concerns, State and local agencies must continue to evaluate and implement measures that result in quantifiable reductions in criteria and toxic air pollutants.

1. Looking to the Future

This section outlines the high-level objectives and goals to reduce GHGs in this sector.

Goals

- Increase energy efficiency.
- Increase fuel switching to non-fossil fuel.
- Promote and support industry that provides products and clean technology needed to achieve the State's climate goals.
- Create market signals for low carbon intensity products.
- Maximize air quality co-benefits.
- Support a resilient low carbon economy and strong job force.
- Make California the epicenter for research, development, and deployment of technology needed to achieve a near-zero carbon future.

2. Cross-Sector Interactions

There are clear, direct relationships between the industrial sector and other sectors that go beyond the economic support that a strong economy provides. For instance, this sector could increase its use of renewable fuels such as biomethane, which would be sourced from landfills or dairies. Additionally, some industries could shift from raw materials to recycled materials to reduce waste and reduce GHG emissions associated with processing of raw materials. Further, addressing energy efficiency could reduce onsite heating, water, and fuel demand. Moreover, supporting mass-transit or ride share programs for employees would reduce VMT. Finally, upgrading existing facilities

or repurposing existing infrastructure instead of constructing new facilities or infrastructure would support land conservation and smart growth goals.

3. Efforts to Reduce Greenhouse Gases

The measures below include some required and new potential measures to help achieve the State's 2030 target and to support the high-level objectives for this sector. Some measures may be designed to directly address GHG reductions, while others may result in GHG reductions as a co-benefit.

Ongoing and Proposed Measures

- International agreement to globally phase down HFC production were agreed upon at the October 2016 annual Montreal Protocol Meeting of Parties in Kigali, Rwanda.
- Depending on the level of future HFC emission reductions expected for California from this agreement, California may also: (1) consider placing restrictions on the sale or distribution of refrigerants with a GWP > 2,500, and (2) consider prohibiting refrigerants with a GWP > 150 in new stationary refrigeration equipment and refrigerants with a GWP > 750 for new stationary air-conditioning equipment.
- Develop a regulatory monitoring, reporting, verification, and implementation methodology for the implementation of carbon capture and sequestration projects.

Sector Measures

- Adopt a post-2020 Cap-and-Trade Program.
- Continue and strategically expand research and development efforts to identify, evaluate, and help deploy innovative strategies that reduce GHG emissions in the industrial sector.
- Promote procurement policies that value low carbon production to delivery options, including at the State and local government levels.
- Identify and remove barriers to existing grant funding for onsite clean technology or efficiency upgrades.
- Evaluate and implement policies and measures to continue to reduce GHG, criteria, and toxic air contaminant emissions in a cost-effective manner, focusing on the largest GHG emission sources.

Potential Additional Actions

The actions below have the potential to reduce GHGs and complement the measures and policies identified in Chapter ll. These are included to spur thinking and exploration of innovation that may help the State achieve its long-term climate goals. It is anticipated that there will be workshops and other stakeholder forums in the years following finalization of the Scoping Plan to explore these potential actions.

- Further deploy fuel cells using renewable fuels.

- Increase utilization of renewable natural gas.
- Partner with California's local air districts to effectively use BARCT to achieve air quality and GHG reduction co-benefits at large industrial sources.
- Evaluate the potential for and promote electrification for industrial stationary sources whose main emissions are onsite natural gas combustion.
- Identify new funding for grants for onsite clean technology or efficiency upgrades.
- Develop an incentive program to install low-GWP refrigeration systems in retail food stores.
- Evaluate and design additional mechanisms to further minimize emissions leakage in the Cap-and-Trade Program.

C. Transportation Sustainability

California's population is projected to grow to 50 million people by 2050. How and where the State grows will have important implications for all sectors of the economy, especially the transportation sector. Supporting this growth while continuing to protect the environment, developing livable and vibrant communities, and growing the economy is dependent on transitioning the State's transportation system to one powered by ZEVs and low carbon fuels. It must also offer other attractive and convenient low carbon transportation choices, including safe walking and bicycling, as well as quality public transportation. Investments should consider California's diverse communities and provide accessible and clean travel options to all.

The transportation system in California moves people between home, work, school, shopping, recreation, and other destinations, and connects ports, industry, residential communities, commercial centers, educational facilities, and natural wonders.[143] California's vast transportation system includes roads and highways totaling more than 175,000 miles and valued at approximately $1.2 trillion, 500 transit agencies, 245 public-use airports, 12 major ports, and the nation's first high-speed rail system, now under construction.[144] Transportation infrastructure also includes sidewalks, bicycle paths, parking, transit stations and shelters, street trees and landscaping, signage, lighting, and other elements that affect the convenience, safety, and accessibility of transportation choices. Increasingly, technologies such as real-time, web- and mobile-enabled trip planning and ride-sharing services are changing how people travel. In the near future, automated and connected vehicles, and unmanned aerial systems (e.g., drones) are expected to be part of our transportation landscape and to transform the way that people and freight are transported. Responsibility for the transportation system is spread across State, regional, and local levels.

Through effective policy design, the State has an opportunity to guide technology transformation and influence investment decisions with a view to mitigate climate and environmental impacts while promoting economic opportunities and community health and safety. The network of transportation technology and infrastructure, in turn, shapes

[143] Caltrans. California Transportation Plan 2040, February 2016. www.dot.ca.gov/hq/tpp/californiatransportationplan2040/final-draft-ctp2040/docs/ctp2040-final-draft.pdf
[144] Ibid.

and is shaped by development and land use patterns that can either support or detract from a more sustainable, low carbon, multi-modal transportation future. Strategies to reduce GHG emissions from the transportation sector, therefore, must actively address not only infrastructure and technology, but also coordinated strategies to achieve development, conservation, and land use patterns that align with the State's GHG and other policy goals.

Transportation also enables the movement of freight such as food, building materials, and other consumable products. The California freight system includes myriad equipment and facilities,[145] and is the most extensive, complex, and interconnected system in the country, with approximately 1.5 billion tons of freight valued at $2.8 trillion shipped in 2015 to, through, and within California.[146] Freight-dependent industries accounted for over $740 billion of California's GDP and over 5 million California jobs in 2014.[147,148]

Transportation has a profound and varied impact on individuals and communities, including benefits such as economic growth, greater accessibility, and transport-related physical activity and adverse consequences such as GHG emissions, smog-forming and toxic air pollutants, traffic congestion, and sedentary behaviors. The sector is the largest emitter of GHG emissions in California.[149] Air pollution from tailpipe emissions contributes to respiratory ailments, cardiovascular disease, and early death, with disproportionate impacts on vulnerable populations such as children, the elderly, those with existing health conditions (e.g., chronic obstructive pulmonary disease, or COPD), low-income communities, and communities of color.[150,151,152,153] Importantly, transportation costs are also a major portion of most Californian's household budgets.[154] Additionally, dependence on cars has a direct impact on levels of physical activity, which is closely linked to multiple adverse health outcomes.

Fortunately, many measures that reduce transportation sector GHG emissions simultaneously present opportunities to bolster the economy, enhance public health, revitalize disadvantaged communities, strengthen resilience to disasters and changing climate, and improve Californians' ability to conveniently access daily destinations and

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[145] The freight system includes trucks, ocean-going vessels, locomotives, aircraft, transport refrigeration units, commercial harborcraft and cargo handling, industrial and ground service equipment used to move freight at seaports, airports, border crossings, railyards, warehouses, and distribution centers.
[146] U.S. Department of Transportation, Bureau of Transportation Statistics and Federal Highway Administration. Freight Analysis Framework, V 4.1, 2016.
[147] U.S. Department of Commerce, Bureau of Economic Analysis. Regional Economic Accounts. Available at: www.bea.gov/regional/index.htm, accessed March 11, 2016.
[148] State of California Employment Development Department. Labor Market Information by California Geographic Areas. Available at: www.labormarketinfo.edd.ca.gov/geography/lmi-by-geography.html, accessed March 21, 2016.
[149] ARB. May 2016. Mobile Source Strategy. Available at: www.arb.ca.gov/planning/sip/2016sip/2016mobsrc.pdf
[150] Hoek, G., Krishnan, R. M., Beelen, R., Peters, A., Ostro, B., Brunekreef, B., and Kaufman, J. D. 2013. Long-term air pollution exposure and cardio-respiratory mortality: a review. Environmental Health, 12(1), 1.
[151] Friedman, M. S., K. E. Powell, L. Hutwagner, L. M. Graham, and W. G. Teague. 2001. "Impact of changes in transportation and commuting behaviors during the 1996 Summer Olympic Games in Atlanta on air quality and childhood asthma." *JAMA* 285(7), 897–905.
[152] Bell, M. L., and K. Ebisu. 2012. "Environmental inequality in exposures to airborne particulate matter components in the United States." *Environmental Health Perspectives* 120(12), 1699.
[153] Morello-Frosch, R., M. Zuk, M. Jerrett, B. Shamasunder, and A. D. Kyle. 2011. "Understanding the cumulative impacts of inequalities in environmental health: implications for policy." *Health Affairs* 30(5), 879–887.
[154] H + T® Index website. htaindex.cnt.org/

nature. There opportunities are particularly important for those who are not able to, or cannot afford to, drive. In addition, a growing market demand for walkable, bikeable, and transit-accessible communities presents a significant opportunity to shift California's transportation systems toward a lower-carbon future while realizing significant public health benefits through increased levels of physical activity (i.e., walking and bicycling). In fact, transport-related physical activity could result in reducing risks from chronic diseases such as cardiovascular disease, diabetes, certain cancers, and more, to such an extent that it would rank among the top public health accomplishments in modern history, and help to reduce the billions of dollars California spends each year to treat chronic diseases. Just as California was the first to mitigate the contribution of cars and trucks to urban smog, it is leading the way toward a clean, low carbon, healthy, interconnected, and equitable transportation system.

Continuing to advance the significant progress already underway in the areas of vehicle and fuel technology is critical to the Transportation sector strategy and to reducing GHG emissions in the transportation sector. The rapid technological and behavioral changes underway with automated and connected vehicles, unmanned aerial systems, and ride-sharing services are redefining the transportation sector, and should be part of the solution for a lower carbon transportation sector. It is critical to support and accelerate progress on transitioning to a zero carbon transportation system. The growing severity of climate impacts, persistent public health impacts and costs from air pollution,[155] and rapid technology progress that supports the expectation that cost parity between some ZEVs and comparable internal combustion vehicles will be attained in a few years, underscores the need for further action on ZEVs. Therefore, CARB solicits input on additional policies to move toward a goal of achieving 100 percent ZEV sales in the light-duty vehicle sector. Austria, Germany, India, Netherlands, and Norway are all taking steps to, or have indicated a desire to, move to 100 percent ZEV sales in the 2020–2030 time frame.

In addition, policies that maximize the integration of electrified rail and transit to improve reliability and travel times, increase active transportation such as walking and bicycling, encourage use of streets for multiple modes of transportation, improve freight efficiency and infrastructure development, and shift demand to low carbon modes will need to play a greater role as California strives to achieve its 2030 and 2050 climate targets.[156]

The State's rail modernization program has identified critical elements of the rail network where improvements, either in timing of service or infrastructure, provide benefits across the entire statewide network, furthering the attractiveness of rail for a range of trip distances.[157] The State also uses the Transit and Intercity Rail Capital Program (TIRCP) and Low Carbon Transit Operations Program (LCTOP) to provide grants from the Greenhouse Gas Reduction Fund to fund transformative improvements

[155] For example, a recent report by the American Lung Association estimates the costs of climate and air pollution from passenger vehicles in California to be $15 billion annually. Holmes-Gen, B. and W. Barrett. 2016. *Clean Air Future – Health and Climate Benefits of Zero Emission Vehicles.* American Lung Association in California, October.
[156] Morello-Frosch, R., M. Zuk, M. Jerrett, B. Shamasunder, and A. D. Kyle. 2011. "Understanding the cumulative impacts of inequalities in environmental health: Implications for policy." *Health Affairs* 30(5), 879–887.
[157] California State Transportation Agency. 2016. 2018 California State Rail Plan factsheet and TIRCP fact sheet.

modernizing California's intercity, commuter, and urban rail systems, as well as bus and ferry transit systems, to reduce emissions of GHGs by reducing congestion and VMT throughout California. As the backbone of an electrified mass-transportation network for the State, the high-speed rail system catalyzes and relies on focused, compact, and walkable development well-served by local transit to funnel riders onto the system and provide alternative options to airplanes and automobiles for interregional travel. Concentrated development, such as that incentivized by the Affordable Housing and Sustainable Communities (AHSC) grant program, can improve ridership and revenue for the system while providing vibrant communities for all.[2]

While most of the GHG reductions from the transportation sector in this Proposed Plan will come from technologies and low carbon fuels, a reduction in the growth of VMT is also needed. VMT reductions are necessary to achieve the 2030 target and must be part of any strategy evaluated in this plan. Stronger SB 375 GHG reduction targets will enable the State to make significant progress toward this goal, but alone will not provide all of the VMT growth reductions that will be needed. There is a gap between what SB 375 can provide and what is needed to meet the State's 2030 and 2050 goals. More needs to be done to fully exploit synergies with emerging mobility solutions like ridesourcing and more effective infrastructure planning to anticipate and guide the necessary changes in travel behavior, especially among millennials. Uniquely, high-speed rail also affects air-miles traveled, diverting, at minimum, 30 percent of the intrastate air travel market in 2040.[158]

In September 2016, the Administration released a discussion document entitled "Vibrant Communities and Landscapes"[159] that set out potential actions that can be taken in parallel to SB 375 Sustainable Community Strategies by State government, regional planning agencies, and local governments, to achieve a broad, statewide vision for more sustainable land use. The document "Potential VMT Reduction Strategies for Discussion" in Appendix C further details State-level strategies that could be employed to close the VMT gap.[160] Discussions among a broad suite of stakeholders from the building community, financial institutions, housing advocates, environmental organizations, and community groups are needed to develop a set of strategies to ensure that we can achieve necessary VMT reductions, and that the associated benefits are shared by all Californians.

