UNITED STATES
CLIMATE ALLIANCE

SEPTEMBER 2018

From SLCP Challenge **to Action**

A roadmap for reducing short-lived climate pollutants to meet the goals of the Paris Agreement

#SLCPChallenge

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EXECUTIVE SUMMARY

The impacts of climate change are apparent in U.S. Climate Alliance states and all around the world. Devastating wildfires and droughts, epic heatwaves and Artic cold snaps, and historic storms and flooding define a new normal that will only get worse.

The global response to climate change must be comprehensive and urgent, and it must include immediate efforts to slash emissions of short-lived climate pollutants (SLCPs) by 2030, as a complement to continued reductions of carbon dioxide (CO_2). Short-lived climate pollutants include methane, hydrofluorocarbons (HFCs), and black carbon (soot). Many are harmful air pollutants and potent climate forcers with a much shorter lifetime in the atmosphere than CO_2. Quickly cutting emissions of these potent pollutants will lead to quick climate benefits and is a necessary element of any path to meet the goals of the Paris Climate Agreement and limit global warming below 1.5-2^{o}C. Fortunately, the solutions to the SCLP challenge exist today, are cost-effective, and deliver substantial health and agricultural benefits for local communities and the planet.

Methane is generated when organic materials break down in oxygen-limiting (anaerobic) landfills or manure lagoons. Methane is also the primary constituent of natural gas, and can leak from oil and gas exploration, production, transmission, and distribution activities. Identifying and plugging leaks as part of oil and gas operations is good for the climate and good for business. Methane produced from organic matter decomposing in a landfill or waste lagoon is better used as a renewable power or fuel resource, or as compost. A small number of sources are often responsible for a very large fraction of methane emissions to the atmosphere. Several technologies and strategies are emerging that will help identify these sources and enable targeted actions to achieve significant reductions.

Hydrofluorocarbons are used as refrigerants and in other applications, and they are the fastest growing source of greenhouse gas emissions. Under the Kigali Amendment to the Montreal Protocol, the world agreed to phase down their use and transition to climate friendly alternatives. In many cases, transitioning to new equipment with lower global warming potential (GWP) refrigerants offers energy efficiency benefits and net cost savings. The U.S. has yet to ratify the Kigali Amendment, and federal rules restricting the use of HFCs have been partly vacated by the D.C. Court of Appeals. U.S. Climate Alliance states are stepping up to fill this void and protect American companies and jobs, and are considering adopting their own regulations to transition away from HFCs.

Black carbon is a component of particulate matter and the product of incomplete combustion of fossil fuels or biomass. As a component of particulate matter, black carbon is a leading environmental health hazard, whose sources contribute to millions of premature deaths around the world each year. It affects climate by absorbing radiation, decreasing the reflectivity of surfaces like snow and ice, and affecting cloud formations. Black carbon emissions in the U.S. reach and affect the vulnerable Arctic, whose changing climate has profound implications for sea level rise and global weather patterns. Black carbon emissions are declining in the U.S., largely due to cleaner fuel and diesel engine standards. Accelerating turnover to cleaner trucks and heavy-duty equipment, as well as reducing pollution from stationary sources of combustion and wildfires, will provide additional global climate benefits, and local health benefits where reductions occur.

Even without the imperative of climate change, there is widespread support for action on SLCPs due to the substantial health, agricultural and economic opportunities that accrue locally to communities that take action. Major oil, gas, and chemical companies and their coalitions are taking steps to reduce their SLCP emissions because it helps meet their bottom line. A wide array of businesses, national and subnational jurisdictions are taking action and working across borders through voluntary partnerships such as the Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants, the Under2 Coalition, and through multilateral frameworks such as the Montreal Protocol.

Until recently, a growing and effective regulatory framework was in place to help reduce SLCP emissions nationally. It included regulations to reduce the loss of valuable methane gas from oil and gas production and landfills, phase out the use of HFCs where climate friendly alternatives are available, improve refrigerant management to limit leaks, and develop cleaner woodstoves to cut pollution in our neighborhoods. Many of these rules have been rescinded or delayed, leading to significant uncertainty in the regulatory landscape affecting businesses and emissions in the U.S. Given this uncertainty and inaction at the federal level, state leadership on SLCPs is necessary.

The U.S. Climate Alliance is stepping up to lead on SLCPs. On June 1, 2018, we issued the SLCP Challenge, committing to comprehensively addressing SLCP emissions as a critical component of meeting the goals of the Paris Agreement, and calling on the world to do so as well.

This Roadmap takes that commitment from SLCP Challenge to Action. It outlines a menu of options states can consider as we pursue an ambitious set of actions that have the potential to reduce SLCP emissions in the U.S. Climate Alliance as a whole by 40-50 percent below current levels by 2030. States commit to develop individual SLCP reduction strategies, will continue to share information and best practices, develop and improve emissions inventories to

track progress, and pursue partnerships to expand action on SLCPs and meet the goals of the SLCP challenge. The U.S. Climate Alliance will track and annually report on progress towards its SLCP reduction goals.

Cutting SLCP emissions is something everyone can get behind, and now is time to act. We have no time to waste, and all the opportunity we need. Join us.

Reducing SLCPs in U.S. Climate Alliance States

We are committed to doing our part to achieve feasible SLCP reductions in-line with the needs of the Paris Agreement. Existing or emerging technologies and strategies can reduce SLCP emissions in the U.S. Climate Alliance as a whole by an estimated 40-50 percent below current levels by 2030. This is in line with scientific assessments of the global need and opportunity, as well as existing targets in California and New York. Reaching these goals would deliver climate benefits equivalent to removing over 30 million cars from our roads, and over 140 million if accomplished nationally. Broad acceptance of the SLCP Challenge and achieving these levels globally would multiply the benefits in our states, including avoiding as many as about 200,000 premature deaths and 6 million tons of crop losses annually in the U.S. by 2030.

