

Carbon Neutrality In California Context Webinar



JANUARY 23, 2019

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Good afternoon. Thank you for joining us for the webinar today. My name is Maureen Hand. I work in the Industrial Strategies Division at CARB. I'm joined by Rajinder Sahota, the Assistant Division Chief for Industrial Strategies.

This webinar is being hosted by the California Air Resources Board to provide some background information on carbon neutrality and put the concept into context for California. Carbon neutrality is an emerging framework for structuring actions to address climate change and is being considered internationally, as well as in California.

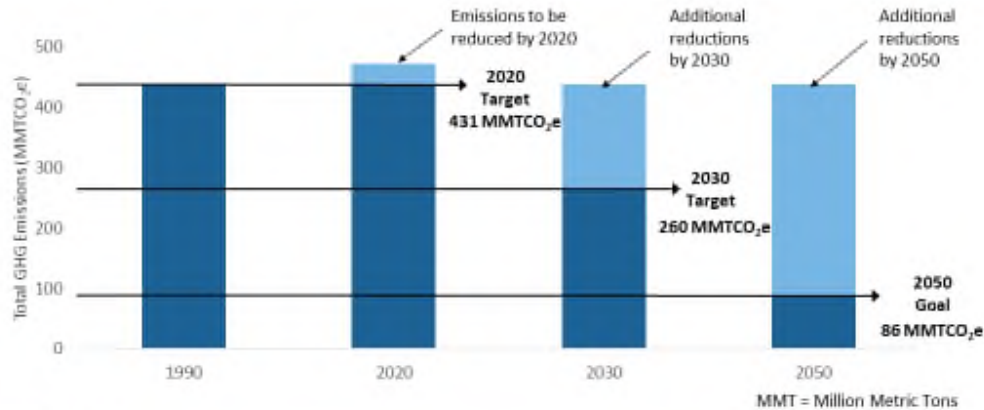
Webinar Logistics

- Presentation posted here:
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- Submit questions using the Questions/Chat box in the Control Panel

We will give a short presentation followed by an opportunity for questions. You can find the presentation slides on the Scoping Plan Meetings webpage link shown on this slide.

We will answer questions after the presentation. Questions can be submitted at any time during the presentation using the Control Panel on your screen. The Control Panel is usually in the top right hand corner of the screen. It may need to be expanded by selecting the red arrow. Questions are entered in the Questions/Chat box. Press the Send button to send the question. The Send button can be selected once text is entered into the Questions/Chat box.

California's GHG Emissions Reduction Targets



Source: CARB, 2018

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A number of key statutes and executive orders guide the State's climate targets which are shown in the figure. The dark blue areas represent estimated annual greenhouse gas emissions in each year. The light blue areas reflect avoided emissions, or emission reductions, needed to achieve the future target or goal.

In 2006, AB 32 set our initial target for 2020: to return to 1990 greenhouse gas emission levels. It's worth noting that our 2016 emissions fell below the 2020 target, four years earlier than mandated in statute.

Then, SB 32 called for a 40% reduction in greenhouse gas emissions below 1990 levels statewide by 2030. The 2017 Scoping Plan lays out a cost-effective and achievable path for this target.

This 2030 target is on the path toward achieving the goal of reducing greenhouse gas emissions 80% below 1990 levels by 2050, established by Executive Order by Governor Schwarzenegger.

Governor Brown's recent Executive Order, calling for carbon neutrality by 2045, has yet to be implemented, but we anticipate that it will build on our successes in reducing carbon dioxide emission from fossil-fuel combustion, and emphasizes our need to focus on our natural and working lands. Carbon neutrality will require both reductions in greenhouse gas emissions as well as carbon sequestration such that there are net zero GHG emissions in mid-century – the dark blue area for 2050 would be zero.

In response to federal inaction on climate, California has joined other states in the U.S. Climate Alliance to affirm commitment to the Paris Agreement.