At the State level, a number of important policies are being developed. Governor Brown signed Senate Bill 743 (Steinberg, Chapter 386, Statutes of 2013), which called for an update to the metric of transportation impact in the CEQA. That update to the CEQA Guidelines is currently underway. Employing VMT as the metric of transportation impact statewide will help to ensure GHG reductions planned under SB 375 will be achieved through on-the-ground development, and will also play an important role in

[158] California High-Speed Rail Authority. 2016. 2016 Business Plan. Ridership and Revenue Forecast.
[159] Governor's Office of Planning and Research, et al. 2016. *Vibrant Communities and Landscapes: A Vision for California in 2050*. Draft for Comment and Discussion. September. Available at: www.arb.ca.gov/cc/scopingplan/meetings/091316/vibrant%20communities.pdf
[160] ARB. Potential State - Level Strategies to Advance Sustainable, Equitable Communities and Reduce Vehicle Miles of Travel (VMT) -- for Discussion. www.arb.ca.gov/cc/scopingplan/meetings/091316/Potential%20VMT%20Measures%20For%20Discussion_9.13.16.pdf

creating the additional GHG reductions needed beyond SB 375 across the State. Implementation of this change will rely, in part, on local land use decisions to reduce GHG emissions associated with the transportation sector, both at the project level, and in long-term plans (including general plans, climate action plans, specific plans, and transportation plans) and supporting sustainable community strategies developed under SB 375. The State can provide guidance and tools to assist local governments in achieving those objectives.

1. Looking to the Future

This section outlines the high-level objectives and goals to reduce GHGs in this sector.

Vibrant Communities and Landscapes / VMT Reduction Goals

- Update the CEQA metric of transportation impact from level of service (LOS) to VMT statewide.
- Promote all feasible policies to reduce VMT, including:
  - Land use and community design that reduce VMT,
  - Transit oriented development,
  - Street design policies that prioritize transit, biking, and walking, and
  - Increasing low carbon mobility choices, including improved access to viable and affordable public transportation and active transportation opportunities.
- Complete the construction of high-speed rail integrated with enhanced rail and transit systems throughout the State.
- Promote transportation fuel system infrastructure for electric, fuel-cell, and other emerging clean technologies that is accessible to the public where possible.
- Increase the number, safety, connectivity, and attractiveness of biking and walking facilities to increase use.
- Promote potential efficiency gains from automated transportation systems and identify policy priorities to maximize sustainable outcomes from automated and connected vehicles (preferably ZEVs), including VMT reduction, coordination with transit, and shared mobility.
- Promote shared-use mobility, such as bike sharing, car sharing and ridesharing services to bridge the “first mile, last mile” gap between commuters’ transit stops and their destinations.
- Continue research and development on transportation system infrastructure, including:
  - Integrate frameworks for lifecycle analysis of GHG emissions with life-cycle costs for pavement and large infrastructure projects, and
  - Health benefits and costs savings from shifting from driving to walking, bicycling, and transit use.
- Quadruple the proportion of trips taken by foot by 2030 (from a baseline of the 2010–2012 California Household Travel Survey).
- Strive for a nine-fold increase in the proportion of trips taken by bicycle by 2030 (from a baseline of the 2010–2012 California Household Travel Survey).

- Strive, in passenger rail hubs, for a transit mode share of between 10 percent and 50 percent and for a walk and bike mode share of between 10 percent and 15 percent.

Vehicle Technology Goals

- Through a strong set of complementary policies—including reliable incentives, significant infrastructure investment, broad education and outreach, and potential regulation—aim to reach 100 percent ZEV sales.
- Make significant progress in ZEV penetrations in non-light-duty segments.
- Deploy low-emission and electrified rail vehicles.

Clean Fuels Goals

- Electrify the transportation sector using both electricity and hydrogen.
- Promote research development and deployment of low carbon fuels such as RNG and renewable hydrogen.
- Rapidly reduce carbon intensity of existing liquid and gaseous transportation fuels.

Sustainable Freight Goals

- Increase freight system efficiency of freight operations at specific facilities and along freight corridors such that more cargo can be moved with fewer emissions.
- Accelerate use of clean vehicle and equipment technologies and fuels of freight through targeted introduction of zero emission or near-zero emission (ZE/NZE) technologies, and continued development of renewable fuels.
- Encourage State and federal incentive programs to continue supporting zero and near-zero pilot and demonstration projects.

Accelerate use of clean vehicle and equipment technologies and fuels of freight through targeted introduction of ZE/NZE technologies, and continued development of renewable fuels. This includes developing policy options that encourage ZE/NZE vehicles on primary freight corridors (e.g., I-710); examples of such policy options include a separated ZE/NZE freight lane, employing market mechanisms such as favorable road pricing for ZE/NZE vehicles, and developing fuel storage and distribution infrastructure along those corridors.

2. Cross-Sector Interactions

The Transportation sector has considerable influence on other sectors and industries in the State. California's transportation sector is still primarily powered by petroleum, and to reduce statewide emissions, California must reduce demand for driving; continue to reduce its gasoline and diesel fuel consumption; diversify its transportation fuel sources by increasing the adoption of low- and zero-carbon fuels; increase the ease and integration of the rail and transit networks to shift travel mode; and deploy ZE/NZE vehicles.

As California's population continues to increase, the location and types of future land use development will directly impact GHG emissions from the transportation sector, as well as those associated with the conversion and development of previously undeveloped land. Specifically, where and how the State population grows will have implications on distances traveled and tailpipe emissions; as well as on "secondary" emissions from the transportation sector, including emissions from vehicle manufacturing and distribution, fuel refining and distribution, demand for new infrastructure (including roads, transit, and active transportation infrastructure), demand for maintenance and upkeep of existing infrastructure, and conversion of natural and working lands, with the attendant impacts to food security, watershed health, and ecosystems. Less dense development also demands higher energy and water use. With the exception of VMT reductions, none of these "secondary" emissions are currently accounted for in the GHG models used in this Proposed Plan, but are nonetheless important considerations. Additionally, compact, lower-VMT future development patterns are essential to achieving public health, equity, economic, and conservation goals, which are also not modeled but are important co-benefits of the overall transportation sector strategy. For example, high-speed rail station locations were identified to reinforce existing city centers.

Achieving LCFS targets and shifting from petroleum dependence toward greater reliance on low carbon fuels also has the potential to affect land use in multiple ways. For example, increased demand for conventional biofuels could require greater use of land and water for purpose-grown crops, which includes interactions with the agricultural and natural and working lands sectors. On the other hand, continuing growth in fuels from waste biomass such as by-processing residues and agricultural waste and excess forest biomass acts to alleviate the pressure on croplands to meet the need for food, feed, and fuel. Likewise, captured methane from landfills or dairy farms for use in vehicles requires close interaction with the waste and farming sectors. Also, as more electric vehicles and charging stations are deployed, drivers' charging behavior will affect the extent to which additional electric generation capacity and ancillary services are needed to maintain a reliable grid and accommodate a portfolio of 50 percent renewable electricity by 2030. Charging control and optimization technologies will determine how well integrated the electric and transportation sectors can become, including, for instance, the widespread use of electric vehicles as storage for excess renewable generation, vehicle to grid, smart charging, and/or smart grid. The GHG emissions intensity of electricity affects the GHG savings of fuel switching from petroleum-based fuels to electricity; the cleaner the electric grid, the greater the benefits of switching to electricity as a fuel. Hydrogen fuel cell vehicles can help expand renewable energy production, but may require additional electric generation capacity to accommodate the energy demand associated with hydrogen production and may require more fuel storage and pipeline infrastructure.

3. Efforts to Reduce Greenhouse Gases

The measures below include some required and new potential measures to help achieve the State's 2030 target and to support the high-level objectives for the

transportation sector. Some measures may be designed to directly address GHG reductions, while others may result in GHG reductions as a co-benefit.

Ongoing and Proposed Measures – Vibrant Communities and Landscapes / VMT Reduction Goals

- Mobile Source Strategy –15 percent reduction in total light-duty VMT in 2050 (with measures to achieve this goal not specified; potential measures identified in Appendix C).
- Work with regions to update SB 375 Sustainable Communities Strategies targets for 2035 to better align with the 2030 GHG target and take advantage of State rail investments.
- Stabilize transportation funding so investments are available to develop sustainable and well-maintained multi-modal transportation networks in California.
- SB 743 – complete the update to the CEQA metric of transportation impact such that it promotes GHG reduction, the development of multimodal transportation networks, and a diversity of land uses.
- Streamline CEQA compliance and other barriers to infill development.
- Complete the pilot road usage charge program pursuant to SB 1077 and evaluate deployment of a statewide program.
- Continue promoting active transportation pursuant to SB 99 – The Active Transportation Program and beyond.
- Continue to build high-speed rail and broader statewide rail modernization pursuant to the funding program in SB 862 and other sources.
- Encourage use of streets for multiple modes of transportation (including public transit and active transportation, such as walking and bicycling), and for all users, including the elderly, young, and less able bodied, pursuant to AB 1358 – Complete Streets policies.
- Support and assist local and regional governments, through grant programs and technical assistance, to develop and implement plans that are consistent with the goals in "Vibrant Communities and Landscapes," including the following:
    - AB 2722 – Implement Transformative Climate Communities Program, ensuring promotion of GHG reductions from neighborhood-level community plans in disadvantaged communities.
    - AB 2087 – Help local and State agencies apply core investment principles when planning conservation or mitigation projects.
    - High speed rail station area plans.
    - Implementation of updated General Plan Guidelines.
- Per SB 350, conduct and publish a study on barriers to accessing ZE/NZE transportation options for low-income customers and recommendations on how to increase access.

Ongoing and Proposed Measures – Vehicle Technology

- Implement the Cleaner Technology and Fuels Scenario of CARB's Mobile Source Strategy, which includes:
    - 4.3 million zero emission and plug-in hybrid light-duty electric vehicles by 2030,
    - Phase 1 and 2 GHG regulations for medium- and heavy-duty trucks,
    - An Advanced Clean Cars program, and
    - Advanced Clean Transit.
- Periodically assess and promote cleaner fleet standards.
- Deploy ZEVs across all vehicle classes, including rail vehicles.
- Encourage State and federal incentive programs to continue supporting zero and near-zero pilot and demonstration projects.
- Collaborate with the U.S. Environmental Protection Agency to promulgate more stringent locomotives requirements, work with California seaports, ocean carriers, and other stakeholders to develop the criteria to incentivize introduction of Super-Low Emission Efficient Ships, and investigate potential energy efficiency improvements for transport refrigeration units and insulated truck and trailer cargo vans.
- Promote research, development, and deployment of new technology to reduce GHGs, criteria pollutants, and toxics.

Ongoing and Proposed Measures – Clean Fuels

- Continue LCFS activities, with increasing stringency of at least 18 percent reduction in carbon intensity (CI).
- Continue to develop and commercialize clean transportation fuels through renewable energy integration goals, tax incentives, research investments, support for project demonstration, public outreach, and State procurement contracts.
- Per SB 1383 and the Short-Lived Climate Pollutant Strategy, adopt regulations to reduce and recover methane from landfills, wastewater treatment facilities, and manure at dairies; use the methane as a renewable source of natural gas (RNG) to fuel vehicles and generate electricity; and establish infrastructure development and procurement policies to deliver RNG to the market.
- Accelerate deployment of alternative fueling infrastructure pursuant to the following:
    - SB 350 – CPUC to accelerate widespread transportation electrification.
    - Executive Order B-16-2012 and 2016 ZEV Action Plan – call for infrastructure to support 1 million ZEVs by 2020.
    - CEC's Alternative and Renewable Fuel and Vehicle Technology Program (ARFVTP).
    - CPUC's NRG settlement.
    - CalGreen Code provisions mandate installation of PEV charging infrastructure in new residential and commercial buildings.[161]
    - IOU electric vehicle charging infrastructure pilot programs.

[161] Such as raceway and panel capacity to support future installation of electrical vehicle charging stations.

Ongoing and Proposed Measures – Sustainable Freight

- Implement the California Sustainable Freight Action Plan:
    - 25 percent improvement of freight system efficiency by 2030.
    - Deployment of over 100,000 freight vehicles and equipment capable of zero emission operation, and maximize near-zero emission freight vehicles and equipment powered by renewable energy by 2030.

Sector Measures

- Adopt a post-2020 Cap-and-Trade Program.

Potential Additional Action

The actions below have the potential to reduce GHGs and complement the measures and policies identified in Chapter ll. These are included to spur thinking and exploration of innovation that may help the State achieve its long-term climate goals.

- Develop a set of complementary policies to make light-duty ZEVs clear market winners, with a goal of reaching 100 percent light-duty ZEV sales. This could include the following:
    - Reliable purchase/trade-in incentives for at least 10 years.
    - Dealer incentives for ZEV sales.
    - Policies to ensure operating cost savings for ZEVs relative to internal combustion engines, including low cost, and potentially free, electricity.
    - Significant investments in charging and ZEV refueling infrastructure.
    - A broad and effective marketing and outreach campaign.
    - Collaborations with cities to develop complementary incentive and use policies for ZEVs.
    - Targeted policies to support ZEV sales and use in low income and disadvantaged communities.
- Develop a Low Emission Diesel Standard to diversify the fuel pool by incentivizing increased production of low-emission diesel fuels. This standard would require incremental progress toward a goal of low-emission diesel comprising 50 percent of the on-and off-road diesel sold in-state by 2030.
- Stabilize transportation funding so investments are available to develop sustainable and well-maintained multi-modal transportation networks in California.
- Continue to develop and explore pathways to implement State-level VMT reduction strategies, such as those outlined in the document "Potential State-Level Strategies to Advance Sustainable, Equitable Communities and Reduce Vehicle Miles of Travel (VMT) for Discussion"[162] (included in Appendix C) through a transparent and inclusive interagency policy development process to evaluate and identify implementation pathways for additional policies to reduce VMT and promote sustainable communities, with a focus on the following:

[162] This refers to the document discussed at the September 2016 Public Workshop on the Transportation Sector to Inform Development of the 2030 Target Scoping Plan Update, also available at: www.arb.ca.gov/cc/scopingplan/meetings/091316/Potential%20VMT%20Measures%20For%20Discussion_9.13.16.pdf.