Now is the time to act. We call on the federal government to keep important and reasonable SLCP rules in place, enforce them, fulfill our commitment to Canada and Mexico to reduce oil and gas methane emissions, ratify the Kigali Amendment to the Montreal Protocol, and develop a national framework for transitioning away from HFCs. Building on existing regulations in some states, U.S. Climate Alliance states will consider regulations, incentives or other actions to fill in where federal regulations are lacking or uncertain. Additional areas of potential action by U.S. Climate Alliance states to reduce SLCPs through individual and shared efforts include the following:

- Help to fulfill a commitment by the U.S., Canada, and Mexico to reduce methane emissions from the oil and gas sector by 40-45 percent below 2012 levels by 2025
- Reduce methane emissions from waste streams by supporting federal efforts to reduce food loss and waste by 50 percent below 2010 levels by 2030, increasing diversion of organic waste from landfills, and improving landfill management
- Achieve economically feasible methane reductions from manure management and enteric fermentation on livestock operations in a manner that supports agricultural food production, farmers, ranchers, and surrounding communities
- Identify and mitigate methane emissions from “super emitters,” which may be responsible for as much as half of methane emissions in some sectors
- Transition away from HFCs and meet or exceed emissions reductions expected from the Kigali Amendment to the Montreal Protocol and recent federal regulations
- Improve refrigerant management practices to minimize HFC emissions from equipment in use and at the end of life
- Accelerate black carbon reductions and public health benefits, especially in disadvantaged communities, by striving for “soot free” transportation as soon as possible
- Pursue additional clean energy and natural and working lands strategies that support efforts to reduce SLCP emissions, while mitigating CO_2 emissions

OPPORTUNITY AND NECESSITY

Short-lived climate pollutants are potent climate forcers and harmful air pollutants that have an outsized impact on climate change in the near-term. Compared to CO_2 and other long-lived climate pollutants, which stay in the atmosphere for centuries, SLCPs have far more warming impact on a gram-to-gram basis, and have a lifetime ranging from days (in the case of black carbon) to decades. Short-lived climate pollutants are responsible for an estimated 40 percent of current net climate forcing, and include:

- **Methane:** Methane is estimated to be 34 times more potent than CO_2 over 100 years and 86 times more potent over 20 years.[1] It has an atmospheric lifetime of about 12 years and is responsible for an estimated 20-25 percent of current global climate forcing. Methane emissions also contribute to the formation of tropospheric ozone, which is itself a short-lived climate forcer and air pollutant that exacerbates smog and harms agricultural productivity. Quickly reducing methane emissions offers one of the greatest opportunities to reduce global warming in the coming decades.
- **Hydrofluorocarbons (HFCs):** HFCs are used in air conditioning units, refrigeration systems, foams, aerosols, and other applications. They are thousands of times more potent than CO_2 and represent the fastest growing source of greenhouse gas emissions in the U.S. and globally. Coupled with efficiency opportunities in refrigeration and cooling, phasing down the use of HFCs and replacing them with gases with lower GWP delivers significant climate and energy efficiency benefits.
- **Black Carbon:** Black carbon, or soot, is a component of toxic particulate matter, which is a leading environmental and health hazard. Black carbon results from incomplete combustion of fossil fuels and biomass and is the third leading contributor to warming behind CO_2 and methane. It affects climate by absorbing light, reducing the reflectively of snow and ice, and interacting with clouds. Black carbon accelerates snowmelt and sea level rise, modifies rainfall patterns, and as a component of fine particulate matter, contributes to millions of premature deaths globally each year. Because it exists in the atmosphere for days or weeks, reducing particulate matter and black carbon emissions delivers immediate climate and local health benefits.

Critical Element of the Global Climate Response

Rapid transitions to renewable and low carbon energy systems are essential to cut CO_2 emissions and meet the goals of the Paris Climate Agreement to limit

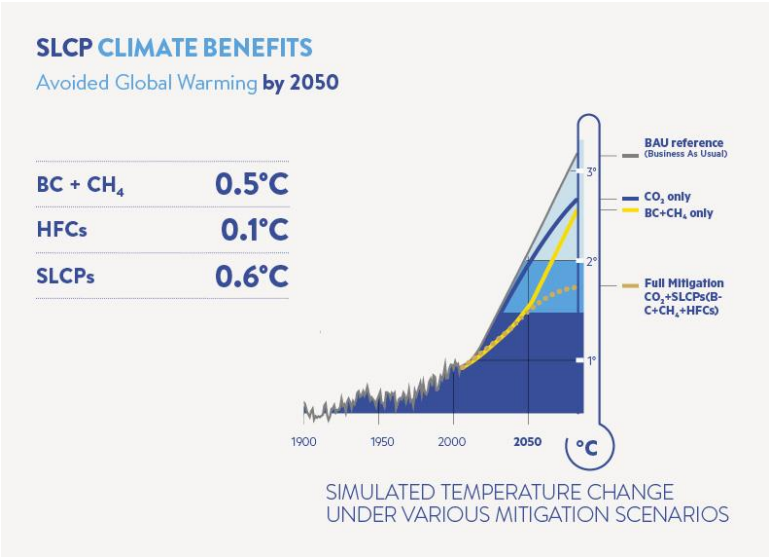
global warming to well below 2°C above pre-industrial levels and to pursue efforts to keep warming below 1.5°C. Targeted action to slash SLCP emissions, and complete those efforts by 2030, are equally critical to meeting the goals of the Paris Agreement and are essential if we are to keep warming below those thresholds through at least 2050.[2]

Near-term actions to address SLCP emissions can slow the pace of warming while we tackle long-lived CO_2, helping to stay on track towards our climate targets. SLCP reductions also limit dangerous feedback loops, like permafrost thaw releasing massive quantities of greenhouse gases that accelerate global warming, and avoid tipping points from which we cannot return, such as the loss of the Greenland Ice Sheet. Pathways that keep global temperatures within a 2°C rise would avoid an estimated 150 million premature deaths worldwide through 2100, including millions in the U.S.[3]

Low-Hanging Fruit

Implementing a collection of cost-effective strategies could significantly reduce SLCP emissions globally by 2030. A study by the United Nations Environment Programme and World Meteorological Organization found that 16 measures alone could reduce methane by about 40 percent and black carbon by about 80 percent below reference levels in 2030.[4]

Figure 1. Role of SLCPs in reducing near-term warming.[5]



Putting these measures in place, along with a global transition away from HFCs, would reduce warming by an estimated 0.6°C through 2050.[6] It would also significantly slow sea level rise and avoid over 3 million premature deaths and 50 million tons of crop losses each year. Through 2050, over 50 million premature deaths could be avoided in total.[7] These scenarios do not include strategies

targeting “super emitters” (a small fraction of sources responsible for a relatively large share of emissions) or additional opportunities to reduce methane from agriculture and waste, which could lead to significant additional methane emissions reductions along with water and air quality, health, and agricultural benefits.