2018 Legislation

- SB 100 (De León, Chapter 312, Statutes of 2018) California Renewables Portfolio Standard Program: emissions of greenhouse gases
 - Increase Renewables Portfolio Standard to 50% renewable resources by December 31, 2026, and to 60% by December 31, 2030.
 - Establish policy that renewable energy resources and zero-carbon resources supply 100 percent of all retail sales of electricity by December 31, 2045
- SB 901 (Dodd, Chapter 626, Statutes of 2018) Wildfire Protection and Forest Health
 - Establishes mechanisms to increase the pace and scale of fuel reduction, thinning, and the use of prescribed fire
 - Provides \$200 million per year for 5 years for fire prevention and forest health activities

The State legislature continues to enhance and strengthen California's commitment to GHG emission reduction.

In 2018 Senate Bill 100 was passed to increase the renewable portfolio standard to 60 percent by 2030, an increase from 50 percent as called for in SB350. SB 100 also directed agencies to explore implications of producing 100% of electricity demand from renewable energy and zero-carbon energy resources.

The legislature also established mechanisms and funding to improve the health of forests enhancing their value as a carbon sink through Senate Bill 901.

This bill aims to make forests more resilient and long-term carbon sinks. Specifically, it establishes mechanisms to reduce the fuel loads in the forests and strategic use of prescribed fire.

SB901 provides 200 million dollars per year for 5 years to support fire prevention and forest health activities.

2018 Climate Change Reports



In the last few months, two seminal climate change reports were published: one with global scope and the other focused on the United States.

The IPCC Special Report provides a global perspective on impacts of global warming of 1.5 degrees Celsius above pre-industrial levels. The Fourth National Climate Assessment, assesses climate change impacts across the United States now and throughout this century.

Our climate is already changing, and these two reports describe similar impacts and risks associated with continued warming of the planet.

Impacts of climate change are already evident in terms of more frequent and intense extreme weather events.

The climate will continue to change as a result of emissions over the last couple centuries. Without substantial and sustained global efforts to reduce emissions and to adapt to our new climate, risks to health, livelihoods, food security, water supply and economic growth increase. Human health is affected by climate change.

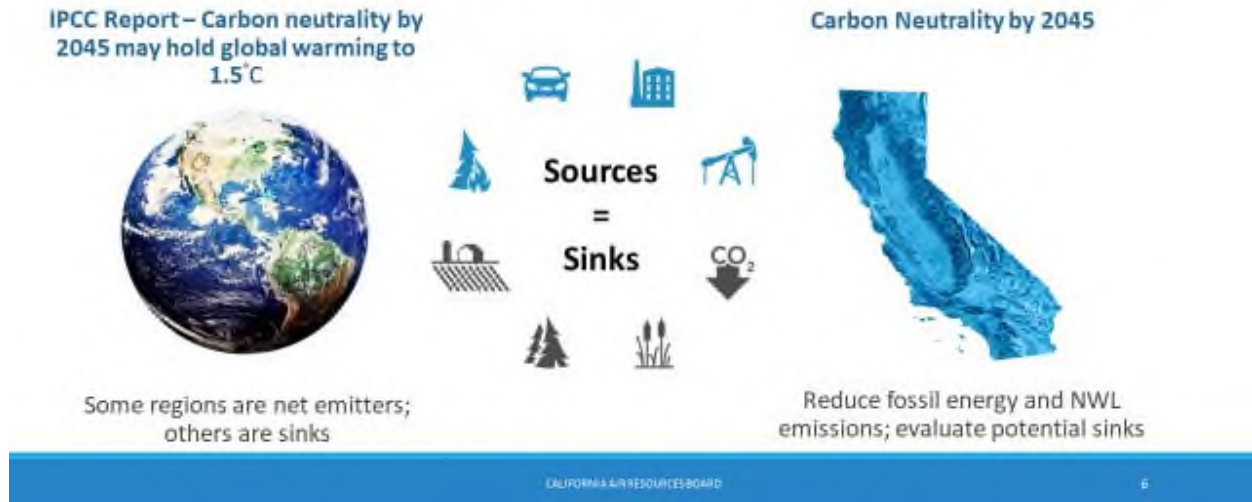
Although there are numerous mitigation and adaptation efforts underway, globally and in the United States, the scale and speed of these actions is not considered sufficient to avoid substantial damages.