- Accelerating equitable and affordable transit-oriented and infill development through new and enhanced financing and policy incentives and mechanisms.
- Promoting stronger boundaries to suburban growth through enhanced support for sprawl containment mechanisms, including urban growth boundaries and transfer of development rights programs.
- Identifying performance criteria for transportation and other infrastructure investments, to ensure alignment with GHG reduction goals and other State policy priorities, and improve proximity, expanded access to transit, shared mobility, and active transportation choices.
- Promoting efficient development patterns that maximize protection of natural and working lands.
- Developing pricing mechanisms such as road user/VMT-based pricing, congestion pricing, and parking pricing strategies.
- Reducing congestion and related GHG emissions through commute trip reduction strategies.
- Programs to maximize the use of alternatives to single-occupant vehicles, including bicycling, walking, transit use, and shared mobility options.
- Take into account the current and future impacts of climate change when planning, designing, building, operating, maintaining, and investing in State infrastructure.

D. Natural and Working Lands Including Agricultural Lands

In his 2015 State of the State address, Governor Brown established 2030 targets for GHG emission reductions and called for policies and actions to reduce GHG emissions from natural and working lands, including forests, rangelands, farms, wetlands, and soils. This policy objective was codified through passage of SB 1386 in 2016. The 2030 Target Scoping Plan focuses renewed attention on California's natural and working lands and the contribution they make to meet the State's long-term goals for carbon sequestration, GHG reduction, and climate change adaptation.

California's natural and working lands encompass a range of land types and uses, including farms, ranches, forests, grasslands, deserts, wetlands, riparian areas, coastal areas and the ocean-- as well as the green spaces in urban and built environments. These lands provide significant environmental and public health benefits to the State, and they support clean air, wildlife and pollinator habitat, and strong economies. They are home to the largest and most diverse sources of food and fiber production and renewable energy in the United States. And, they are the foundation of the State's water supply, with more than two-thirds of California's water supply originating in the Sierra Nevada.[163]

Policy in this sector must balance carbon sequestration with other co-benefits. California's climate objective for natural and working lands is to maintain them as a carbon sink (i.e., net zero or even negative GHG emissions) and minimize the net GHG

[163] www.sierranevada.ca.gov/our-region/ca-primary-watershed

and black carbon emissions associated with management, biomass utilization, and wildfire events. The State's lands, as well as sub-tidal waters, can be both a source and sink for GHG emissions. The carbon contained in vegetation and soils represents the accumulated exchange of carbon between the land surface and the atmosphere.

CARB has worked extensively with other State agencies, academic researchers and the public to quantify the individual components of the Natural and Working Lands inventory. Recent work has focused on estimating the 2001- 2010 total carbon and carbon fluxes for forests in California. The initial results from this work show that, for 2010, California's natural lands contained an estimated 898 million metric tons of carbon (MMT C) in above-ground live stock for all natural lands combined (forest, grasslands, wetlands and other natural lands), and an additional 1,603 MMT C in additional pools included in the Natural and Working Lands inventory.[164] CARB continues to expand the scope of the inventory using the most recent data available and plans to update the forest component of the Natural and Working Lands (to include 2012 GHG emissions estimates) inventory next year, followed by emissions estimates for soil carbon, urban forestry, and croplands by mid-2018. Work currently in progress applies airborne and space-based technologies to monitor forest health and quantify emissions associated with land-based carbon. Remote sensing technology is maturing rapidly. California and federal agencies are working with researchers and funding studies to enhance our understanding of the roles of forests and other lands in climate change using this advanced technology.[165,166] CARB is continuously reviewing the latest science in this sector and is committed to working closely with other State agencies and the public to ensure a comprehensive review of the updates to the inventory.

While not all of this stored carbon is in imminent danger of emission to the atmosphere, recent trends indicate that significant pools of carbon risk reversal: an estimated 150 MMT C was lost to disturbance over the period 2001–2010, with the majority—approximately 120 MMT C—lost through wildland fire. At the same time, energy use, methane, and N_2O emissions from the agricultural sector accounts for 8 percent of the emissions in the statewide GHG inventory. While growing trees and other vegetation, as well as soil carbon sequestration, make up for some of these losses, climate change itself is expected to further stress many of these systems and affect the ability of California's landscapes to maintain its carbon sink without proactive management. There are ways to slow and reverse this trend, in concert with other productive and ecological objectives of land use, and the State will continue to rely on best available science to promote those actions. These efforts can not only protect California's natural carbon stocks, they can also improve quality of life in urban and rural communities alike and increase the climate resilience of agricultural, forestry, and recreational industries and the rural communities they support; the State's water supply; biodiversity; and the safety and environmental health of all who call California home.

[164] ARB's forest and other natural lands inventory tables, methodology development publications, and a workshop presentation providing an overview of the inventory development are available at: www.arb.ca.gov/cc/inventory/sectors/forest/forest.htm
[165] Asner, G. et al. (2015) Progressive forest canopy water loss during the 2012–2015 California drought. PNAS 113.2: E249-E255
[166] Battles, J. et al. (in progress) Innovations in measuring and managing forest carbon stocks in California. Project 2C: 4th California Climate Change Assessment. Natural Resources Agency. resources.ca.gov/climate/fourth/

This Proposed Plan includes an initial analysis of business-as-usual net carbon sequestration rates from natural and working lands, including forecasts to 2030 and 2050. This is being done outside of the PATHWAYS model used for the other sectors in the Proposed Plan through a research contract with Lawrence Berkeley National Laboratory that is managed by the California Natural Resources Agency (CNRA). Additional 2030 and 2050 scenarios assess the expected impact of a set of development, land protection, management, and restoration objectives on carbon sequestration and GHG emissions. The Discussion Draft includes more information on the initial modeling as does Appendix G.[167] These projections will continue to be developed in the coming months. The projections will be used to estimate the difference between current carbon sequestration levels and expected sequestration levels in the scenarios to achieve the net zero loss goal by 2030 and net sequestration goal by 2050. This work will help guide near and long-term State policies to ensure net sequestration in our natural and working lands. Refinement of these projections will need to continue after the Final Plan is adopted. These refinements will be important to support implementation planning and to model implementation scenarios to 2100 to better understand the response of natural and working lands to major climate change impacts such as increased temperature, drought, and wildfire. The business-as-usual statewide baseline emission projection and carbon sequestration results may also inform the accounting framework requirements set forth in SB 859.

1. Looking to the Future

This section outlines the high-level objectives to reduce GHGs in the natural and working lands sector to meet California's climate objective to: (1) maintain them as a resilient carbon sink (i.e., net zero or even negative GHG emissions) to 2030 and beyond, and (2) minimize the net GHG and black carbon emissions associated with management, biomass disposal, and wildfire events to 2030 and beyond. Achieving these objectives will include establishment of agriculture sector GHG emission reduction planning targets for the mid-term time frame and 2050.

Implementation will include policy and program pathways, with activities related to land protection; enhanced carbon sequestration; and innovative biomass utilization:

(1) **Protect** land from conversion to more intensified uses by increasing conservation opportunities and pursuing local planning processes urban and infrastructure development patterns that avoid greenfield development. The latter is being done in coordination with transportation and infrastructure climate policy, as described in prior sections of this Proposed Plan.
(2) **Enhance** the resilience of and potential for carbon sequestration on those lands through management and restoration, and reduce GHG and black carbon emissions from wildfire and management activities. This includes expansion and management of green space in urban areas.
(3) **Innovate** biomass utilization such that harvested wood and excess agricultural and forest biomass can be used to advance statewide objectives for renewable

[167] https://www.arb.ca.gov/cc/scopingplan/meetings/meetings.htm

energy and fuels, wood product manufacturing, agricultural markets, and soil health, resulting in avoided GHG emissions relative to traditional utilization pathways. Associated activities should increase the resilience of rural communities and economies.

The Forest Climate Action Team, Healthy Soils Initiative, State Coastal Conservancy's Climate Ready Program, various Greenhouse Gas Reduction Fund programs, and CARB's compliance offset program already undertake this work. Future work will identify and seek to fill gaps, and set a comprehensive and strategic path forward. Research is underway across agencies to advance the state of the science on natural and working lands carbon dynamics, including a number of projects within the Fourth Climate Change Assessment.

2. Cross-Sector Interactions

Strategies that reduce GHG emissions or increase sequestration in the natural and working lands sector often overlap and result in synergies with other sectors, most notably at intersections with land use, biomass and waste utilization, and water.

Landowner, local, and regional decisions affect land use development patterns and natural and working land conversion rates; conversely, conservation activities can support infill-oriented regional development and related transportation needs. As discussed earlier in the Transportation Sustainability section, under SB 375, Sustainable Communities Strategies (SCSs) aim to link transportation, housing, and climate policy to reduce per capita GHG emissions while providing a range of other important benefits for Californians. Some SCSs include policies, objectives or implementation measures relating to conservation and land protections, and to urban greening.[168] Protecting natural and working lands that are under threat of conversion can promote infill development, reduce VMT, limit infrastructure expansion, and curb associated GHG emissions. An integrated vision for community development, land conservation and management, and transportation was presented at the 2030 Target Scoping Plan Workshop on September 14, 2016.[169]

Agricultural and commercial forestry operations produce biomass as both an objective (i.e., food and fiber production) and a waste product. How this material is utilized can either increase or decrease emissions associated with management and restoration activities, turn waste into usable products, displace fossil fuels used in energy and transportation, and increase carbon stored in durable wood products in the built environment. Finding productive ways to use this material offers new opportunities to reduce GHG emissions, promote carbon sequestration, and generate economic resources for forest, agricultural, and waste sectors and communities. California is investigating ways to transform how organic waste from the agricultural and municipal sectors is managed to meet emission reduction targets required by SB 1383,[170] and to

[168] Livingston, Adam. Sustainable Communities Strategies and Conservation. January 2016. Available at: www.nature.org/ourinitiatives/regions/northamerica/unitedstates/california/sustainable-communities-strategies-and-conservation.pdf
[169] www.arb.ca.gov/cc/scopingplan/meetings/meetings.htm
[170] SB1383 (Lara, Chapter 396, Statutes of 2016) requires a 50 percent reduction in anthropogenic black carbon emissions by 2030.

protect public health. Cross-sector synergies and complete waste inter-cycles, discussed further in the Waste Management section, result from conscientious treatment of these resources, including opportunities to improve soil health, increase renewable energy generation, and enhance market support for non-commercial products and waste. Productive utilization of dead and dying trees is a significant focus of the Governor's Tree Mortality Task Force, and efforts to resolve the current shortfall in utilization capacity is addressed in that State of Emergency Declaration as well as in SB 859.

Natural and working lands stewardship is essential to securing the State's water supply along the entire supply chain, from protection and management of the forested headwaters to preserving retention function of mountain meadows, ensuring flows and habitat in the Delta and its tributaries, end use efficiencies in agricultural and urban uses, and groundwater infiltration and utilization statewide. For example, efforts to increase water and energy use efficiency of farming operations could support GHG emission reduction goals in the energy sectors. And improving forest health in the Sierra Nevada and other headwaters will protect water quality and availability, in alignment with the California Water Action Plan.

a) Agriculture's Role in Emission Reduction and Carbon Sequestration

As the State works to meet emission reduction goals, the agricultural sector can contribute by reducing emissions from production and by playing a role in cross-sectoral efforts to maximize the many benefits of natural and working lands.

Climate-smart agriculture is an integrated approach to achieving GHG reductions while also ensuring food security in the face of climate change and promoting agricultural adaptation to the compounding impacts of climate change. Conserving agricultural land, sequestering carbon in agricultural soils, employing a variety of techniques to manage manure on dairies, and increasing the efficiency of on-farm water and energy use are examples of practices that can achieve climate and food production goals across diverse agricultural systems. Climate-smart agriculture can support the goals of Protect, Enhance, and Innovate. Focus areas that can lead to reduced emissions and other co-benefits are discussed in the following paragraphs.

California agriculture accounts for 8 percent of the State's GHG emission inventory. A large percentage of agricultural emissions are methane emissions from the dairy and livestock sectors. Emissions come from the animals themselves, through enteric fermentation, as well as from manure management—especially at dairies. Senate Bill 1383 and the resultant Proposed SLCP Reduction Strategy identify a mix of voluntary, incentive-based, and potential regulatory actions to achieve significant emissions reductions from these sources. A variety of techniques will be employed to attain the best results for each specific farming operation, and effectively implementing a broad mix of strategies will reduce the GHG emissions from the agricultural sector significantly.

Another source of GHG from agriculture is nitrous oxide resulting from nitrogen fertilizer applications. Optimizing the rate, timing, placement and type of nitrogen fertilizers has significant potential to reduce nitrous oxide (N_2O) emissions. Reducing synthetic nitrogen fertilizer sources by enhancing the use of organic nitrogen sources (such as cover crops and compost) can achieve net GHG reductions as well. Over the last several years steps have been taken to help farms optimize fertilizer applications to protect water quality, reduce N_2O emissions, and maintain high yields. Farmers are required through the Irrigated Lands Regulatory Program to manage nitrogen fertilizers carefully to protect water quality through the use of nitrogen management plans. Nitrogen management plans are a tool designed to prevent over-applications of nitrogen through an approach that accounts for the nitrogen inputs from water, soil amendments and other sources, and also accounts for nitrogen removed from the field. The California Department of Food and Agriculture's (CDFA's) Fertilizer Research and Education Program, in coordination with university researchers and others, has developed fertilization guidelines to optimize the rate, timing and placement of fertilizers for crops that represent more than half of the irrigated agriculture in California. Similarly, innovations in water management and the expansion of high efficiency irrigation methods also are contributing to N_2O reductions.

California's farms and ranches have the ability to remove carbon from the atmosphere through practices that build and retain soil organic matter. Adequate soil organic matter ensures the soil's continued capacity to function as a vital living ecosystem with multiple benefits, producing food for plants, animals, and humans. The Healthy Soils Initiative, announced by Governor Brown in 2015, offers an opportunity to incentivize the management of farmland for increased carbon sequestration in soil, also augmenting co-benefits such as increased water-holding capacity and soil fertility and supporting biodiversity and integrated farming techniques. State and local efforts to manage land for carbon sequestration must work in conjunction with existing plans, incentives, and programs protecting California's water supply, agricultural lands, and wildlife habitat. The Proposed Plan fits within a wide range of ongoing planning efforts throughout the State to advance economic and environmental priorities associated with natural and working lands.