This report lays out opportunities to achieve significant SLCP reductions across the U.S. Climate Alliance. Many efforts could reduce costs or increase revenues for farmers, energy producers, and other companies. Targeting SLCP emissions will improve air quality in our communities and help provide the fast response to climate change that is urgently needed.

Economic Opportunity for States

In addition to the health and climate imperatives, reducing SLCP emissions is an economic opportunity for businesses and states. Targeting SLCP emissions offers economic opportunities in the agricultural, energy, industrial, transportation, and waste sectors. It can support health and prosperity in rural and urban economies, alike.

Effectively designed measures to reduce SLCP emissions will make U.S. businesses and states more competitive. Capturing and utilizing methane improves health and safety and offers billions of dollars in potential revenue in the U.S. annually from the sale and use of captured gas.[8] Capturing and utilizing methane from anaerobic digestion at wastewater treatment facilities offers significant opportunities to reduce energy costs and improve water quality. Converting manure or other agricultural residues into energy, fuels, or soil amendments creates new, diverse revenue streams for farmers, helping insulate against fluctuating agricultural commodity prices.[9] A broad, global effort to slash SLCP emissions would boost production of staple crops in the U.S. by over 6 million tons annually by 2030.[10]

From HFC alternatives to innovative methane capture systems and clean diesel technologies and fuels, American companies stand to gain by offering their solutions to the global market. Phasing down the use of HFCs will help keep American companies globally competitive, and could create tens of thousands of jobs and tens of billions of dollars in annual economic value in the U.S.[11] Retooling refrigeration and air conditioning systems to reduce HFC emissions can boost energy efficiency, further reducing greenhouse gas emissions and lowering costs for businesses and households.

These opportunities are widely available in regions adopting strategies to reduce SLCP emissions. For example, in U.S. Climate Alliance states:

- Dairy and swine farms could support thousands of anaerobic digesters producing renewable gas and other products worth billions of dollars per

year. Farms in California, Minnesota, and North Carolina alone can support an estimated 2,500 projects.[12]

- The U.S. Environmental Protection Agency (EPA) estimates that about 45 percent of methane emissions in the U.S. from coal mining and oil and natural gas systems can be reduced nationally at low or negative cost.[13] The International Energy Agency and the Environmental Defense Fund have similarly found that nearly half of methane emitted from oil and gas operations in the U.S. and globally can be reduced at essentially zero net cost.[14,15] Capturing these emissions improves mine and pipeline safety, conserves energy, and saves money.
- Alliance states are home to more than 250 landfill energy projects that consume methane that would be otherwise emitted or flared, and opportunities exist for nearly 100 more.[16]

Accordingly, there is growing, widespread support for reducing SLCPs, including among businesses. Major companies and organizations representing the chemical, dairy, food, and oil and gas industries have made commitments to reduce SLCP emissions, as part of broader climate and sustainability programs. Most chemical and appliance manufacturers support national and global efforts to transition away from and phase down the production and use of HFCs.[17] The Innovation Center for U.S. Dairy, representing over 80 percent of the dairy supply chain in the U.S., recently renewed a Memorandum of Understanding with the U.S. Department of Agriculture including a goal to reduce greenhouse gas emissions by 25 percent below 2007 levels by 2020.[18] Major food companies like General Mills and McDonald's, which has set a goal to reduce the greenhouse gas intensity from its supply chain by 31 percent by 2030,[19] have set greenhouse gas reduction and sustainability goals, including reducing methane from agriculture and food waste.

Many oil and gas companies are involved in efforts to reduce methane emissions through efforts like the Environmental Partnership and the Oil and Gas Climate Initiative. The Oil and Gas Climate Initiative, in particular, represents ten major international oil companies that aim to achieve near-zero methane emissions from the natural gas supply chain.[20] Some companies have set specific targets, including ExxonMobil, which aims to reduce methane by 15 percent by 2020,[21] and Italian oil major Eni, which has committed to reducing upstream methane emissions by 80 percent below 2014 levels by 2025.[22] Some companies have even expressed support for regulatory efforts to mitigate emissions and improve emissions data reporting.[23]

State Leadership amid Federal Uncertainty

Until recently, a broad and effective national regulatory framework was in place to help reduce SLCP emissions, which provided a strong foundation

underpinning state and local actions. Rules covered methane from landfills and the oil and gas sector, supported transitions away from HFCs, and were under development to reduce particulate matter and black carbon from woodstoves. (See Appendix B for a detailed list of federal policies related to SLCPs and their status). Many of these rules have been delayed or vacated, leading to significant uncertainty in the regulatory landscape affecting businesses and emissions in the U.S. The federal government is also working to unwind additional rules related to CO_2, such as the Clean Power Plan and vehicle greenhouse gas standards, which would help to reduce methane and black carbon emissions from combustion, as well.

Historically, the U.S. has been a leader in fostering global action on SLCPs.

In 2004, the Bush Administration launched the Global Methane Initiative (known as Methane to Markets), which is an international effort dedicated to the abatement, recovery, and use of methane. In 2011, the U.S. was a founding member of the Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants, which has grown to include 60 countries and hundreds of non-state and local partners. As part of the Arctic Council, and in recognition of the especially acute impacts of climate change and SLCP emissions in the Arctic, the U.S. and other countries adopted a framework for enhanced action to reduce black carbon and methane emissions and a goal to reduce black carbon collectively by 25-33 percent below 2013 levels by 2025.[24,25] In 2016, the U.S. agreed with Canada and Mexico to take "common sense actions" to drive down SLCP emissions. They include developing and implementing federal regulations to reduce methane from existing and new sources in the oil and gas sector by 40-45 percent below 2012 levels by 2025, taking significant national actions to reduce black carbon emissions in North America, promoting alternatives to HFCs, and developing and implementing national methane reduction strategies for the oil and gas, agricultural, and waste (including food waste) sectors.[26] While Canada and Mexico have proposed regulations to reduce oil and gas methane, the U.S. has yet to propose a regulation on existing sources and is working to undo regulations currently in effect for new sources (see Appendix B).