Global warming impacts will not be distributed equally – both at the global and national scale. Disadvantaged and vulnerable populations as well as communities dependent on agriculture or coastal livelihoods are at higher risk of adverse consequences.

In summary, these two reports further substantiate what we already know.

While actions we take here in California will reduce GHG emissions and provide public health co-benefits, the reports confirm that unless others take similar actions, we are still susceptible to the adverse impacts of this global issue. To avoid the impacts of climate change here, our path forward must continue to include collaboration and coordination with other jurisdictions in taking similar actions.

Framing the Path Forward



Our thinking about how to approach the climate challenge is evolving.

The concept of carbon neutrality is gaining importance. The concept is that to address climate change, the carbon dioxide and other greenhouse gas emissions generated by sources such as vehicles, power plants, and industrial processes must be less than or equal to the amount of carbon dioxide that is stored, both in natural sinks such as forests and mechanical sequestration such as carbon capture and sequestration.

The magnitude of climate change impacts will depend upon when carbon neutrality is achieved.

The IPCC's Special Report finds that to limit global temperature increase to 1.5 degrees Celsius we need to both reduce greenhouse gas emissions and remove carbon from the atmosphere. We need to reach global carbon neutrality by mid-century.

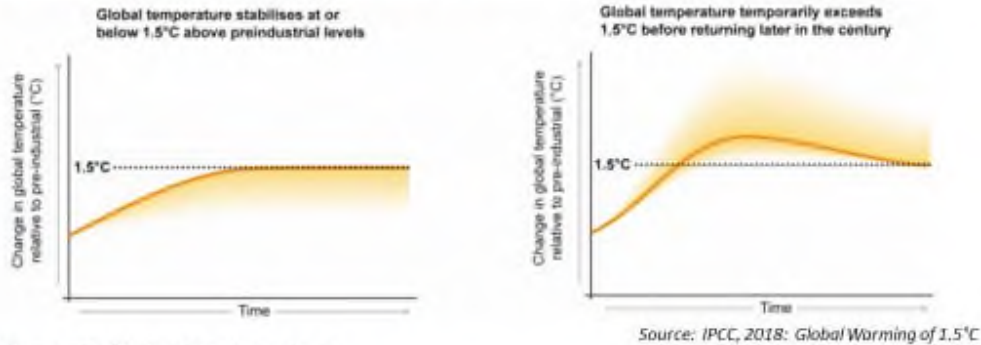
The report also indicates that on a global scale, some regions may remain net emitters, while others are better suited to be net sinks.

In September, Governor Brown signed an executive order for carbon neutrality by 2045, consistent with the IPCC report findings.

This executive order introduces the concept of balancing emissions and sequestration within the state.

In short, the framing of near zero emissions is not sufficient to limit global warming to 1.5 degrees Celsius. We need our GHG emissions flux to be at zero or net negative - where we remove more greenhouse gases than we emit.

Global Warming Limit



- Pathways to limit global warming:
 - Reduce net global emissions to zero before the carbon budget is reached (left)
 - Extract carbon such that there are net negative global emissions after the carbon budget is exceeded (right)

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This graphic from the IPCC Special Report shows two conceptual global temperature pathways where global temperature reaches a stable temperature over time – in this case 1.5 degrees Celsius. The concept could be applied to any other temperature limit as well. The figures show global temperature relative to the pre-industrial period, or the amount of warming since the late 1800s. The global temperature rises or falls based on the amount of carbon dioxide in the atmosphere.

Limiting global warming requires limiting the total cumulative global anthropogenic emissions of CO₂, that is, staying within a carbon budget. Cumulative CO₂ emissions are kept within the budget by reducing the annual CO₂ emissions to net zero.

There are two conceptual approaches:

1. Reduce net emissions to zero before the carbon budget is reached; this approach leads to a global temperature increase that approaches the limit and remains at that level as shown in the figure on the left.
2. Extract carbon such that there are net negative emissions after the carbon budget is exceeded; this approach likely results in global temperature overshooting the limit but returning later in the century as shown in the figure on the right.