3. Potential Actions to Enhance Carbon Sequestration and Reduce Greenhouse Gases

The land management targets outlined below are illustrative of the types of actions that will be necessary to maintain California's natural and working lands and urban green space as a net sink of carbon, and are being used to aid in development of the Lawrence Berkeley National Laboratory scenario modeling—both the Reference scenario and "with-policy" scenarios. Once the carbon implications of these activities are established within that scenario modeling framework, the State and stakeholders can begin the process of more accurately scoping the scale of action needed to reach the carbon sequestration and GHG emission reduction targets. The preliminary modeling results were included in the Discussion Draft and Appendix G.

a) Protection of Land and Land Use

California will continue to pursue development and new infrastructure construction patterns that avoid greenfield development, limit conflicts with neighboring land uses, and increase conservation opportunities for natural and working lands to reduce conversion to intensified uses. Success here will depend on working through local and regional land use planning and permitting, as well as developing incentives for participation by local governments and individual landowners. The preliminary modeling results are included in Discussion Draft and Appendix G.

b) Enhance Carbon Sequestration and Resilience through Management and Restoration

California will increase efforts to manage and restore land to secure and increase carbon storage and minimize GHG and black carbon emissions in a sustainable manner so that the carbon bank is resilient over time.

To better understand the potential carbon outcomes of this strategy, the initial modeling for this sector, as detailed in the Discussion Draft and Appendix G, considers a variety of management and restoration activities employed across the State. The model considers two potential scenarios, a "low" and a "high" rate of implementation to 2030, with resulting carbon sequestration outcomes to 2050. The acreages given in the "low" scenario all represent implementation above and beyond current rates for the listed activity, but that could be considered reasonably achievable if additional funding and other supporting resources are available. This applies to implementation on both private and public lands. Many of these goals can be accomplished through existing administrative structures, but will require additional public and private investment. The "high" scenario includes more ambitious targets, and may entail new programs and policies, including additional coordination with federal partners, to support implementation. Details about the modeling are included in the Discussion Draft and Appendix G.

The activities presented in Discussion Draft and Appendix G as part of the initial modeling are not inclusive of all activities that will be considered under this strategy. The modeled management strategies were included because well-established science indicates that the strategies increase carbon sequestration and resilience. For example, an increase in urban tree canopy is included in the initial modeling exercise though urban greening initiatives will not be limited to tree planting. State agencies seek input through this Scoping Plan process on the suite of activities to be considered under this strategy to improve modeling and projections. Because modeling will need to continue beyond finalization of the Final Plan, actions to reduce emissions and increase carbon sequestration for this sector include next steps to identify and analyze land management and restoration activities to advance the State's climate objectives and improvements in modeling projections or other quantification protocols.

Management and restoration activities to be considered beyond those included in the initial modeling include, but are not limited to the following:

- Improved forest management such as forest fuel reduction treatments, reforestation, other restoration activities, prescribed fire and managed ignition.
- Restoration of mountain meadows, managed wetlands in the Sacramento San Joaquin Delta, coastal wetlands and desert habitat.
- Increased extent of eelgrass beds.
- Creation and management of parks and other greenspace in urban areas, including expansion of the existing urban tree canopy.
- U.S. Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) management practices suitable for California agriculture.

The Discussion Draft includes additional information about the initial modeling inputs, assumptions, and results.

State agencies will require additional resources to complete efforts to model projections for this sector.

c) Innovate Biomass Utilization Pathways

Excess biomass generated by commercial agricultural and forestry operations, biomass and wood harvested through forest health and restoration treatments, and material that is generated in response to Tree Mortality Emergency activities, should be used in a manner that minimizes GHG and black carbon emissions and promotes public and environmental health. The legislature has called for reducing disposal of organic waste in landfills, including millions of tons of wood and green waste that can be composted or turned into other products, fuels, and electricity. The State must develop targeted policies or incentives to support durable markets for all of this material. Achieving this outcome will require diversion of this biomass to production of renewable electricity and biofuels, commercial products including durable wood products, compost and other soil amendments, animal feed and bedding, and other uses. Research, development, and implementation activities underway in energy, wood products, and soil amendment fields should be evaluated for utility in optimizing these resources on regional and community scales.

4. Efforts to Support Sector Objectives

To ensure the natural and working lands sector is a net carbon sink, the State will complete an Integrated Natural and Working Lands Climate Change Action Plan by 2018. Modeling efforts currently underway with Lawrence Berkeley National Laboratory and additional modeling efforts, as needed, will support the development of this plan. This plan will consider aggregation of eco-regional plans and efforts to achieve net sequestration goals. The following list includes additional efforts that support this sector's goals, many of which will be included in the Action Plan.

Protect

- Promote and provide incentives for infill development through community revitalization and urban greening and support for permanent and temporary voluntary conservation of lands under threat of development, paired with stewardship plans where possible.
- Promote the adoption of regional transportation and development plans, such as SB 375 Sustainable Communities Strategies and Climate Action Plans that prioritize infill and compact development and also consider the climate change impacts of land use and management.
- Provide support and technical assistance for counties, cities, and regions to integrate natural and working lands conservation priorities into plans, drawing from existing Natural Community Conservation Plans, Habitat Conservation Plans, the State Wildlife Action Plan, and critical agricultural lands. Partner with landowners, local and federal agencies, and private conservation organizations to conserve critical lands.
- Coordinate State-funded land and easement acquisition and management among departments within the Natural Resources Agency, including the Department of Parks and Recreation, Department of Conservation, Department of Fish and Wildlife, Department of Forestry and Fire Protection, Department of Water Resources, Wildlife Conservation Board, Ocean Protection Council, and State Conservancies, to effectively leverage State resources to meet common goals.
- Support ocean management actions that result in protection of subtidal habitats such as eelgrass, to avoid loss of these systems.

Enhance

- Identify land use and management and restoration treatments that are expected to increase the resilience and/or level of carbon sequestration and reduce GHG and black carbon emissions, based on best available science.
- Promote on-farm and ranch management practices that sequester carbon or reduce GHG emissions.
- Engage local communities and private and public landowners to implement best practices for carbon sequestration to achieve net GHG benefits by undertaking actions that reduce on-farm GHG emissions, improve soil and biomass carbon sequestration, restore wetlands and other natural systems, or reduce the risk of wildfire. Support implementation with technical assistance.
- Research, develop, and deploy actions and initiatives for oceans and trophic systems to mitigate and adapt to climate change.
- Increase the use of green infrastructure in urban areas to enhance carbon sequestration potential in a manner that also results in co-benefits of energy efficiency of the built environment and transportation systems, reduction of the urban heat island effect, and improvement of water capture and storage, and supports direct, long-lasting benefits to disadvantaged communities and public health benefits.[171]

[171] For a detailed analysis of public health implications and impacts of climate mitigation measures, please see Appendix J: Public Health Analysis (to be released in early 2017).

- Promote local and regional performance targets for mitigation of the urban heat island (UHI) effect and provide technical support for identification and implementation of urban greening, building and transportation policies, and programs to achieve it. Such a goal might take the form of reducing the UHI differential by 3°F between urban core and surrounding rural areas, versus current UHI impacts in major metropolitan areas.[172]

Innovate

- By 2019, develop through an interagency working group a holistic plan to address excess biomass generated by commercial agricultural and forestry operations and urban biomass, while minimizing GHG and black carbon emissions, through a transition to technologies that can produce cleaner bioenergy, transportation fuels, other commercial products, and soil amendments. This working group will build upon work initiated by the 2012 Bioenergy Action Plan.
- Scale bioenergy capacity to contribute significantly to meeting community and regional agricultural and forest biomass disposal needs over time, in a manner that protects public health. This includes accelerated build-out of the capacity mandated by SB 1122 and the procurement requirements contained in the Tree Mortality State of Emergency Declaration and SB 859.
- Develop recommendations and identify pilot projects to expand wood products markets, as per SB 859. Support research and development and pathways to market for wood products made from non-merchantable timber.

Scoping and Tracking Progress

- Collaborate with other State agencies to ensure the initiatives below complement other Proposed Plan measures:
    - Expand the scope of lands targeted for carbon sequestration, building off of the Initial Scoping Plan goal for forest carbon sequestration (later codified in AB 1504) and the First Update's broader discussion of sequestration potential from agricultural and natural systems.
    - Identify implementation mechanisms to protect and manage land at relevant scales. Implementation will rely on existing regulatory, policy, and incentive structures, and include mandated programs, voluntary efforts, and state, local, regional and federal partnerships with the U.S. Forest Service and USDA NRCS, among others.
    - Identify the scale and scope of implementation for mechanisms to reduce GHG emissions and achieve the goal of maintaining natural and working

[172] CalEPA's Urban Heat Island Index Maps acts as a tool to establish baselines for 31 urban areas. The Index is calculated as a positive temperature differential over time between an urban census tract and nearby upwind rural reference points at a height of two meters above ground level, where people experience heat. See more at: www.calepa.ca.gov/UrbanHeat/Index.htm#sthash.SZkxGYIA.dpuf. CalEPA concludes daytime temperatures in urban areas are on average 1°F–6°F higher than in rural areas, while nighttime temperatures can be as much as 22°F higher as the heat is gradually released from buildings and pavement. The U.S. Environmental Protection Agency (EPA) encourages cities to set quantitative goals. For example, the City of Los Angeles's The Sustainable City pLAn aims to reduce the temperature difference between the urban core and the surrounding rural areas by 1.7°F by 2025 and 3.0°F by 2035.

lands as a carbon sink, as well as the resources and policy pathways for implementation.
    - Evaluate the GHG benefits that result from cross-sectoral programs or programs with alternative goals than GHG emission reductions; for example, the Agricultural Tractor Replacement Program and the Irrigated Lands Regulatory Program.
- Complete the Reference Case, with-policy carbon sequestration, GHG and black carbon emissions scenario projections in order to set targets and develop statewide and regional plans.
- Complete CARB's Natural and Working Lands inventory, including estimates of black carbon emissions from natural and working lands, in concert with the Action Plan. Continue to refine the natural and working lands inventory based on input from other State agencies, stakeholders, and academic experts. Complete a standardized accounting framework for forests and other lands, as described in SB 859, by December 30, 2018.
- Develop implementation tracking and performance monitoring systems for the Action Plan.
- Incorporate a variety of cropland types, agricultural management practices, and bundling of those practices into carbon accounting models to assess the potential for carbon sequestration.
- Develop and implement a Healthy Soils Action Plan.
- Complete and implement the Forest Carbon Plan.
- Design planning and implementation for conservation and restoration strategies to be effective at the watershed or other regionally relevant large landscape scale.

Efforts to reduce GHGs in the agricultural sector:

- Employ a suite of ready-to-implement voluntary practices, such as increasing the efficiency of on-farm water and energy use, managing manure in dairies, and agricultural practices that increase net carbon sequestration and reduce GHG emissions across diverse agricultural systems.
- Per SB 1383, reduce methane emissions from livestock manure and dairy manure management operations, including establishment of energy infrastructure development and procurement policies. The regulations will take effect on or after January 1, 2024, if CARB determines the regulations are technologically and economically feasible and cost effective.
- Implement a Healthy Soils Program to incentivize a variety of practices that are known to sequester carbon in agricultural soils and plants and provide multiple ecosystem services.
- Increase the number of agricultural acres using innovative on-farm water management practices.
- Utilizing existing reporting mechanisms, such as the Irrigated Lands Regulatory Program, identify metrics that can be tracked into the future to evaluate reductions in nitrous oxide emissions from fertilizing materials on California's agricultural lands.

- Further the development and calibration of quantification tools (Comet-Farm, Comet-Planner, and others) and monitoring tools for agriculture to understand trends in practices (aerial imagery, mapping, and sampling).
- Continue to support research to understand emission factors from soils throughout California and to understand sequestration potential.
- Support research and development and pathways to market for dairy digesters, including pipeline injection and interconnection.
- Support research and development for non-digester dairy manure methane mitigation options including scrape, solids separation, converting to pasture-based systems, and other technologies to help meet CARB's proposed methane reduction goals on dairies.
- Facilitate agricultural biomass utilization.
- Increase the number of farms generating on-farm renewable energy (solar, wind, bioenergy, geothermal, etc.).
- Continue to implement and evaluate other potential actions to include in the Compliance Offset Program to generate GHG reductions in the agricultural sector.

E. Waste Management

The Waste Management sector covers all aspects of solid waste[173] and materials management including reduction/reuse; recycling, and remanufacturing of recovered material; composting and in-vessel (anaerobic and aerobic) digestion; biomass management (chip and grind, composting, biomass conversion); municipal solid waste transformation; and landfilling. This sector also includes market development programs, such as the State's recycled-content product procurement program and a range of grant and loan programs. Data from CalRecycle's report, *2014 Disposal Facility-Based Characterization of Solid waste in California*, shows that materials, such as organics, that decompose in landfills and generate methane comprise a significant portion of the waste stream. Methane is a potent SLCP with a global warming potential 25 times greater than that of carbon dioxide on a 100-year time horizon and more than 70 times greater than that of carbon dioxide on a 20-year time horizon.[174]

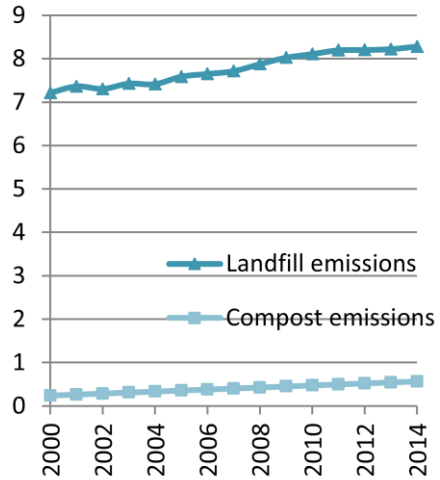
Within CARB's greenhouse gas inventory, emissions from the waste management sector consist of methane and nitrous oxide emissions from landfills and from commercial-scale composting, with methane being the primary contributor to the sector's emissions. The sector emitted 8.85 $MMTCO_2e$ in 2014, comprising approximately 2 percent of the State's GHG emissions.

[173] In general, the term *solid waste* refers to garbage, refuse, sludges, and other discarded solid materials resulting from residential activities, and industrial and commercial operations. This term generally does not include solids or dissolved material in domestic sewage or other significant pollutants in water such as silt, dissolved or suspended solids in industrial wastewater effluents, dissolved materials in irrigation return flows or other common water pollutants.