Under President Reagan, the U.S. played a leading role in the negotiation of the Montreal Protocol, originally designed to phase down the use of fluorinated gases responsible for the growing hole in the ozone layer. It is often referred to as the most effective environmental and climate policy in the world. After its unanimous approval by the U.S. Senate, President Reagan wrote in his signing statement that the Protocol was a "milestone" with an adjustment mechanism of which the "wisdom of this unique provision is already being realized."[27] That adjustment mechanism has allowed for several amendments to the Protocol, recently including the Kigali Amendment in 2016, which set a global phasedown schedule for the production and use of HFCs. The U.S. was a key leader in

negotiating this amendment – working hand-in-hand with industry, but has yet to ratify it, despite the clear economic benefits to U.S. companies and our economy.[28]

Given the uncertainty and inaction at the federal level, state leadership on SLCPs is even more necessary and urgent. The U.S. Climate Alliance is stepping up and accepting the mantle of leadership.

On June 1, 2018, the U.S. Climate Alliance issued the SLCP Challenge, committing to comprehensively addressing SLCP emissions as a critical component of meeting the goals of the Paris Agreement, and calling on the world to do so as well.

Building on its commitment, the Alliance developed this Roadmap, offering a menu of options supporting ambitious goals to drive down SLCPs, and offering examples of leadership already demonstrated by states.

SLCP CHALLENGE TO ACTION: A ROADMAP FOR REDUCING SLCPS

Available and emerging technologies and strategies have the potential to reduce methane, HFCs, and black carbon in the U.S. and across the U.S. Climate Alliance by an estimated 40-50 percent below current levels by 2030 (see Appendix A). Reaching these goals would deliver climate benefits equivalent to removing over 30 million cars from our roads, and over 140 million if accomplished nationally.[1] Broad acceptance of the SLCP Challenge and achieving these levels globally would multiply the benefits in our states, including avoiding as many as about 200,000 premature deaths and 6 million tons of crop losses annually in the U.S. by 2030.[29]

Our states are already taking many steps to reduce SLCP emissions. This section describes the opportunities states have and the actions states may take to reduce SLCPs as they pursue the full potential of available SLCP reductions and tailor strategies to fit local conditions.

Methane

Methane is often emitted from livestock operations, landfills, or fossil energy systems – including leaks and venting in coal mines, oil and gas production operations, and natural gas transmission and distribution systems. Reducing methane requires identifying and replacing old leak-prone pipes, improving capabilities to quickly identify and mitigate leaks from diffuse sources, and requiring or incentivizing practices that reduce or avoid emissions from these sources.

In the energy sector, once leaks have been identified, the case for capturing methane is often clear – either for economic or safety reasons. In the agricultural and waste sectors, methane generated from manure or organic waste can be put to valuable use creating clean energy or soil amendments. Integrated planning and policy development (described in the Cross-Cutting Policies section) helps

[1] Achieving the SLCP reductions potential identified in Appendix A could reduce SLCP emissions by about 150 $MMTCO_2e$ below business-as-usual levels in 2030 in U.S. Climate Alliance states, and about 670 $MMTCO_2e$ nationally. Based on EPA's Greenhouse Gas Equivalences Calculator, this is equivalent to removing 32 million and 143 million cars from the road, respectively. https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

put these resources to use and capture that value, leading to management practices that significantly reduce odors and avoid methane emissions.

Several state and national programs are already working to reduce methane emissions. In 2014, the Obama Administration issued a *Strategy to Reduce Methane Emissions*, which outlined a number of existing and new federal programs that it estimated would reduce methane emissions by about 15 percent by 2020.[30] Some, but not all, of this framework has materialized (see Appendix B). Among U.S. Climate Alliance states, California and New York have developed comprehensive plans to cut methane emissions by 40 percent by 2030.[31,32] Colorado was the first state to adopt regulations limiting methane from oil and gas operations, and several other states have subsequently done so, as well. U.S. Climate Alliance states have many other activities in place to reduce methane from the agricultural, energy, and waste sectors.

Significant additional opportunities exist to cut methane emissions quickly and cost effectively across the U.S. Capturing the full potential of expected reduction opportunities, as described in Appendix A, could reduce methane emissions by 40-50 percent below current levels in the U.S. Climate Alliance. Existing and emerging strategies and technologies can achieve these reductions by 2030.

Energy

Do Our Part to Reduce Methane Emissions 40-45% by 2025

There is an opportunity for the U.S. Climate Alliance to help fulfill the commitment by the U.S., Canada, and Mexico to implement federal regulations on new and existing sources in the oil and gas sector to reduce methane emissions by 40-45 percent below 2012 levels by 2025.[33] Federal rules developed pursuant to this commitment are uncertain, and leadership from states will help ensure continued progress to reduce emissions from these sources.

In addition to reducing SLCP emissions, finding and fixing leaks in the energy sector improves safety and saves money. Significant methane emissions reductions are achievable from oil, gas, and coal facilities at negative or very low cost. U.S. Climate Alliance states could consider the following actions:

- **Develop Regulations to Reduce Methane in the Oil and Gas Sector.** States can design their own rules to reduce methane emissions from new and existing oil and natural gas facilities through emissions monitoring requirements, replacing of leak-prone pipes, and limiting methane venting and flaring, which has the added benefit of reducing black carbon emissions. In 2014, Colorado became the first state to directly regulate oil and gas methane emissions. The state requires facilities to detect and repair leaks infrared

cameras or other approved technologies, which was found in a two-year pilot project to reduce the incidence of leaks by over 70 percent. California has subsequently developed regulations, and New York is currently in the development phase of state regulations to enact new source performance standards and control techniques guidelines. Virginia is beginning a process to limit methane pollution from natural gas infrastructure and landfills.