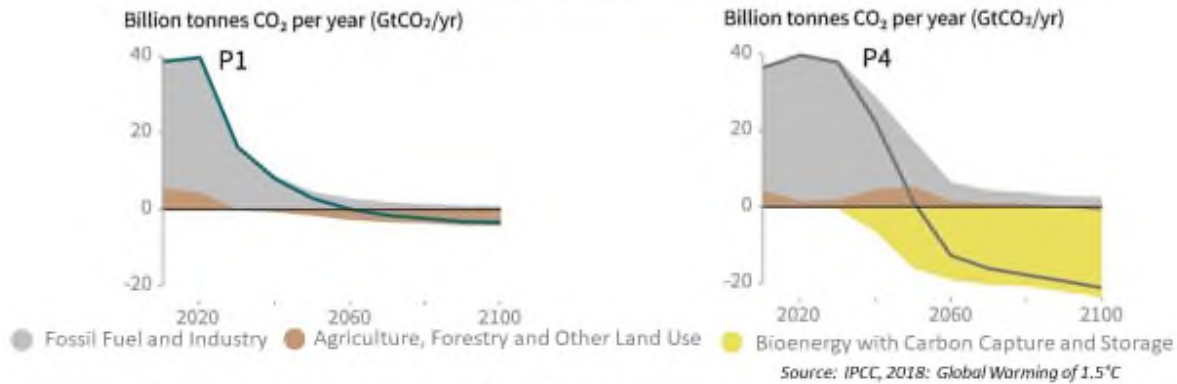
The IPCC estimates a remaining budget of 580 billion tonnes carbon dioxide for a 50/50 chance of limiting warming to 1.5 degrees C, and it implies reaching global carbon neutrality in 30 years.

It is important to note that non-CO₂ emissions affect the remaining carbon budget. The modelled pathways that limit warming to 1.5 degrees Celsius that were assessed in the

IPCC Special Report involve deep reductions in emissions of methane, black carbon, and cooling aerosols by 2050.

Future climate risks depend on the mitigation pathway to reduce emissions and on the possible occurrence of transient overshoot of global temperature – impacts on natural and human systems would be greater if mitigation pathways temporarily overshoot 1.5 degrees Celsius and return to 1.5 degrees Celsius later in century.

Global Carbon Neutrality



- Reduced energy demand combined with steep, near-term emission reductions reduces the need for carbon dioxide removal.

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The IPCC assessed a number of model scenarios that limit global warming to 1.5 degrees Celsius; these scenarios reflect a wide range of assumptions about future economic growth, technology development and lifestyles.

Two illustrative mitigation pathways are shown here; the P1 scenario limits warming to 1.5 degrees Celsius with no or limited temperature overshoot. The P4 scenario also limits warming to 1.5 degrees Celsius, but with higher overshoot.

The gray areas represent carbon dioxide emissions from fossil fuel and industry. Brown shading represents carbon removals in the Agriculture, Forestry and Other Land Use sector. Land use emissions in this sector include deforestation, afforestation, fertilization, irrigation, harvesting, and other aspects of cropland, grazing land and livestock management. Yellow shading illustrates the contribution from Bioenergy with Carbon Capture and Storage.

Both pathways illustrate net negative emissions in mid century - where the dark line crosses zero.

These illustrative mitigation pathways are characterized by energy demand reductions, decarbonization of electricity and other fuels, electrification of energy end use, deep reductions in agricultural emissions, and some form of carbon dioxide removal with carbon storage on land or sequestration in geological reservoirs

The P1 scenario incorporates significant energy demand reduction, which enables rapid decarbonization of the energy supply. In this scenario afforestation, or planting new forests, is the only carbon dioxide removal option; neither fossil fuels with Carbon

Capture and Sequestration nor Bioenergy with Carbon Capture and Sequestration are used.

The P4 scenario, on the other hand, represents a resource and energy-intensive scenario with high demand for transportation fuels and livestock products. In this scenario there is strong use of carbon dioxide removal through the deployment of Bioenergy with Carbon Capture and Storage.