[174] Intergovernmental Panel on Climate Change. 2007. *Climate Change 2007: Working Group I: The Physical Science Basis.* 2.10.2 Direct Global Warming Potentials. Fourth Assessment Report. www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html

Emissions from recycling and waste have grown by 19 percent since 2000 (Figure IV-3).[175] The majority of those emissions are attributed to landfills, despite the majority of landfills having gas collection systems in place.[176] Landfill emissions account for 94 percent of the emissions in this sector, while compost production facilities make up a small fraction of emissions.[177] The annual amount of solid waste deposited in California landfills grew from 37 million tons in 2000 to its peak of 46 million tons in 2005, followed by a declining trend until 2009 when landfilled solid waste stabilized to relatively constant levels. Landfill emissions are driven by the total waste-in-place, rather than year-to-year fluctuation in annual deposition of solid waste, as the rate and volume of gas produced during decomposition depends on the characteristics of the waste and a number of environmental factors. As a result, waste disposed in a given year contributes to emissions that year and in subsequent years.

Figure IV-3. Emissions from Landfill and Compost ($MMTCO_2e$)



In addition to direct emissions, the reduction, reuse, and recycling of waste materials decreases upstream GHG emissions associated with the extraction and processing of virgin materials and their use in production and transport of products. Although many of these upstream GHG emissions happen outside of California, California's waste policies can reduce both local and global GHG emissions and create jobs within the State. While landfills are an effective and relatively safe way to manage some waste, disposal-centric activities result in squandering valuable resources and generate landfill gases as well as other risks. A large fraction of the organics in the waste stream can be diverted from landfills to composting or digestion facilities to produce beneficial products. Moreover, food waste is the largest component of organics disposed in landfills; a portion of this is edible and should be captured at its source and, for example, provided to food banks to feed people in need. A State waste management sector "loading order" should focus more attention on reducing how much waste we generate and recovering and recycling whatever resources we can, using landfills as a last resort.

Landmark initiatives like the Integrated Waste Management Act of 1989 (AB 939) demonstrate California's efforts to build communities that consume less, recycle more, and take resource conservation to higher and higher levels. Statewide, Californians achieved a 49 percent recycling rate in 2014, and recycling programs support an estimated 75,000 to 115,000 green jobs in California. If California were to achieve a

[175] ARB. 2016. Documentation of California's 2000–2014 GHG Inventory – Index. Last modified March 30, 2016. www.arb.ca.gov/cc/inventory/doc/doc_index.php
[176] ARB. 2013. California Greenhouse Gas Inventory for 2000–2013 – by Category as Defined in the 2008 Scoping Draft Plan (based upon IPCC Fourth Assessment Report's Global Warming Potentials).
[177] ARB. 2016. *2016 Edition California GHG Emission Inventory*. California Greenhouse Gas Emission Inventory: 2000–2014. Version June 17, 2016.

75 percent statewide solid waste recycling rate by 2020—a goal set out by the Legislature in AB 341 (Chesboro, Chapter 476, Statutes of 2011) —by recycling and remanufacturing at in-state facilities, the State could potentially generate an additional 100,000 green jobs.[178] In addition to employment contributions, diversion of organic waste from landfills can generate positive environmental impacts. Compost from organic matter provides soil amendments to revitalize farmland, reduces irrigation and landscaping water demands, contributes to erosion control in fire-ravaged landscapes, and potentially increase long-term carbon storage in rangelands. Production and use of bioenergy in the form of biofuels and renewable natural gas has the potential to reduce dependency on fossil fuels for the transportation sector. For the energy sector, however, renewable natural gas faces safety, feasibility, and cost issues.

The State has a robust waste management system in place, with established programs that reduce air emissions through activities such as gas collection systems from landfills[179] and stringent recycling mandates. AB 939 required cities and counties to reduce the amount of waste going to landfills by 50 percent in 2000, and municipalities have nearly universally met this mandate. Californians dispose about 30 million tons of solid waste in landfills each year. To further reduce landfilled solid waste, the Legislature adopted AB 341 to achieve more significant waste reductions by setting a goal that 75 percent of solid waste generated be reduced, recycled, or composted by 2020, and by mandating commercial recycling. AB 1826 (Chesboro, Chapter 727, Statutes of 2014) added requirements regarding mandatory commercial organics recycling.

Although solid waste management has evolved over the last 27 years and diversion rates (which include more than recycling) have increased more than six-fold since 1989, if no further changes in policy are made, the State's growing population and economy will lead to higher amounts of overall disposal along with associated increases in GHG emissions. The pathway to reducing disposal and associated GHG emissions will require significant expansion of the composting, anaerobic digestion, and recycling manufacturing infrastructure in the State.

To help reduce GHG emissions by 40 percent below 1990 levels by 2030 and meet California's waste reduction goals, California's waste management sector strives to achieve in-state processing and management of waste generated in California. To carry out this vision, we must work with residents and producers to reduce the volume of waste generated overall and capitalize on technology and social changes that might enable waste reduction. Packaging comprises approximately 8 million tons of waste landfilled in California annually, or about one quarter of the State's total disposal stream. To reduce the climate change footprint of packaging, the State is promoting the inclusion of source reduction principles in packaging and product design; fostering recycling and recyclability as a front end design parameter for packaging and products

[178] CalRecycle. 2013. AB 341's 75 Percent Goal and Potential New Recycling Jobs in California by 2020. July. www.calrecycle.ca.gov/Publications/Documents/1463/20131463.pdf

[179] ARB approved a regulation to reduce methane from municipal solid waste landfills as a discrete early action measure under AB 32. The regulation became effective June 17, 2010. Additional information is available at: www.arb.ca.gov/regact/2009/landfills09/landfillfinalfro.pdf

that cannot be reduced; and encouraging recycling markets and market development for recycled-content products and packaging. CalRecycle is developing a packaging policy model containing components necessary for a mandatory comprehensive, statewide packaging program in California; this would need to be legislatively enacted to achieve a packaging reduction goal, such as 50 percent by 2030. CalRecycle is also continuing to work with stakeholder organizations and industry to explore complementary voluntary activities that have the potential to significantly decrease packaging disposal in California. In addition, large-scale shifts in materials management will be necessary, including steps to maximize recycling and diversion from landfills and build the necessary infrastructure to support a sustainable, low carbon waste management system within California. Working together, State and local agencies will identify ways to increase the use of waste diversion alternatives and expand potential markets, obtain funds and incentives for building the infrastructure and strengthening markets, and evaluate the need for additional research to achieve California's GHG reduction and waste management goals.

Recently adopted legislation outlines new opportunities and requirements to reduce GHG emissions from the waste sector, with a focus on reducing organic waste sent to landfills. SB 605 (Lara, Chapter 523, Statutes of 2014) requires that CARB develop a strategy to reduce SLCPs and SB 1383 requires the strategy to be implemented by January 1, 2018. CARB's Proposed SLCP Reduction Strategy includes organic waste diversion targets for 2020 and 2025 consistent with SB 1383 to reduce methane emissions from landfills. It requires CalRecycle, in consultation with CARB, to adopt regulations to achieve statewide disposal targets to reduce landfilling of organic waste by: (1) 50 percent from the 2014 level by 2020, and (2) 75 percent from the 2014 level by 2025. Under SB 1383, of the edible food destined for the organic waste stream, not less than 20 percent is to be recovered to feed people in need by 2025. The regulations are to take effect on or after January 1, 2022, and CalRecycle, in consultation with CARB, must analyze the progress that the waste management sector, State government, and local government have made in achieving the 2020 and 2025 goals by July 1, 2020. Incorporating SB 1383 requirements, CARB's Final SLCP Reduction Strategy is expected to be presented to the Board for approval in the first quarter of 2017. It is estimated that the combined effect of the food waste prevention and rescue programs and organics diversion from landfills will reduce 4 $MMTCO_2e$ of methane in 2030 (using a 20-year GWP), but one year of waste diversion in 2030 is expected to result in a reduction of 14 $MMTCO_2e$ of emissions over the lifetime of waste decomposition.

1. **Looking to the Future**

This section outlines the high-level objectives and goals to reduce GHGs in this sector.

Goals

- Take full ownership of the waste generated in California.
- View waste as a resource.

- Develop a sustainable, low carbon waste management system that processes collected waste within California and generates jobs.
- Maximize recycling and diversion from landfills.
- Reduce direct emissions from composting and digestion operations through improved technologies.
- Build the infrastructure needed to support a sustainable, low carbon waste management system within California.
- Increase organics markets which complement and support other sectors.[180]
- Capture edible food before it enters the waste stream and provide to people in need.
- Increase production of renewable transportation fuels from anaerobic digestion of waste.
- Recognize the co-benefits of compost application.

2. Cross-Sector Interactions

The waste management sector interacts with all of the other sectors of the State's economy. Reducing waste, including food waste, is key to reducing the State's overall carbon footprint. Additionally, replacing virgin materials with recycled materials reduces the energy and GHGs associated with the goods we produce and consume.

California leads the United States in agricultural production in terms of value and crop diversity. Soil carbon is the main source of energy for important soil microbes and is key for making nutrients available to plants. Waste-derived compost and other organic soil amendments support the State's Healthy Soils Initiative being implemented by CDFA. In addition, the use of compost to increase soil organic matter in the agricultural sector provides other benefits, including reduced GHG emissions, conserved water, reduced synthetic (petroleum-based) fertilizer and herbicide use, and sequestered carbon.

3. Efforts to Reduce Greenhouse Gases

The measures below include some required and new potential measures to help achieve the State's 2030 target and to support the high-level objectives for this sector. Some measures may be designed to directly address GHG reductions, while others may result in GHG reductions as a co-benefit. In addition, to move forward with the goals of the waste management sector and achieve the 2030 target, certain actions are recommended to help set the groundwork. These actions affect several broad areas and are necessary for reducing the challenges facing this sector, and they are listed below as supporting actions.

[180] Examples may include renewable energy (biogas to renewable transportation fuels or electricity); soils (application of organics to agricultural soils for building soil organic matter and conserving water; application of organics to mulch for erosion control; application of organics to rangelands for increased carbon sequestration); and forests (support use of forest residues for erosion control; stabilization of fire-ravaged lands).

Ongoing and Proposed Measures

- Continue implementation of the Landfill Methane Control Measure.
- Continue implementation of the Mandatory Commercial Recycling Regulation and the Mandatory Commercial Organics Recycling requirements.
- As required by SB 1383:
  - By 2018, CARB will adopt and implement the Short-Lived Climate Pollutant Reduction Strategy.
  - CalRecycle will develop regulations to require 50 percent organic waste diversion from landfills from 2014 levels by 2020 and 75 percent by 2025, including programs to achieve an edible food waste recovery goal of 20 percent below 2016 levels by 2025. The regulations shall take effect on or after January 1, 2022. By July 1, 2020, analyze the progress that the waste sector, State government, and local governments have made in achieving these goals.
  - CEC will develop recommendations for the development and use of renewable gas as part of the 2017 Integrated Energy Policy Report. Based on these recommendations, adopt policies and incentives to significantly increase sustainable production and use of renewable gas.

Potential Additional or Supporting Action

The actions below have the potential to reduce GHGs and complement the measures and policies identified in Chapter ll. These are included to spur thinking and exploration of innovation that may help the State achieve its long-term climate goals.

- Establishing a sustainable State funding source (such as an increased landfill tip fee and new generator charge) for development of waste management infrastructure, programs, and incentives.
- Working with residents and producers to reduce the volume of waste generated overall and capitalize on technology and social changes that might enable waste reduction.
- Increasing organics diversion from landfills, building on established mandates (AB 341's 75 percent by 2020 solid waste diversion goal, AB 1594,[181] AB 1826,[182] AB 876[183]) and new short-lived climate pollutant targets for 2025 (SB 605, SB 1383) to be accomplished via prevention (including food rescue), recycling, composting/digestion, and biomass options.
- Addressing challenges and issues associated with significant expansion and construction of organics and recycling infrastructure in California that is needed to achieve recycling and diversion goals. Challenges and issues include permitting, grid/pipeline connection, funding, local siting, markets, and research.
- Developing programmatic Environmental Impact Reports (EIRs) and model permit and guidance documents to assist in environmental review and CEQA for new facilities.
- Providing incentives for expanded and new facilities to handle organics and recyclables to meet 2020 and 2030 goals.

[181] Assembly Bill 1594, *Waste Management* (Williams, Chapter 719, Statutes of 2014).
[182] Assembly Bill 1826, *Solid Waste: Organic Waste* (Chesbro, Chapter 727, Statutes of 2014).
[183] Assembly Bill 876, *Compostable Organics* (McCarty, Chapter 593, Statutes of 2015).

- Providing incentives to develop and expand food rescue programs to reduce the amount of edible food being sent to landfills.
- Further quantifying co-benefits of compost products and addressing regulatory barriers that do not provide for consideration of co-benefits.
- Supporting existing and new technologies and markets for excess woody biomass from urban areas, forests, and agriculture.
- Supporting the development of transportation fuel production at digestion facilities to generate renewable transportation fuels.
- Resolving issues of pipeline injection and grid connection to make renewable energy projects competitive.
- Supporting the use of available capacity at wastewater treatment plants that have digesters to process food waste.
- Working with local entities to provide a supportive framework to advance community-wide efforts that are consistent with, or exceed, statewide goals.
- Supporting research and development and pathways to market for dairy and co-digestion digesters, including pipeline injection and interconnection.
- Supporting research on digestate characterization and end products.

F. Water

Water is essential to all life, and is vital to our overall health and well-being. A reliable, clean, and abundant supply of water is also a critical component of California's economy and has particularly important connections to energy, food, and the environment. California's water system includes a complex infrastructure that has been developed to support the capture, use, conveyance, storage, conservation, and treatment of water and wastewater. This elaborate network of storage and delivery systems enables the State to prosper and support populations, amidst wide variability in annual precipitation rates and concentration of rain north of Sacramento, through storing and moving water when and where it is needed.