- **Extend "Upstream" Requirements to all Segments of the System.** Federal rules address oil and gas methane emissions at the point of production for new and some existing sources. Additional rules could expand coverage further, to existing sources as well as transmission and distribution facilities. For example, states can update existing rules requiring leak detection and repair from natural gas transmission and distribution for the sake of safety to account for climate change impacts, as well. New methane sensing technologies are becoming more widely available to help measure natural gas flux associated with leaks and not just the presence of leaks. In New Jersey, a major gas utility (PSE&G) applied such technologies, and has reported successfully reducing methane emissions by 83 percent from targeted areas.
- **Cap Emissions from Natural Gas Distribution.** Massachusetts imposes annually declining emission limits on gas operators to reduce methane from natural gas distribution mains and services. The caps decline from 2018-2020 to help meet the state's 2020 greenhouse gas emissions limit.[34]
- **Require Reporting and Best Management Practices.** Requiring utility companies and gas suppliers to report natural gas emission data and implement best management practices to mitigate leaks provides data to measure progress and identify additional mitigation opportunities. California requires utilities to incorporate 26 best practices for methane leak detection, quantification, and elimination.[35]
- **Replace Old, Leak-Prone Pipes.** Non-cathodically protected steel, cast-iron, and wrought-iron pipes are vulnerable to methane leaks, and tend to have a higher risk of leaks as they age. States can pursue several strategies to require and incentivize their replacement. Massachusetts law requires replacing aged pipelines, which are the most leak-prone infrastructure.[36] New York has developed incentives for gas distribution companies to encourage accelerated replacement of leak-prone pipes, and has instituted negative revenue adjustments for gas utilities that do not meet their required replacement levels.
- **Capture Methane from Active and Inactive Coal Mines.** Methane captured from coal mines is eligible for Colorado's Renewable Portfolio Standard and carbon offsets under California's Cap-and-Trade Program.

- **Identify and Plug Abandoned and Unpermitted Wells.** In certain oil and gas production areas there are wells that pre-date tracking systems, which may be potentially large emission sources that are neither identified nor monitored. States may consider committing resources and establishing programs to search for and prioritize plugging orphaned oil and gas wells.

Agriculture

Achieve Feasible Methane Reductions, Including from Livestock Operations

Actions to improve manure management and to reduce methane from enteric fermentation have the potential to significantly reduce agricultural methane emissions across U.S. Climate Alliance states. Improving manure storage and handling, composting manure, utilizing pasture-based systems, or installing anaerobic digesters significantly reduces methane from manure management on dairy, swine, and other livestock operations. These practices may reduce methane from manure management by as much as 70 percent in U.S. Climate Alliance states (Appendix A) and can help improve soil quality and fertility, reduce water use and increase water quality, reduce odors, and decrease the need for synthetic fertilizers and associated greenhouse gas emissions. Promising technologies are also emerging that may cut methane emissions from enteric fermentation by 30 percent or more (Appendix A). Developing strategies that work for farmers and surrounding communities can significantly reduce methane emissions, increase and diversify farm revenues, and support water quality and other environmental benefits. U.S. Climate Alliance states have several options for reducing methane emissions from the agricultural sector:

- **Collaborate to Develop Effective Solutions.** California has formed a dairy and livestock greenhouse gas reduction working group and three dairy and livestock subgroups focused on fostering markets for digester and non-digester projects and research needs, including enteric fermentation.[37] The subgroups comprise a diverse group of stakeholders, experts, and state and local governmental agencies to identify and address barriers to the development of dairy methane reduction projects. Hawaii's Greenhouse Gas Sequestration Task Force will identify policies that provide greenhouse gas benefits in the agricultural and other sectors.
- **Incentivize Strategies to Reduce Methane.** Several state and federal programs offer financial assistance or tax incentives for projects that help reduce agricultural methane and other emissions. When developing or implementing agriculture funding programs, states can incorporate methane emissions reductions as a requirement or scoring criteria.

- California offers grants that cut methane from dairy manure through the Dairy Digester Research and Development Program[38] and Alternative Manure Management Program[39]
- Massachusetts provides grants through the Massachusetts Clean Energy Center to conduct organics-to-energy project feasibility studies and move forward with implementation and pilot projects[40]
- New York offers cost sharing for projects that improve water quality or reduce climate impacts from agriculture through the Agricultural Environmental Management Framework and Climate Resilient Farming Program
- **Create Markets to Make Improved Manure Management Financially Viable.** Building markets for clean energy or soil amendment products adds value to farming practices and supports improved manure management efforts (see "Cross-Cutting Policies"). California utilities share costs of pipeline interconnection for renewable sources of gas, including from dairies, and are implementing at least five dairy biomethane pipeline interconnection pilot projects.[41]
- **Require Application of Best Practices to Manure Management.** States can work with the agricultural industry to develop best practices for manure management, and facilitate implementation of those best practices. California law requires state agencies, if certain conditions are met, to adopt regulations to reduce methane emissions from livestock manure management, not to take effect before 2024.
- **Demonstrate and Deploy Strategies to Reduce Methane from Enteric Fermentation.** Support for research, demonstration, and deployment will help bring technologies or strategies that reduce enteric fermentation emissions to market and into wide practice. States can explore voluntary, incentive-based, or regulatory approaches to capture economical and market-feasible methane reductions.
- **Improve Predictability of Revenue Streams for Renewable Gas from Dairies and Farms.** Environmental credit markets, such as from low carbon fuel standards, renewable portfolio standards or cap-and-trade programs, provide valuable revenue streams that may be sufficient to cover the costs of dairy digester or other projects. However, credit prices can be unpredictable, making it difficult to finance projects. California is exploring a "pilot financial mechanism" for the state's Low Carbon Fuel Standard to reduce the economic uncertainty associated with the value of environmental credits for dairy-related projects producing low carbon transportation fuels. California and Vermont offer feed-in tariffs for small bioenergy projects, and Green Mountain Power's voluntary Cow Power program offers an adder to the feed-in tariff in Vermont. North Carolina's Renewable Portfolio Standard includes a set-aside for energy from swine and poultry waste.

- **Encourage Best Practices to Reduce Methane from Rice Cultivation.** Projects to reduce methane emissions from rice can receive offset credits under California's Cap-and-Trade Program. Incentives, regulations, or other programs can help further reduce emissions from this source.

Waste

Reduce Food Loss and Waste, Increase Diversion and Treatment of Organic Waste, and Improve Landfill Management

The waste sector offers a significant opportunity to reduce methane emissions while transforming wasted resources into beneficial products. Methane capture systems and other best management practices at landfills significantly reduce methane emissions and can generate heat, renewable electricity, or fuel from landfill gas. Diverting organics from landfills avoids generating methane from decomposition, and offers a valuable resource stream to produce compost or renewable energy. Reducing food waste and recovering edible food for human consumption is a particularly good opportunity to provide economic and health benefits while reducing methane emissions. The EPA has set a goal to reduce food loss and waste by 50 percent by 2030, consistent with the Sustainable Development Goals.[42]

Significant opportunities for reducing methane emissions from landfills and capturing value can be seized by reducing food loss and waste, diverting organic waste to beneficial uses, and improving landfill management. These and other actions collectively could reduce methane emissions from waste by an estimated 40-50 percent by 2030 (Appendix A). Such efforts could add value in our states by reducing emissions of volatile organic compounds and toxic air contaminants from landfills, recovering healthy food for human consumption in food insecure communities, supporting healthy soils and agriculture, generating clean energy and displacing fossil fuel consumption, and providing economic opportunities across these diverse sectors. Many of these benefits will accrue in low-income and disadvantaged communities.