California's greenhouse gas emission reduction efforts described in the Scoping Plan set a course for 2030 which is similar in magnitude to the rapid, near-term reduction associated with the P1 scenario and others that result in limiting global warming to 1.5 degrees Celsius with no or limited overshoot. Although reliance on carbon dioxide removal is more limited in this approach, it is still a feature required to achieve carbon neutrality by mid-century.

Importance of 1.5°C

Anticipated California Climate Change Impacts



Source: CARB, 2017: California's 2017 Climate Change Scoping Plan

- Limiting global warming to 1.5°C compared to 2°C is projected to:
 - Slow the rate of sea level rise
 - Reduce climate-related risks to health, livelihoods, food security, water supply, human security, and economic growth
 - Reduce most adaptation needs
 - Increase potential to reduce climate related inequities for vulnerable populations

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Temperature will continue to rise without efforts to reduce emissions. The IPCC report evaluates differences between limiting warming to 1.5 degrees Celsius and 2 degrees Celsius. In general, limiting to 1.5 degrees Celsius reduces climate related risks and increases flexibility of mitigation and adaptation options.

California has identified a number of climate change impacts shown in the graphic, and the magnitude of these impacts will be affected by the global temperature. Limiting global warming to 1.5 degrees Celsius could slow the rate of sea level rise as compared to reaching a higher global temperature limit of 2 degrees Celsius.

Risks to water supply and food security associated with drought and reduced snowpack could be lessened; risks to human security and health associated with wildfires and heat waves would be reduced if global temperature stabilized at 1.5 degrees Celsius.

California is investing in adaptation projects to lessen the impact of climate change. The scale of adaptation needed would be reduced with global temperatures of 1.5 degrees Celsius.

Vulnerable populations are disproportionately affected by climate change, but if warming is limited to 1.5 degrees Celsius, there is greater potential to reduce climate change related inequalities.

Portfolio Approach and Ambition

IPCC

- Carbon pricing needs to be complemented with other policies
- Innovation policies and international cooperation can contribute to the development, commercialization, and widespread adoption of new and possibly disruptive technologies and practices
- Education, information, and community approaches, when combined with other policies, are more effective in accelerating wide-scale behavior changes

California

- Since the 2008 Scoping Plan, California has deployed a portfolio of incentives, prescriptive regulations, and carbon pricing

The IPCC special report also explored policy paths to reduce emissions. Rapid and far-reaching transitions in energy, land, urban and infrastructure, and industrial systems are needed to achieve carbon neutrality by mid-century and limit global warming to 1.5 degrees Celsius.

A range of policy instruments will be needed to mobilize large increases in investments in low-emission infrastructure and buildings. The report supports the need to couple carbon pricing with complementary policies to quickly transform in a cost-effective manner.

Wide-spread adoption of new and possibly disruptive technologies contribute to the systems transitions needed to limit global warming to 1.5 degrees Celsius. Innovation policies may be more effective when they combine public support for research and development with policy mixes that provide incentives for technology diffusion.

Behavior changes consistent with adapting to and limiting global warming to 1.5 degrees Celsius can be accelerated when policies are combined with education, information and community approaches.

Together, policy instruments, increased investment and accelerated technological innovation and behavior change can enable system transitions that lead to carbon neutrality by mid-century.

It is worth noting that California has consistently pursued a portfolio of incentives, prescriptive regulations and carbon pricing to trigger system transitions to achieve the State's greenhouse gas emission goals. Our reductions in greenhouse gas emissions lend proof that our approach is working while the economy has grown.