Local water agencies play an important role in delivering water to communities, farms, and businesses. Some purchase water from the major State and federal projects, treat the water as needed, and deliver it to their customers; others act as wholesale agencies that buy or import water and sell it to retail water suppliers. Some agencies operate their own local water supply systems, including reservoirs and canals that store and move water as needed. Many agencies rely on groundwater exclusively, and operate local wells and distribution systems. In recent decades, local agencies have developed more diversified sources of water supplies. Many agencies use a combination of imported surface water and local groundwater, and also produce or purchase recycled water for end uses such as landscape irrigation.[184]

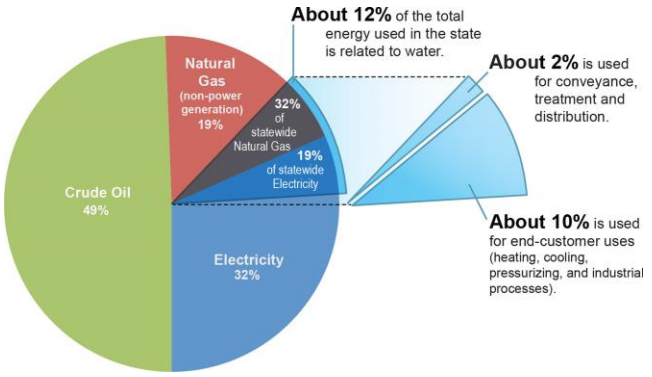
[184] California Department of Water Resources. Regional Energy Intensity of Water Supplies. www.water.ca.gov/climatechange/RegionalEnergyIntensity.cfm

The State's developed surface and groundwater resources support a variety of residential, commercial, industrial, and agricultural activities. California's rapidly growing population—estimated to reach 44 million by 2030[185]—is putting mounting pressure on the water supply system. In the future, the ability to meet most new demand for water will come from a combination of increased conservation and water use efficiency, improved coordination of management of surface and groundwater, recycled water, new technologies in drinking water treatment, groundwater remediation, and brackish and seawater desalination.[186]

One of the State's largest uses of energy is attributed to several aspects of the water life cycle, including treatment, heating, and conveyance of water. As shown in Figure IV-4, overall, 10 percent of the State's energy use is associated with water-related end uses, while water and wastewater systems account for 2 percent of the State's energy use.[187] Therefore, as water demand grows, energy demand may increase concurrently. Population growth drives demand for both water and energy resources, so both grow at about the same rates and in many of the same geographic areas.[188] This dynamic is further exacerbated by the precipitation-population mismatch between Northern and Southern California.

The principal source of GHG emissions from the water sector comes from the fossil fuel-based energy used to "produce" (e.g., pump, convey, treat) water and the fossil fuel-based energy consumed for water end uses (e.g., heating). Therefore, emission reduction strategies are primarily associated with reducing the energy intensity of the water sector. Energy intensity is a measure of the amount of energy required to take a unit of water from its origin (such as a river or aquifer) and extract and convey it to its end use.[189] Within California, the energy intensity of water varies greatly depending on the geography and water source. The California Department of Water Resources (DWR) subdivides the State into 10 regions corresponding to the State's major drainage basins. An interactive map on the DWR website allows users to see a summary of the energy intensity of

Figure IV-4. Energy Use Related to Water



[185] www.dof.ca.gov/research/demographic/reports/projections/P-1/
[186] California Natural Resources Agency, California Department of Food and Agriculture, and California Environmental Protection Agency. California Water Action Plan. resources.ca.gov/docs/californiawateractionDraft Plan/2014CaliforniaWaterActionDraft Plan.pdf
[187] California Department of Water Resources. Water-Energy Nexus: Statewide. Web page accessed November 2016 at: www.water.ca.gov/climatechange/WaterEnergyStatewide.cfm.
[188] Ibid.
[189] A broader definition of energy intensity could consider the "downstream" energy (i.e., wastewater treatment) as well as the upstream components. More robust data are needed, and the State is working to better quantify these upstream and downstream emissions.

regional water supplies.[190] As the energy sector is decarbonized through measures such as increased renewable energy and improved efficiency, energy intensities will also be reduced. It is also important to note that end user actions to reduce water consumption or replace fresh water with recycled water do not automatically translate into GHG reductions. The integrated nature of the water supply system means that a reduction by one end user can be offset by an increase in consumption by another user. Likewise, use of recycled water has the potential to reduce GHGs if it replaces, and not merely serves as an alternative to, an existing, higher-carbon water supply.

The State is currently implementing several targeted, agricultural, urban, and industrial-based water conservation, recycling, and water use efficiency programs as part of an integrated water management effort that will help achieve GHG reductions through reduced energy demand within the water sector.

While it is important for every sector to contribute to the State's climate goals, ensuring universal access to clean water as outlined in AB 685 (Eng, Chapter 524, Statutes of 2012), also known as the "human right to water" bill, should take precedence over achieving GHG emission reductions from water sector activities where a potential conflict exists. AB 685 states that it is the policy of the State that "every human being has the right to safe, clean, affordable, and accessible water adequate for human consumption, cooking, and sanitary purposes." As described in this section, water supplies vary in energy intensity and resulting GHGs, depending on the source of the water, treatment requirements, and location of the end user.

1. Looking to the Future

This section outlines the high-level objectives and goals to reduce GHGs in this sector.

Goals

- Develop and support more reliable water supplies for people, agriculture, and the environment, provided by a more resilient, diversified, sustainably managed water resources system with a focus on actions that provide direct GHG reductions.
- Make conservation a California way of life by using and reusing water more efficiently through greater water conservation, drought tolerant landscaping, stormwater capture, water recycling, and reuse to help meet future water demands and adapt to climate change.
- Develop and support programs and projects that increase water sector energy efficiency and reduce GHG emissions through reduced water and energy use.
- Increase the use of renewable energy to pump, convey, treat, and utilize water.
- Reduce the carbon footprint of water systems and water uses for both surface and groundwater supplies through integrated strategies that reduce GHG emissions while meeting the needs of a growing population, improving public

[190] California Department of Water Resources. Regional Energy Intensity of Water Supplies. www.water.ca.gov/climatechange/RegionalEnergyIntensity.cfm

safety, fostering environmental stewardship, aiding in adaptation to climate change, and supporting a stable economy.

2. Cross-Sector Interactions

Water, energy, food, and ecosystems are inextricably linked, and meeting future climate challenges will require an integrated approach to managing the resources in these sectors.

Water is used in various applications in the energy sector, ranging in intensity from cooling of turbines and other equipment at power plants to cleaning solar photovoltaic panels. In 2003, CEC adopted a water conservation policy for power plants to limit the use of freshwater for power plant cooling, and has since encouraged project owners proposing to build new power plants in California to reduce water consumption with water-efficiency technologies such as dry cooling and to conserve fresh water by using recycled water. Likewise, energy is used in multiple ways and at multiple steps in water delivery and treatment systems, including energy for treating and delivering drinking water; heating and chilling water; conveying water; extracting groundwater; desalination; pressurizing water for irrigation; and wastewater collection, treatment, and disposal.

Although GHG reduction strategies for the water sector have the closest ties to energy, the water sector also interacts with the natural and working lands, agricultural, waste management, and transportation sectors. Water flows from mountains to downstream regions through natural and working lands, which provide habitat for many species and function to store water, recharge groundwater, naturally purify water, and moderate flooding. Protection of key lands from conversion results in healthier watersheds by reducing polluted runoff and maintaining a properly functioning ecosystem. California is the United States' leading agricultural production state in terms of value and crop diversity. Approximately nine million acres of farmland in California are irrigated.[191] In addition, water use is associated with livestock watering, feedlots, dairy operations, and other on-farm needs. Altogether, agriculture uses about 40 percent of the State's managed water supply.[192] In the end, agricultural products produced in California are consumed by humans throughout the world as food, fiber, and fuel. Wastewater treatment plants provide a complementary opportunity for the waste management sector to help process organic waste diversion from landfills. Treatment plants with spare capacity can potentially accommodate organic waste for anaerobic co-digestion of materials such as food waste and fats, oil, and grease from residential, commercial, or industrial facilities to create useful by-products such as electricity, biofuels, and soil amendments. The water sector is also essential to our community health and long-term well-being, and measures must ensure that we continue to have access to clean and reliable sources of drinking water. Climate change threatens to impact our water supplies, for example, with long-term droughts leading to wells and other sources of

[191] Hanson, Blaine. No date. Irrigation of Agricultural Crops in California. PowerPoint. Department of Land, Air and Water Resources University of California, Davis. www.arb.ca.gov/fuels/lcfs/workgroups/lcfssustain/hanson.pdf

[192] *Applied water use* is the official terminology used by DWR. "Applied water refers to the total amount of water that is diverted from any source to meet the demands of water users without adjusting for water that is used up, returned to the developed supply, or considered irrecoverable."

water running dry. This can have devastating consequences, especially on communities already vulnerable and sensitive to changes in their water supply and natural hydrological systems, including rural communities who have limited options for water supplies. Water conservation and management strategies that are energy efficient can also ensure a continued supply of water for our health and well-being.

3. Efforts to Reduce Greenhouse Gases

The measures below include some required and new potential measures to help achieve the State's 2030 target and to support the high-level objectives for this sector. Some measures may be designed to directly address GHG reductions, while others may result in GHG reductions as a co-benefit. In addition, several recommended actions are identified to help the water sector move forward with the identified goals and measures to achieve the 2030 target; these are listed as supporting actions.

Ongoing and Proposed Measures

- As directed by Governor Brown's Executive Order B-37-16, DWR and State Water Resources Control Board (SWRCB) will develop and implement new water use targets to generate more statewide water conservation than existing targets (the existing State law requires a 20 percent reduction in urban water use by 2020 [SBx7-7, Steinberg, Chapter 4, Statutes of 2009]). The new water use targets will be based on strengthened standards for indoor use, outdoor irrigation, commercial, industrial, and institutional water use.
- SWRCB will develop long-term water conservation regulation, and permanently prohibit practices that waste potable water.
- DWR and SWRCB will develop and implement actions to minimize water system leaks, and to set performance standards for water loss, as required by SB 555 (Wolk, Chapter 679, Statutes of 2015).
- DWR and CDFA will update existing requirements for agricultural water management plans to increase water system efficiency.
- CEC will certify innovative technologies for water conservation and water loss detection and control.
- CEC will continue to update the State's Appliance Efficiency Regulations (California Code of Regulations, Title 20, Sections 1601–1608) for appliances offered for sale in California to establish standards that reduce energy consumption for devices that use electricity, gas, and/or water.
- California Environmental Protection Agency (CalEPA) will oversee development of a registry for GHG emissions resulting from the water-energy nexus, as required by SB 1425 (Pavley, Chapter 596, Statutes of 2016).
- The State Water Project has entered long-term contracts to procure renewable electricity from 140 MW solar installations in California.
- As described in its Climate Action Plan, DWR will continue to increase the use of renewable energy to operate the State Water Project.

Overall, these actions will contribute to the broader energy efficiency goals discussed in the Low Carbon Energy section of this chapter.

Potential Additional or Supporting Action

The actions below have the potential to reduce GHGs and complement the measures and policies identified in Chapter ll. These are included to spur thinking and exploration of innovation that may help the State achieve its long-term climate goals.

- Local water and wastewater utilities should adopt a long-term goal to reduce GHGs by 80 percent below 1990 levels by 2050 (consistent with DWR's Climate Action Plan), and thereafter move toward low carbon or net-zero carbon water management systems where technically feasible and cost-effective.
- Local water and wastewater utilities should develop distributed renewable energy where feasible, using the expanded Local Government Renewable Energy Bill Credit (RES-BCT) tariff and new Net Energy Metering (which allow for installation without system size limit).
- In support of the Short-Lived Climate Pollutant Strategy, encourage resource recovering wastewater treatment projects to help achieve the goal of reducing fugitive methane by 40 percent by 2030, to include:
    - Determining opportunities to support co-digestion of food-related waste streams at wastewater treatment plants.
    - Incentivizing methane capture systems at wastewater treatment plants to produce renewable electricity, transportation fuel, or pipeline biomethane.
- Support compact development and land use patterns, and associated conservation and management strategies for natural and working lands that reduce per capita water consumption through more water-efficient built environments.

V. Achieving Success

Meeting, and exceeding, our mandated GHG reduction goals in 2020 and through 2030 requires building on California's decade of success in implementing effective climate policies. State agencies are increasingly coordinating planning activities to align with overarching climate, clean air, social equity, and broader economic objectives.

However, to definitely tip the scales in favor of rapidly declining emissions, we also need to reach beyond State policy-making and engage all Californians. Further progress can be made by supporting innovative actions at the local level—among governments, small businesses, schools, and individual households. Ultimately, success depends on a mix of regulatory program development, incentives, institutional support, and education and outreach to ensure that clean energy and other climate strategies are clear, winning alternatives in the marketplace—to drive business development and consumer adoption.

A. Enabling Local Action

Local governments are essential partners in achieving California's goals to reduce GHG emissions. They can implement climate strategies to address local conditions and issues, and they can often more effectively engage citizens than the State can. They have broad jurisdiction—and in some cases, unique authorities—through community-scale planning and permitting processes, discretionary actions, local codes and ordinances, outreach and education efforts, and municipal operations. And local jurisdictions often develop new, innovative approaches to reduce emissions that are then adopted elsewhere. Their efforts are critical to supporting the State's efforts to reduce emissions and can ultimately deliver additional GHG and criteria emissions reductions beyond what State policy can, along with local economic benefits.

Many cities and counties are already setting GHG reduction targets, developing climate action plans, and making progress toward reducing emissions. Climate action plans allow a local government or region to look holistically at their GHG emissions and develop their own strategies to reduce them, while providing specific, local co-benefits. These plans should include the carbon sequestration values associated with natural and working lands, as well as the importance of jurisdictional lands with regards to water, habitat, agricultural, and recreational resources. Examples of plan-level GHG reduction actions that could be implemented by local governments are listed in Appendix B.

The Statewide Energy Efficiency Collaborative and ICLEI recently released a report, *The State of Local Climate Action: California 2016*,[193] which highlights local government efforts, including the following:

[193] Statewide Energy Efficiency Collaborative. 2016. *State of Local Climate Action: California 2016.* californiaseec.org/wp-content/uploads/2016/10/State-of-Local-Climate-Action-California-2016_Screen.pdf

- In California, 60 percent of cities and over 70 percent of counties have completed a GHG inventory, and 42 percent of local governments have completed a climate, energy, or sustainability plan that directly addresses GHG emissions. Many other community-scale local plans such as general plans, have emissions reduction measures incorporated as well (see Governor's Office of Planning and Research [OPR] Survey questions 23 and 24).[194]
- Over one hundred California local governments have developed emissions reduction targets that, if achieved, would result in a reduction of more than 45 $MMTCO_2e$ each year by 2020, and 83 $MMTCO_2e$ each year by 2050.