U.S. Climate Alliance states could consider the following actions:

- **Develop Regulations to Backstop against Federal Uncertainty.** Colorado has adopted the federal New Source Performance Standards for landfills. California and Washington have regulations on landfills to reduce emissions of methane and other pollutants. New York is in the process of developing regulations to further address methane emissions from landfills.
- **Require Reporting and Best Management Practices.** EPA requires mandatory reporting by landfills under the federal greenhouse gas reporting

program. The data are documented in EPA's FLIGHT system,[43] but the current database is limited to large facilities and lacks some key information about the number of gas capture systems and quality and quantity of gas captured at each facility. Additional federal data collected by the Landfill Methane Outreach Program (LMOP) relies on voluntary reporting.[44] Reporting requirements, including the number of gas capture systems and quality and quantity of gas captured at each facility, would improve understanding of opportunities to capture and utilize methane from landfills. Once landfill gas collection systems are in place, they require regular monitoring for leak detection and repair. Providing technical support to landfill owners may help improve leak detection and landfill gas collection.

- **Avoid Methane Emissions by Mandating or Incentivizing the Diversion of Organic Materials from Landfills.** Banning the disposal of organics in landfills, and taking steps to ensure alternative, cost-effective treatment is available for diverted organics, can dramatically reduce methane emissions from landfills. Where banning is not feasible, states may set ambitious diversion targets backed by programs to support, monitor and enforce diversion – including by putting it to beneficial use as energy or compost. Massachusetts bans commercial disposal of organic waste from businesses and institutions that dispose more than one ton of organic materials per week. Vermont has a Universal Recycling Law that contains an organics diversion mandate by 2020. California has a target to reduce organic waste disposal by 75 percent below 2014 levels by 2025. Connecticut has a municipal solid waste 60 percent diversion goal. Maryland has long-term recycling and waste diversion goals.
- **Develop and Implement Food Rescue and Recovery Programs.** The Pacific Coast Collaborative, which includes the U.S. Climate Alliance states of Washington, Oregon, and California, has a low carbon waste goal to advance organic waste prevention and recovery.[45] New York has provided more than $3.5 million to food banks and other providers to facilitate the increase in food donations, especially fresh fruit and vegetables. California has a goal to recover at least 20 percent of edible food waste for human consumption by 2025.[46]
- **Accelerate Development of Infrastructure to Utilize Diverted Organic Material.** Connecticut has streamlined permitting requirements for certain waste facilities that use newer technologies, like anaerobic digesters, to generate renewable energy and avoid landfilling organics. California's Organics Grant Program helps expand capacity for compost or energy production from diverted organic waste streams. New York's Climate Smart Communities Projects and Municipal Recycling Programs offer cost share for municipalities to implement organics diversion infrastructure, and a grant

program for large organics generators through New York's Empire State Development.

- **Create Markets to Support Organics Diversion.** States can help build markets for clean energy or soil amendment products that support organics diversion goals (described in "Cross-Cutting Policies"). California utilities share costs of pipeline interconnection to renewable sources of gas, including from landfills and anaerobic digesters, and the state's Healthy Soils Initiative promotes activities to increase soil organic matter and improve soil health.[47] State and local agencies can increase use of compost in their operations. New York is supporting research to increase the use of compost in agriculture.
- **Capture Opportunities at Wastewater Facilities.** Many wastewater treatment plants already have anaerobic digesters, and capture and utilize methane to generate renewable energy. In some cases, these facilities have excess capacity to take additional organic material. Integrated state planning that identifies organic waste flows, available infrastructure, and remaining gaps may help capture these and other opportunities to derive value from waste resources. States could consider requiring or incentivizing installation of methane recovery technologies at facilities that currently do not have the technology.

Super Emitters

Identify and Mitigate Emissions from "Super Emitters"

Super emitters are a small fraction of sources that are responsible for a large percentage of emissions. Wide scale efforts are underway to develop low cost methane sensors, as well as ubiquitous global methane monitoring capabilities with satellites. Within a few years, far more data will likely be available regarding methane emissions, perhaps including nearly real-time detection of super emitters globally.

As data becomes available, there is an opportunity for U.S. Climate Alliance states to use it to improve planning and inventories, but also to act and target the largest sources of methane emissions.

Effectively identifying and targeting super emitters could quickly reduce total methane by an estimated 30 percent or more (Appendix A), and likely offers one of the most significant near-term opportunities to slow the impacts of climate change.

To pursue this opportunity, U.S. Climate Alliance states could consider the following actions:

- **Identify Methane Hot Spots and Super Emitters.** More than 50 percent of methane emissions may come from fewer than 10 percent of methane sources, across multiple sectors (Appendix A). California is monitoring methane "hot spots" in the state and is exploring options to launch a satellite capable of identifying super emitters around the world.
- **Plan for Quickly Acting on Data.** States can anticipate increased data availability in the near future, and can plan to quickly address the largest methane sources in different sectors as that data becomes available.