International Carbon Neutrality Efforts

- European Union
 - strategic long-term vision climate-neutral economy by 2050
 - aggregate goal over a region of 28 member states
- Sweden
 - goal of net zero emissions of greenhouse gases by 2045, negative thereafter
 - 85 percent reductions achieved in-jurisdiction, balance remaining 15 percent with investments abroad
- Costa Rica
 - aims to achieve carbon neutrality by 2021

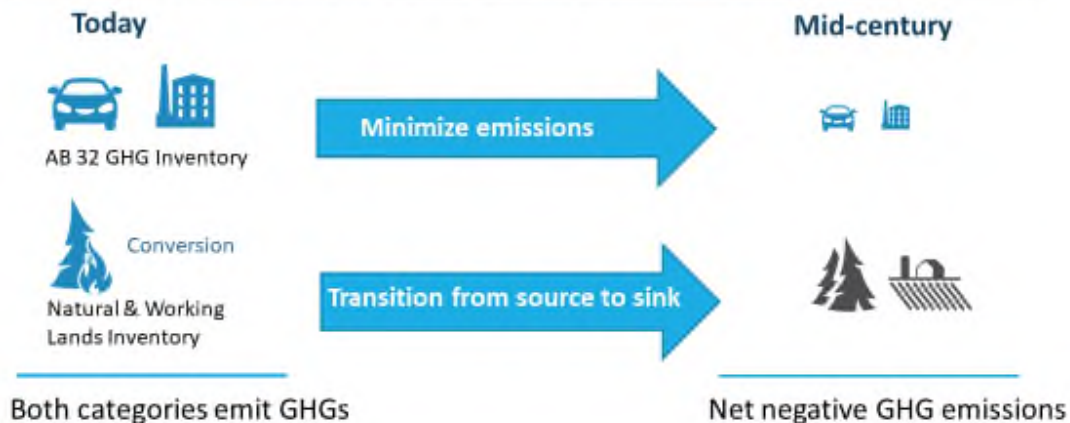
While the IPCC report was released in fall of 2018, several regions have begun to adopt or develop carbon neutrality goals. Each of these efforts involves serious consideration of unique attributes of the jurisdiction in question.

The European Commission developed a long-term strategy that outlines a vision of the deep economic and societal transformations required, engaging all sectors of the economy and society, to achieve the transition to a climate-neutral economy by mid-century. This strategy opens a thorough debate on how the European Union should prepare for a socially fair transition. It is worth noting this goal is an aggregate goal across 28 member states.

Sweden's climate policy framework includes a goal of net zero GHG emissions by 2045 and negative emissions thereafter. Their goal identifies that they need to reduce 85 percent of their emissions within their border, but will need to rely on investments in out-of-region actions for balancing the remaining 15% in emissions

Costa Rica is developing plans to offset all carbon emissions, implementing measures to address transportation sector emissions as well as considering a carbon certificate market.

California Carbon Neutrality (CO₂e)



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California is assessing its unique characteristics and the associated implications of carbon neutrality in the State.

The path to carbon neutrality requires action on both sources and sinks.

Today, we track statewide greenhouse gas emissions from transportation, electricity, commercial, residential, industrial, agricultural, and waste management sectors, including high-global warming potential gases. The GHG Inventory reflects statewide emissions and is an important tool for tracking progress toward the 2030 GHG emission reduction target.

Efforts are currently underway to develop a comprehensive inventory for the state's Natural and Working Lands so that we can quantify both the greenhouse gas emissions and sequestration in this sector. Our natural and working lands have great sequestration potential. Some amount of emissions from this sector are part of the natural cycle and are necessary for healthy systems—this includes some periodic fires. Recent wildfires need to be better understood in terms of what is part of a natural cycle versus what was the result of historical fire suppression policies and climate change. Activities like land conversion for housing or other uses not only removes the land from being a potential carbon sink but can promote additional greenhouse gas emissions associated with transportation.

Today California emits greenhouse gases from fossil energy and industrial sectors, as well as from our natural and working lands.

To achieve carbon neutrality by mid-century, we must minimize emissions from our fossil energy and industrial sources and transition our natural and working lands from a source to a sink such that we achieve net negative greenhouse gas emissions.

As we start to consider the concept of carbon neutrality, our starting point is the existing accounting framework which includes the major GHGs and not just carbon dioxide.