Several other local government agencies have important impacts on GHG emissions. Local air districts have a key role to play in reducing regional and local sources of criteria pollutants and GHG emissions. As State agencies are doing, many air districts are actively integrating climate protection into air quality programs. Air districts also support local climate protection programs by providing technical assistance and data, quantification tools, and even funding.[195] Local metropolitan planning organizations (MPOs) support the State's climate action goals via sustainable communities strategies (SCSs), required by the Sustainable Communities and Climate Protection Act of 2008 (SB 375, Chapter 728, Statutes of 2008). Per SB 375, MPOs must prepare SCSs as part of their regional transportation plan to meet regional GHG reduction targets for passenger vehicles in 2020 and 2035. The SCSs contain land use, housing, and transportation strategies that allow regions to meet their GHG emission reduction targets.

State agencies support these local government actions in a number of ways. CoolCalifornia.org is an informational website that includes a "local government toolkit" to help local governments, small businesses, schools, and households reduce emissions. The local government toolkit includes carbon calculators, success stories, climate action plan templates, a Funding Wizard that outlines available grant and loan programs, and monitoring and tracking tools developed through the Statewide Energy Efficiency Collaborative in coordination with CARB and OPR. Additionally, OPR's forthcoming General Plan Guidelines will provide specific, updated guidance for addressing GHG emissions in general plans and related documents. Finally, a significant portion of the $3.4 billion in cap-and-trade expenditures to date has either directly or indirectly supported local government efforts to reduce emissions, including $142 million to support Transformative Climate Communities and provide technical assistance for local planning efforts.

[194] Governor's Office of Planning and Research. 2016. *2016 Annual Planning Survey Results.* November. www.opr.ca.gov/docs/2016_APS_final.pdf

[195] Examples include: (1) Bay Area Air Quality Management District (BAAQMD). *2016 Clean Air Plan and Regional Climate Protection Strategy*. Available at: www.baaqmd.gov/plans-and-climate/air-quality-plans/plans-under-development; (2) California Air Pollution Control Officers Association. California Emissions Estimator Model (CalEEMod). Available at: www.caleemod.com/; (3) San Joaquin Valley Air Pollution Control District. Grants and Incentives. Available at: valleyair.org/grants/; (4) BAAQMD. Grant Funding. Available at: www.baaqmd.gov/grant-funding; (5) South Coast Air Quality Management District. Funding. Available at: www.aqmd.gov/grants-bids/funding; (6) Sacramento Metropolitan Air Quality Management District. Incentive Programs. Available at: www.airquality.org/Residents/Incentive-Programs.

State agencies are interested in ideas to further support local government, small business, school, and household efforts to reduce GHG emissions. Along these lines, CARB is currently developing a centralized database and map that will allow local governments to view and compare emission inventories, reduction targets, climate action planning strategies, and other climate planning materials. This information will help jurisdictions around California identify what climate action strategies are working in other, similar jurisdictions across the State, and will facilitate collaboration among local governments pursuing GHG reduction strategies and goals. This database and map will be featured on the CoolCalifornia.org website and are anticipated to be available in 2017. Additional information on local government activities is available on Cal-Adapt (www.cal-adapt.org), OPR (www.opr.ca.gov), and Cool California's websites.

CoolCalifornia City Challenge
To engage communities in efforts to reduce GHG emissions, CARB has partnered with Energy Upgrade California on the CoolCalifornia Challenge. It's a competition among California cities to reduce their carbon footprints and build more vibrant and sustainable communities. Three challenges have been completed. Most recently, the 2015–2016 Challenge included 22 cities and engaged nearly 3,200 households, who each took actions to reduce energy use and carbon GHG emissions. In total, the participants reported that they completed actions that will collectively save 5,638 $MTCO_2$, equivalent to the emissions more than 1,000 cars or from electricity used by more than 2,500 California homes in a year.

B. Climate Action through Local Planning and Permitting

Local governments play an important role in achieving the State's long-term GHG goals because they have broad influence, and sometimes-exclusive authority, over activities that enable or thwart uptake of policies that can contribute to significant direct and indirect GHG emissions. These actions include their community-scale planning and permitting processes, discretionary actions, local codes and ordinances, outreach and education efforts, and municipal operations. Local government efforts to reduce emissions within their jurisdiction can also provide important co-benefits, including improved air quality, local economic benefits, more sustainable communities, and an improved quality of life.

Although the Proposed Plan focuses on State agency actions necessary to achieve the 2030 GHG limit, local governments are essential partners in achieving California's goals to reduce GHG emissions. The 2030 target will require an increase in the rate of emission reductions compared to what was needed to achieve the 2020 limit, and this will require action and collaboration at all levels, including local government action to complement and support State-level actions. Cities and counties are already setting targets, developing climate action plans, and making progress toward reducing emissions.

Recommended Local Plan-Level Greenhouse Gas Emissions Reduction Goals

CARB recommends that local governments aim to achieve community-wide goal to achieve emissions of no more than six metric tons CO_2e per capita by 2030 and no more than two metric tons CO_2e per capita by 2050.[196] Per capita and mass emissions goals are consistent with the statewide emissions limits established in AB 32, SB 32, Sb 391,[197] and Executive Order S-3-05 and B-30-15.[198] Service population goals allow for linkages with metropolitan planning organization reductions required under SB 375. To develop a GHG mitigation strategy to achieve these targets, local governments should refer to "The U.S. Community Protocol for Accounting and Reporting of Greenhouse Gas Emissions," which provides detailed guidance on completing a GHG emissions inventory at the community scale in the United States—including emissions from businesses, residents, and transportation. Tools such as ClearPath California, which was developed with California agencies, may also be used to support analysis of community-scale GHG emissions.

These per-capita goals are also consistent with the Under 2 MOU that California originated with Baden-Württemberg and has now been signed or endorsed by 165 jurisdictions representing 33 countries and six continents.[199,200] Central to the Under 2 MOU is that all signatories agree to reduce their GHG emissions to two metric tons CO_2e per capita by 2050. This limit represents California's and these other governments' recognition of their "fair share" to reduce GHG emissions to the scientifically based levels necessary to limit global warming below two degrees Celsius. This limit is also consistent with the Paris Agreement, which sets out a global action plan to put the world on track to avoid dangerous climate change by limiting global warming to below 2°C.[201] This local government-recommended goal expands upon the reduction of 15 percent from "current" (2005–2008) levels by 2020 previously recommended in the 2008 Scoping Plan.[202] This is a statewide goal based on all emissions sectors in the State, and local jurisdictions may choose to derive region-specific evidenced based on per capita or per service population GHG emissions goals tied to these statewide goals. Once adopted, the plan and policies to achieve this goal can serve as a performance metric for subsequent projects.

The State must accommodate population growth and economic growth in a far more sustainable manner than in the past. While State-level investments, policies, and actions play an important role in shaping growth and development patterns, regional and local governments and agencies are uniquely positioned to influence the future of the built environment and its associated GHG emissions. Contributions from policies and programs such as renewable energy and energy efficiency are helping achieve the

[196] These goals are appropriate for the plan level (city, county, subregional, or regional level, as appropriate), but not for specific individual projects because they include all emissions sectors in the State.
[197] http://www.leginfo.ca.gov/pub/09-10/bill/sen/sb_0351-0400/sb_391_bill_20091011_chaptered.html
[198] This number represents the 2030 and 2050 limits divided by total population projections from California Department of Finance.
[199] http://under2mou.org/ California signed the Under 2 MOU on May 19, 2015. See under2mou.org/wp-content/uploads/2015/05/California-appendix-English.pdf and under2mou.org/wp-content/uploads/2015/05/California-Signature-Page.pdf.
[200] The Under 2 MOU signatories include jurisdictions ranging from cities to countries to multiple-country partnerships. Therefore, like the goals set forth above for local and regional climate planning, the Under 2 MOU is scalable to various types of jurisdictions.
[201] UNFCCC. The Paris Agreement. unfccc.int/paris_agreement/items/9485.php
[202] 2008 Scoping Plan, page 27. https://www.arb.ca.gov/cc/scopingplan/document/scopingplandocument.htm

near-term 2020 target, but longer-term targets cannot be achieved without land use decisions that allows more efficient use and management of land and infrastructure. Local governments have primary authority to plan, zone, approve, and permit how and where land is developed to accommodate population growth, economic growth, and the changing needs of their jurisdictions. Land use decisions affect GHG emissions associated with transportation, water use, wastewater treatment, waste generation and treatment, energy consumption, and conversion of natural and working lands. Local land use decisions also play a particularly critical role in reducing GHG emissions associated with the transportation sector, both at the project level, and in long-term plans, including general plans, local and regional climate action plans, specific plans, transportation plans, and supporting sustainable community strategies developed under SB 375 among others. While the State can do more to accelerate and incentivize these local decisions to better align with State and local climate and other goals, local actions that reduce VMT are also necessary to meet transportation sector-specific goals and achieve the 2030 target under SB 32.

Climate action plans (CAPs) allow a local government or region to look holistically at regional GHG emissions and local strategies to support the statewide GHG limit. Greenhouse gas strategies in CAPs can also lead to important co-benefits, such as improved air quality, local economic benefits such as green jobs, more transportation choices, improved public health and quality of life, protection of locally, statewide, and globally important natural resources, and more equitable sharing of these benefits across communities. These plans should include the carbon sequestration values associated with natural and working lands, as well as the importance of jurisdictional lands with regards to water, habitat, agricultural, and recreational resources. Examples of plan-level GHG reduction actions that could be implemented by local governments are listed in Appendix B.

Sufficiently detailed and adequately supported GHG reduction plans (including CAPs) also provide local governments and project applicants with a valuable tool for streamlining project-level environmental review. For example, under CEQA, individual projects that comply with the strategies and actions within an adequate local CAP can streamline the project-specific GHG analysis.[203] The California Supreme Court in a recent decision expressly called out this provision in CEQA that allows tiering from a geographically specific GHG reduction plan.[204] The court also recognized that GHG determinations in CEQA should be consistent with the statewide Scoping Plan goals, including the State's long-term 2050 goals.[205] The recommended local government goals of six metric tons CO_2e per capita by 2030 and no more than two metric tons CO_2e per capita by 2050 are intended to provide consistency with the 2030 Target Scoping Plan and the State's long term goals. Knowing that the per capita emissions goals may not be appropriate in some jurisdictions, mass emissions and service population emissions are also important to discuss. Per the community protocol, a local government should focus on those emissions that the jurisdiction controls, while

[203] CEQA Guidelines, § 15183.5, sub. (b).
[204] *Center for Biological Diversity v. California Dept. of Fish and Wildlife* (2015) 62 Cal.4th 204, 229–230.
[205] *Id*. at *pp.* 223–224.

disclosing emissions within its geographical boundary but for which the local government does not have regulatory authority.

Project-Level Greenhouse Gas Emissions Reduction Actions and Thresholds
For transportation projects or transportation components of projects that affect amounts and patterns of vehicle travel, refer to OPR's guidance on CEQA VMT thresholds of significance and for examples of VMT mitigation.

Beyond plan-level thresholds and actions, local governments can also support climate action when considering discretionary approvals and entitlements of individual projects through CEQA.[206] Absent conformity with an adequate geographically specific GHG reduction plan, CARB recommends that all new land use development implement all feasible measures to reduce GHG emissions.[207]

Several recent examples of sustainable land use development projects in California have demonstrated that it is feasible to design projects that achieve zero net additional GHG emissions. For example, several projects have received certification from the governor under AB 900, the Jobs and Economic Improvement through Environmental Leadership Act (Buchanan, Chapter 354, Statutes of 2011), demonstrating an ability to design economically viable projects that create jobs without contributing any net additional GHG emissions.[208] Another example is the Newhall Ranch Resource Management and Development Plan and Spineflower Conservation Plan, in which the applicant, Newhall Land and Farming Company, proposed a commitment to achieve net-zero GHG emissions for a very large-scale residential and commercial specific planned development in Santa Clarita Valley.[209]

CARB believes that achieving no net increase in GHG emissions is the correct overall objective, but it may not be appropriate or feasible for every development project. An inability to mitigate a project's GHG emissions to zero does not necessarily imply a substantial contribution to the cumulatively significant environmental impact of climate change under CEQA. Lead agencies may develop evidenced-based bright-line numeric thresholds—consistent with the Proposed Plan and the State's long-term GHG goals—and projects with emissions over that amount may be required to incorporate on-site design features and mitigation measures that avoid or minimize project emissions to the degree feasible.[210] Otherwise, a performance-based metric using a climate action plan or other plan to reduce GHG emissions is appropriate.

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[206] For transportation projects or transportation components of projects that affect amounts and patterns of vehicle travel, refer to OPR's guidance on CEQA VMT thresholds of significance and examples of VMT mitigation.
[207] This is where there is no adequate climate action plan to tier from, as discussed earlier.
[208] Governor's Office of Planning and Research. California Jobs. www.opr.ca.gov/s_californiajobs.php
[209] California Department of Fish and Wildlife. Newhall Ranch Resource Management and Development Plan and the Spineflower Conservation Plan Environmental Impact Report. www.wildlife.ca.gov/regions/5/newhall
[210] ARB provided some guidance on developing project thresholds in a paper issued in October 2008, which included a concept utilizing a bright-line mass numeric threshold based on capturing approximately 90 percent of emissions in that sector and a concept of minimum performance based standards. Some districts built upon that work to develop thresholds. For example, Santa Barbara County adopted a bright-line numeric threshold of 1,000 $MTCO_2e$/yr for industrial stationary-source projects, and Sacramento Metropolitan Air Quality Management District adopted a 10,000 $MTCO_2e$/yr threshold for stationary source projects and a 1,100 $MTCO_2e$ threshold for construction activities and land development projects in their operational phase. ARB is not endorsing any one of these approaches.

To the degree a project relies on GHG mitigation measures, CARB recommends that lead agencies prioritize on-site design features and direct investments in GHG reductions in the vicinity of the project, to help provide potential air quality and economic co-benefits locally. For example, direct investment in a local building retrofit program can pay for cool roofs, solar panels, solar water heaters, smart meters, energy efficient lighting, energy efficient appliances, energy efficient windows, insulation, and water conservation measures for homes within the geographic area of the project. This type of local program generates real demand side benefits and local jobs, while creating the market signals for energy efficiency materials and goods—some of which can be and are currently produced in California. Other examples of local direct investments include financing installation of regional electric vehicle (EV) charging stations, paying for electrification of public school buses, and investing in local urban forests. It is critical that any such investments in actions to reduce GHG emissions are real and quantifiable. Where further project design or regional investments are infeasible or not proven to be effective, it may be appropriate and feasible to mitigate project emissions through purchasing and retiring carbon credits issued by a recognized and reputable accredited carbon registry. Appendix B includes other examples of on-site project design features, mitigation measures, and direct regional investments that may be feasible to minimize GHG emissions from land use development projects.