Improve Emissions Monitoring and Accounting

Improve Understanding and Expand Opportunities to Reduce Methane

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Methane emissions are difficult to estimate and measure, and some studies suggest that state and national inventories underestimate them.[48] U.S. Climate Alliance states could work to improve understanding of emissions and sources of leaks, which would accelerate efforts to mitigate emissions and enable deeper reductions, through actions including:

- **Include Methane in State Climate Plans and Targets.** Comprehensive planning and goal setting helps guide activities to achieve necessary and available emissions reductions. California and New York have developed comprehensive methane action plans.
- **Expand Emissions Monitoring.** There are a number of ways to measure methane emissions, including satellite-based measurements, aircraft-based remote sensing, a network of towers, small sensors, and ground verification. California has developed a "tiered observation system" including each of these elements. In New York, some local distribution utilities are working with the Environmental Defense Fund to determine which non-hazardous leaks on the distribution system are emitting the most methane so that they are targeted for quicker repair. New York has also required several of the State's local distribution companies to provide residential methane detectors to residents, and some of the utilities are working on methane detectors that would send a signal to the utility's control room through the advanced metering infrastructure if methane is detected, improving response time and reducing the time elapsed before repair.
- **Improve Emissions Inventories Based on Latest Science.** Many state inventories scale from national inventories or use averaged emissions factors that may not accurately reflect the distribution of emissions from a given sector, including the impact of super emitters. Satellite and aerial measurements often suggest methane emissions are higher than inventory levels. States can support continued research and expanded monitoring to

better understand emissions, including from satellites. As emissions monitoring improves and new science emerges, states could work to continuously improve their inventories to capture the distribution of emissions among types of sources and spatially within states.

- **Use Updated Global Warming Potential (GWP) Values in Climate Programs.** International convention uses an older GWP value of 25 in accounting for the climate impact of methane over 100 years, relative to that of CO_2. The prevailing scientific consensus, however, suggests this value could be 34 or higher.[49,50,51] International accounting of GWP may be revised, but in the meantime, updating this value would reflect the latest science, increase the importance of methane in meeting greenhouse gas targets, and increase value associated with methane reductions in some climate programs. States could consider using 20-year GWPs or other accounting frameworks, in addition to the current practice of using 100-year GWPs, to better reflect the near-term impacts of SLCP emissions, including methane. Changes in emissions accounting frameworks deserve careful deliberation, however, especially in the context of existing climate programs. California is considering updating the GWP values used in its programs starting in 2021, and in its SLCP planning, accounts for emissions using both 20-year and 100-year GWPs.

Hydrofluorocarbons (HFCs)

HFCs are the fastest growing source of greenhouse gas emissions, and a global transition to climate-friendly alternatives is important to meeting the goals of the Paris Agreement and limiting global warming to well below 2°C. Minimizing leaks from refrigeration systems and collecting and destroying used HFCs are also necessary to reducing emissions. States could take steps to support the global transition away from HFCs, detect and repair leaks, and collect and destroy used refrigerants. By addressing all three areas, states can reverse trends in emissions from this fast-growing sector and reduce them by as much as 40-50 percent by 2030 (Appendix A).

Transition Away from HFCs

Meet or Exceed Reductions Expected from Kigali Amendment and Vacated SNAP Rules

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There is near-universal support among countries and affected stakeholders for phasing down the use of HFCs globally under the Kigali Amendment to the Montreal Protocol.

In the U.S., the vacated Significant New Alternatives Policy (SNAP) rules effectively guided this transition, by requiring HFC replacements with a lower

climate impact in applications and end uses where better alternatives are available.

The Clean Air Act explicitly allows states to set more stringent regulations than the federal government.[2] In the absence of comprehensive federal rules, U.S. Climate Alliance states could consider a range of actions, including:

- **Adopt State-Level Regulations to Transition Away from HFCs.** The federal SNAP rules include a list of available alternatives to HFCs and require using those alternatives by certain dates in end use applications where they are available. California adopted new HFC regulations that prohibit the use of HFCs in refrigeration and foam end uses, making much of the vacated SNAP rules enforceable in the state.[52] The state will consider additional regulations covering other end uses and further supporting the transition away from HFCs. At the September 2018 Global Climate Action Summit, Connecticut, Maryland and New York announced their intention to adopt similar rules and others are considering the same. Monitoring and reporting programs would help implement those rules and track progress.
- **Support Ratifying the Kigali Amendment to the Montreal Protocol.** There is widespread, bipartisan support nationally and internationally for the Kigali Amendment to the Montreal Protocol, including from the business community. States could call on the federal government to ratify it and adopt a comprehensive federal framework for implementing it.
- **Limit the Use of High- GWP Refrigerants in Existing Equipment.** In addition to limiting the sale of new equipment using HFCs, California will consider rules to limit the use of high-GWP refrigerants in new and existing refrigeration and air conditioning equipment, when low-GWP alternatives are available. States could consider restricting sales of the very most polluting refrigerants, as well.
- **Develop Incentive Programs to Accelerate Transitions from HFCs.** State or utility incentives can encourage adoption of new refrigerant technologies and transitions away from HFCs in supermarkets, homes, and commercial buildings. California is exploring statewide incentive programs. One of its utilities, the Sacramento Municipal Utility District, has developed the Pilot Natural Refrigerant Incentive Program, which provides incentives to commercial customers who use natural refrigerants (ammonia, CO_2, or a hydrocarbon) in new or retrofitted refrigeration systems.[53] These systems may offer energy efficiency benefits, as well.
- **Lead through State and Municipal Procurement and Investment.** States could adopt procurement standards requiring public agencies to procure equipment with low-GWP alternatives to HFCs. Incentives or other

[2] Some states, however, are restricted from adopting regulations more stringent than federal standards in certain circumstances.

investments can support retrofitting large cooling systems, such as public ice rinks or school cafeterias, to use low-GWP alternatives.

- **Account for HFCs in Building Codes and Efficiency Standards/Programs.** Expand the focus of building codes, appliance standards, and other energy efficiency programs where there are direct energy benefits to account for HFCs, or focus on greenhouse gas emissions more broadly. This could include accounting for or requiring the use of low-GWP alternatives in foams and building appliances.
- **Provide Technical Support to Businesses.** Alternatives to HFCs in refrigeration and other uses may offer improved energy efficiency and cost savings. States could provide audits or other technical assistance to help businesses identify opportunities to reduce HFC emissions and costs.