Carbon Neutrality: Key Questions for California

- Pathways to minimize emissions in fossil energy and industrial sectors by mid-century?
- Maximum potential of NWL to sequester carbon and timing to transition from emissions source to sink?
- Options for additional mechanical sequestration technologies?
- Optimal mix of carbon pricing with complementary policies?
- Tools to assess economic and environmental outcomes of achieving carbon neutrality under different scenarios at multiple levels (e.g., state economy, jobs, households and small businesses)?

It's easy to look at carbon neutrality as simply balancing emissions with sequestration, but it is more complex than that.

We need to understand the potential additional efforts to reduce reliance on fossil energy and to minimize emissions in the industrial sector. What is the minimum level of greenhouse gas emissions that will be technically feasible, cost effective, and scalable?

We know that our natural and working lands can become a valuable emissions sink. We know they are emissions sources today. What is the maximum potential for sequestration, and when could that happen?

What are options for mechanical sequestration technologies that can extract carbon emissions and store them through geologic sequestration or other forms? This past year, the Board adopted a Carbon Capture and Sequestration Protocol for projects that capture CO₂ and sequester it in geologic formations. What technologies are relevant for California?

A number of policy instruments have the potential to motivate economic transitions. What is an optimal mix of carbon pricing with complementary policies?

Finally, this new framework requires tools to assess economic and environmental outcomes associated with carbon neutrality under different scenarios.

Any path to achieving carbon neutrality will need to balance across science, the desire to avoid adverse impacts to the economy, households and small businesses, and the mandate to ensure we do not disproportionately impact vulnerable communities.

2019 Engagement

- Workshops to explore topic areas on achieving carbon neutrality
 - Energy demand and supply
 - Transformation across economic sectors (i.e. transportation, industrial)
 - Options and support for sequestration activities
- Continued collaboration
 - State and local agencies
 - Academics and researchers
 - International partners

The 2017 Scoping Plan established a strategy to achieve the State's greenhouse gas emission targets. The programs implemented to date put us on track toward the 2030 target, but we must diligently monitor and adjust, as needed, scoping plan measures to ensure we achieve the 2030 target.

In addition to establishing a path to achieve the 2030 target, the Scoping Plan identified a number of potential actions that could enhance the strategy and position the State on a trajectory of continued greenhouse gas emission reductions beyond 2030.

These actions may not have been included in the specific scoping plan strategy due to costs, the need for additional research, or technical feasibility. However, those actions were included in the broader scoping plan as they have the potential to reduce GHGs and provide co-benefits to the state, such as safe drinking water and cleaner air.

In 2019, staff will initiate dialog and begin gathering information to assess the potential actions identified in the Scoping Plan as well as additional opportunities to help further reduce emissions or sequester carbon.

Workshops will provide a forum to explore specific topics focused on sequestration activities, energy demand and supply, and transformation across economic sectors.

In addition, we will continue to work with other agencies, academics, and international partners.

Our state and local partners have expertise and authority that are critical in helping the state reduce its greenhouse gas emissions.

We also want to leverage external resources. This year provides an opportunity to engage with academics and researchers who may already be evaluating some of the actions in the broader scoping plan. Our planned discussions can help inform their research agendas.

International partners are facing similar challenges and considering similar options. For example, California is working with the EU to understand pathways for industry to transition away from fossil fuels toward low-carbon intensity products and processes.

The path forward for addressing climate change must include both reducing emissions and sequestration. This must happen globally for us to avoid the most adverse impacts of climate change. This year provides us an opportunity to start engaging on what it will take to achieve carbon neutrality here, but can help inform what must be scaled up and implemented elsewhere

California has 10 years of experience developing and implementing strategies to reduce GHGs, while growing our economy, and improving public health. The workshops and discussion planned for 2019 offer an opportunity to build on our successes and to continue to demonstrate environmental leadership.

Resources

- [CARB, 2017: California's 2017 Climate Change Scoping Plan](#)
- [IPCC, 2018: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty](#)
- [USGCRP, 2018: Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II](#)

This slide provides links to the reports referenced in this presentation: the CARB Scoping Plan, the IPCC Special Report, and the Fourth National Climate Assessment.

Thank You

- Presentation posted here:

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- Contact Information

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