C. Implementing the Proposed Plan

This Proposed Plan outlines the regulations, programs, and other mechanisms needed to reduce GHG emissions in California. CARB and other State agencies will work closely with local agencies, stakeholders, and the public to develop regulatory measures and other programs to implement the Proposed Plan. CARB and other State agencies will develop regulations in accordance with established rulemaking guidelines. Per Executive Order B-30-15, as these regulatory measures and other programs are developed, building programs for climate resiliency must also be a consideration. Additionally, agencies will further collaborate and work to provide the institutional support needed to overcome barriers that may currently hinder certain efforts to reduce GHG emissions and to support the goals, actions, and measures identified for key sectors in Chapter IV. Table V-1 provides a high-level summary of the Climate Change Policies and Measures discussed in the Proposed Plan, including but not limited to, those identified specifically to achieve the 2030 target.

Table V-1. Climate Change Policies and Measures

Recommended Action	Lead Agency
By 2018, develop Integrated Natural and Working Lands Action Plan to secure California's land base as a net carbon sink: • Protect land from conversion through conservation easements and other incentives. • Increase the long-term resilience of carbon storage in the land base and enhance sequestration capacity • Utilize wood and agricultural products to increase the	CNRA and departments within

amount of carbon stored in the natural and built environments • Establish scenario projections to serve as the foundation for the Action Plan and a carbon accounting framework for natural and working lands as described in SB 859	
By 2019, develop a Utilization of Biomass and Waste Plan: • Develop through an interagency working group a holistic plan to address excess biomass generated by commercial agricultural and forestry operations and urban biomass, while minimizing GHG and black carbon emissions, through a transition to technologies that can produce cleaner bioenergy, transportation fuels, other commercial products, and soil amendments. This working group will build upon work initiated by the 2012 Bioenergy Action Plan.	CNRA and departments within CalEPA and departments within CPUC CEC
Implement SB 350 by 2030: • Reduce GHG emissions in the electricity sector through the implementation of GHG emission reduction planning targets in the IRP process. Load-serving entities meet GHG emission reduction planning targets through a combination of measures as described in IRPs. • Increase the Renewables Portfolio Standard to 50% of retail sales by 2030 and ensure grid reliability. • Establish annual targets for statewide energy efficiency savings and demand reduction that will achieve a cumulative doubling of statewide energy efficiency savings in electricity and natural gas end uses by 2030.	CPUC CEC CARB
Increase in Low Carbon Fuel Standard by 2030: Carbon intensity reduction of at least 18%.	CARB
Implement currently proposed Short-Lived Climate Pollutant Strategy by 2030: • 40% reduction in methane and hydrofluorocarbon emissions. • 50% reduction in black carbon emissions.	CARB CalRecycle CDFA SWRCB Local air districts
Increase stringency of SB 375 Sustainable Communities Strategy (2035 targets).	CARB
Implement Mobile Source Strategy (Cleaner Technology and Fuels): • At least 1.5 million zero emission and plug-in hybrid light-duty electric vehicles by 2025. • At least 4.2 million ZEVs by 2030. • Medium- and heavy-duty GHG Phase 2. • Advanced Clean Transit: 20% of new urban buses purchased beginning in 2018 will be zero emission buses,	CARB CalSTA SGC CalTrans CEC OPR Local agencies

ramping up to 100% of new sales in 2030. New natural gas buses starting in 2018, and diesel buses starting in 2020, meet the optional heavy-duty low-NOx standard. • Last Mile Delivery: Requirement to purchase low-NOx engines if available, and phase-in of zero emission trucks for Class 3–7 last mile delivery trucks starting in 2020. Zero emission vehicles comprise 2.5% of new Class 3–7 truck sales in local fleets starting in 2020, increasing to 10% in 2025 and remaining flat through 2030. • Further reduce VMT through continued implementation of SB 375 and regional Sustainable Communities Strategies; forthcoming statewide implementation of SB 743; and additional VMT reduction strategies not specified in the Mobile Source Strategy but included in the document "Potential VMT Reduction Strategies for Discussion."	
Implement California Sustainable Freight Action Plan: • Improve freight system efficiency. • Deploy over 100,000 freight vehicles and equipment capable of zero emission operation and maximize near-zero emission freight vehicles and equipment powered by renewable energy by 2030.	CalSTA Cal/EPA CNRA CARB CalTrans CEC GoBiz
Adopt a post-2020 Cap-and-Trade Program with declining annual caps.	CARB
Adopt a regulation to achieve a 20% reduction in GHG emissions from refineries in California by 2030.	CARB

D. A Comprehensive Approach to Support Climate Action

Ultimately, successfully tipping the scales in the fight against climate change relies on our ability to make clean technologies clear winners in the marketplace and other climate strategies clearly understood and easily accessible. We must support and guide our businesses as they continue to innovate and make clean technologies ever more attractive to ever more savvy consumers. Until the point that clean technologies become the best and lowest cost option—which is clearly on the horizon for many technologies, including renewable energy and electric cars—we must continue to support emerging markets through incentives and outreach efforts. More than just coordinating among agencies and providing institutional support as described above, we will succeed if we tackle climate change from all angles—through regulatory and policy development, targeted incentives, and education and outreach.

Regulations and Programmatic Development

Our decade of climate leadership has demonstrated that developing mitigation strategies through a public process, where all stakeholders have a voice, leads to effective actions that address climate change and yield a series of additional economic

and environmental co-benefits to the State. As we implement this Proposed Plan, State agencies will continue to develop and implement new and existing programs, as described herein. During any rulemaking process, there are many opportunities for both informal interaction with technical staff in meetings and workshops, and formal interaction at Board meetings, Commission business meetings, monthly public meetings, and others. Each State agency will consider all information and stakeholder input during the rulemaking process. Based on this information, the agency may modify proposed measures to reflect the status of technological development, the cost of the measure, the cost-effectiveness of the measures, and other factors before presenting them for consideration and adoption.

Further, to achieve cost-effective GHG reductions, California State agencies must consider the environmental impact of small businesses and provide mechanisms to assist businesses as GHG reduction measures are implemented. CARB provides resources and tips for small businesses to prevent pollution, minimize waste, and save energy and water on an informational website: www.CoolCalifornia.org. California's small businesses and their employees represent a valuable economic resource in the State and "greening" existing businesses is not only achievable, but sets an example for new businesses which will prove significant as California transitions to a low carbon state.

State agencies conduct environmental and environmental justice assessments of our regulatory actions. Many of the requirements in AB 32 overlap with agency traditional evaluations. In adopting regulations to implement the measures recommended in the Proposed Plan, or including in the regulations the use of market-based compliance mechanisms to comply with the regulations, the agency will ensure that the measures have undergone the aforementioned screenings and meet the requirements established in California Health and Safety Code Section 38562(b)(1-9) and Section 38570(b)(1-3).

Incentive Programs

Financial incentives and direct funding are critical components of the State's climate framework. In particular, incentives and funding are necessary to support GHG emission reduction strategies for priority sectors, sources, and technologies. Although California has a number of existing incentive programs, available funding is limited. It is critical to target public investments efficiently and in ways that encourage integrated, systemwide solutions to produce deep and lasting public benefits. Significant investments of private capital, supported by targeted, priority investments of public funding, are necessary to scale deployment and to maximize benefits. Public investments can help incentivize early action to accelerate market transition to cleaner technologies, which can also be supported by regulatory measures.

Many existing State funding programs work in tandem to reduce emissions from GHGs, criteria pollutants, and toxic air contaminants, and are helping to foster the transition to a clean energy economy and are protecting and managing land for carbon sequestration. State law, including Senate Bill 535 (De León, Chapter 830, Statutes of

2012) and Assembly Bill 1550 (Gomez, Chapter 369, Statutes of 2016) also requires focused investment in low income and disadvantaged communities.

The State will need to continue to coordinate and utilize funding sources, such as the Greenhouse Gas Reduction Fund (cap-and-trade auction proceeds), the Alternative and Renewable Fuel and Vehicle Technology Program (AB 118), Electric Program Investment Charge (EPIC) Program, Carl Moyer Program, Air Quality Improvement Program, and Proposition 39 to expand clean energy investments in California and further reduce GHG and criteria emissions. Additionally, programs including the Bioenergy Feed-In Tariff, created by Senate Bill 1122 (Rubio, Chapter 612, Statutes of 2012), Low Carbon Fuel Standard, Cap-and-Trade, Self-Generation Incentive Program, Federal Renewable Fuel Standard, utility incentives pursuant to Assembly Bill 1900 (Gatto, Chapter 602, Statutes of 2012), and others provide important market signals and potential revenue streams to support projects to reduce GHG emissions.

These programs represent just a portion of the opportunities that exist at the federal, State, and local levels to incentivize GHG emission reductions. The availability of dedicated and long-lasting funding sources is critical to help meet the State's climate objectives and help provide certainty and additional partnership opportunities at the national, State, regional, and local levels for further investing in projects that have the potential to expand investments in California's clean economy and further reductions in GHG emissions.

Public Education and Outreach Efforts

California State agencies are committed to meaningful opportunities for public input and effective engagement with stakeholders and the public through the development of the Scoping Plan, and as measures are implemented through workshops and other meetings. Additionally, the State has broad public education and outreach campaigns to support markets for key technologies, like ZEVs and energy efficiency, as well as resources to support local and voluntary actions, such as CoolCalifornia.org.

In developing this Proposed Plan, there has been extensive outreach with environmental justice organizations and disadvantaged communities. The EJAC launched a community engagement process starting in July 2016, conducting 11 community meetings throughout the State and collecting hundreds of individual comments. To enhance the engagement opportunity, CARB coordinated with local government agencies and sister State agencies to hold collaborative discussions with local residents about specific climate issues that impact their lives. This effort was well received and attended by local community residents and initiated a new community engagement endeavor for CARB. Recognizing the value of the input received and the opportunity to present California's climate strategy to communities across the State, CARB intends to continue this community involvement to generate awareness about California's climate strategy and be responsive to specific community needs as climate programs are implemented.

Education and Environment Initiative
The California Environmental Protection Agency (CalEPA), the California Department of Education, and the California Natural Resources Agency have developed an environmental curriculum that is being taught in more than half of California's school districts. The Education and Environment Initiative (EEI) provides California's teachers with tools to educate students about the natural environment and how everyday choices can improve our planet and save money.

Abbreviations

AB	Assembly Bill
AC	air conditioning
AEO	Annual Energy Outlook
AHSC	Affordable Housing and Sustainable Communities
ARFVTP	Alternative and Renewable Fuel and Vehicle Technology Program
BARCT	best available retrofit control technology
BAU	business-as-usual
BC	British Columbia
CARB	California Air Resources Board
CAISO	California Independent System Operator
CalEPA	California Environmental Protection Agency
CALGreen	California Green Building Standards
CalPERS	California Public Employees' Retirement System
CalSTA	California State Transportation Agency
CalSTRS	California State Teachers' Retirement System
CAP	Climate Action Plan
CARE	California Alternate Rates for Energy Program
CDFA	California Department of Food and Agriculture
CDPH	California Department of Public Health
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CFT	Clean Fuels and Technology
CH_4	methane
CI	carbon intensity
CNRA	California Natural Resources Agency
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COPD	chronic obstructive pulmonary disease
CPUC	California Public Utilities Commission
CSI	California Solar Initiative
dge	diesel gallon equivalent
DWR	California Department of Water Resources
EA	Environmental Analysis
EEI	Education and Environment Initiative
EIR	Environmental Impact Report
EJAC	Environmental Justice Advisory Committee
EO	Executive Order
EPIC	Electric Program Investment Charge Program
F-gases	fluorinated gases
FERA	Family Electric Rate Assistance
GCF	Governors' Climate and Forests Task Force

GDP	gross domestic product
GGRF	Greenhouse Gas Reduction Fund
GHG	greenhouse gas
GoBiz	Governor's Office of Business and Economic Development
GWP	global warming potential
HFC	hydrofluorocarbon
HVAC	heating, ventilation and air conditioning
ICAP	International Carbon Action Partnership
IEPR	Integrated Energy Policy Report
IOU	investor-owned utility
IPCC	United Nations Intergovernmental Panel on Climate Change
IRP	integrated resource plan
LCFS	Low Carbon Fuel Standard
LCTOP	Low Carbon Transit Operations Program
LDV	light-duty vehicle
LED	light-emitting diode
LIWP	Low-Income Weatherization Program
LOS	level of service
$MMTCO_2e$	million metric tons of carbon dioxide equivalent
MOU	memorandum of understanding
MPO	metropolitan planning organization
MRR	Regulation for the Mandatory Reporting of GHG Emissions
$MTCO_2$	metric tons of carbon dioxide
MW	megawatt
N_2O	nitrous oxide
NAICS	North American Industry Classification System
NEM	Net-Energy Metering
NF_3	nitrogen trifluoride
NOx	nitrogen oxide
NZE	near-zero emission
OEHHA	Office of Environmental Health Hazard Assessment
OPR	Governor's Office of Planning and Research
PEV	plug-in electric vehicle
PFC	perfluorocarbon
PM	particulate matter
$PM_{2.5}$	fine particulate matter
PMR	Partnership for Market Readiness
REMI	Regional Economic Models, Inc.
RES-BCT	Renewable Energy Bill Credit
RNG	renewable natural gas
RPS	renewable portfolio standard
RTP	regional transportation plan
SB	Senate bill
SCS	Sustainable Communities Strategies
SF_6	sulfur hexafluoride

SGC	Strategic Growth Council
SGIP	Self-Generation Incentive Program
SLCP	Short-lived climate pollutant
SWRCB	State Water Resources Control Board
TBD	to be determined
TCU	Transportation Communications and Utilities
TIRCP	Transit and Intercity Rail Capital Program
UCLA	University of California, Los Angeles
UHI	urban heat island
UIC	International Union of Railways
UNFCCC	United Nations Framework Convention on Climate Change
USDA	U.S. Department of Agriculture
U.S. EPA	United States Environmental Protection Agency
VMT	vehicle miles traveled
WWTP	waste water treatment plant
ZE	zero emission
ZEV	zero emission vehicles