Refrigerant Management

Implement Best Practices to Minimize Leaks and Emissions from Equipment in Use

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One of the largest sources of HFC emissions is leaks in commercial refrigeration systems. Adopting best practices and other programs to detect and repair leaks, retire or retrofit old systems, and ensure proper use of refrigerants can reduce equipment downtime and refrigerant costs for supermarkets and other large stationary refrigeration systems, while reducing emissions. U.S. Climate Alliance states could implement best practices to minimize HFC emissions from refrigeration systems and other equipment, and consider actions including:

- **Adopt In-Use Refrigerant Management Regulations/Programs.** Given the uncertainty around the future of EPA's Refrigerant Management Regulations (see Appendix B), states may consider adopting their own rules. California, for example, has a Refrigerant Management Program that requires large refrigeration facilities to conduct periodic leak inspections, report and promptly repair leaks, and use practices that minimize HFC emissions.[54] California also has a program ensuring that small cans of automotive refrigerant have self-sealing valves to prevent leaks.[55]
- **Develop Incentives to Retire or Retrofit Old Systems.** As part of an incentive program to transition away from HFCs, states could consider targeting the largest users of HFCs, including large and/or old stationary refrigeration systems.
- **Implement Record Keeping and Reporting.** As part of a broader refrigerant management program, states could consider collecting information from the owners of large stationary refrigeration systems on the use of refrigerants and management practices. This information could allow

states to target technical assistance, incentives, or other efforts where they might have the most impact.

- **Expand Partnerships and Use of Best Practices.** States could work with other states, industry, non-governmental organizations, and others to develop and disseminate best practices for refrigerant management. One example is EPA's GreenChill Partnership program.[56] Product labeling is another option, and improves consumer awareness to support sales and use of efficient and climate friendly equipment or refrigerants.

Collect and Destroy Used Refrigerants

Avoid Venting HFCs at End-of-Life

Properly disposing of appliances like air conditioning units or refrigerators, including collection and destruction of high-GWP refrigerants, is important to reducing HFC emissions. As they phase out, stockpiles of new or used high-GWP refrigerants should be destroyed properly, once they are no longer needed. States could consider efforts to collect and destroy used refrigerants and avoid unnecessary HFC emissions, including:

- **Mandate or Incentivize Collection and Proper Destruction of Used Refrigerants.** California's Cap-and-Trade Program includes an offset protocol for the collection and destruction of ozone depleting substances. States could consider requiring appropriate collection and destruction, or providing direct incentives or funding for a collection and destruction program with fees or refundable deposits on the purchase of new HFC-containing equipment or canisters, similar to deposits paid on recyclable bottles in many states.
- **Work through Utility and Appliance Efficiency Programs.** Several states and utilities have rebate programs to support the purchase of energy efficiency appliances, which sometimes includes collection of old equipment. New Jersey, for example, offers a double rebate – one for purchasing an Energy Star® refrigerator and another for recycling old units. States and utilities can expand efficiency rebate programs to consider the use of refrigerants, as well, and include added incentives for the use of low-GWP alternatives. States could also work with utilities to ensure their programs and contractors properly manage, collect, and destroy HFCs and other high-GWP refrigerants during servicing and at end of life.

Black Carbon

Actions to reduce black carbon, which has a lifetime of just days, have almost immediate health, environmental, and climate benefits. Because black carbon is

a particulate that frequently stays near its point of emission, communities that take action to reduce black carbon reap the benefits. Black carbon also has a disproportionate impact on ice, especially that in the Arctic. Fortunately, black carbon emissions are declining in the U.S., primarily as a result of clean vehicle and fuel standards, and are expected to fall 49 percent below 2013 levels by 2025.[57]

More can be done to accelerate and deepen these reductions and their local benefits, particularly in disadvantaged communities. States could accelerate black carbon reductions and community benefits by accelerating the turnover of diesel vehicles and equipment to the cleanest available, "soot free" options as soon as possible.

Transportation

Achieve Soot-Free Transportation as Soon as Possible

The transportation sector, especially heavy-duty diesel vehicles, offers significant additional potential for black carbon reductions in the U.S. Black carbon emissions from transportation are already declining quickly, as new trucks in the U.S. include particulate filters that eliminate about 99 percent of fine particulate matter and black carbon. Supporting fleet turnover to these newer vehicles and cleaner technologies and fuels – including renewable diesel, renewable natural gas, and zero emissions technologies using electricity or hydrogen – will accelerate progress to virtually eliminate diesel soot. This will also help to reduce other emissions, including smog-forming pollutants like volatile organic compounds (VOCs) and nitrogen oxides (NO_x). States have several options to reduce black carbon emissions from transportation, including:

- **Implement Broad Frameworks for Reducing Transportation Pollution.** States can build from existing efforts to reduce carbon emissions from the transportation sector. For example, eight Climate Alliance states are part of the Transportation and Climate Initiative of the Northeast and Mid-Atlantic States, which is a regional collaboration of states that seeks to reduce emissions from the transportation sector.
- **Create Integrated Sustainable Freight Plans.** Comprehensive planning can help identify key opportunities to reduce diesel pollution from ports, rail, and truck systems. California has developed a comprehensive Sustainable Freight Action Plan, which includes a detailed list of activities among state agencies to improve freight efficiency, transition to zero-emission technologies, and increase the competitiveness of California's freight system.[58]

- **Incentivize Vehicle Replacement or Retrofits.** Federal regulations require diesel particulate filters on new diesel engines, but there is a significant opportunity to reduce black carbon emissions from existing diesel vehicles by incentivizing retrofits or replacement. California's Carl Moyer Program, for example, provides grant funding for cleaner-than-required engines and equipment, including vehicle retrofits.[59] The state also has several programs to support cleaner on-road and off-road vehicles and equipment through its Low Carbon Transportation Investments and Air Quality Improvement Program Funding Plans.[60] All U.S. Climate Alliance states participate in the EPA's Clean Diesel Program and have received funding to help reduce diesel pollution, including from grants and rebates funded by the Diesel Emissions Reduction Act (DERA)[61] All states also have access to funding in the Volkswagen Diesel Emissions Environmental Mitigation Trust.[62] These funds must be used to reduce emissions of nitrogen oxides (NO_x), but many of those projects will serve to reduce particulate matter and black carbon, as well.
- **Require Increasing Zero Emission Vehicle Sales.** Nine U.S. Climate Alliance states already have adopted increasing zero emission vehicle sales requirements for light-duty vehicles. As zero emission technologies increasingly enter the market and become cost-effective, similar requirements could apply to heavy-duty vehicles and off-road equipment. Zero emission vehicles do not emit particulate matter and black carbon from combustion, and emit less particulate matter from brake wear, because of the use of regenerative braking.
- **Transition Bus Fleets to 100 Percent Electric.** Buses offer one of the most attractive, early heavy-duty vehicle markets for transitioning to zero emissions. Several cities have announced plans to transition to 100 percent electric buses between now and 2040. California is considering a regulation that would require all new buses to be zero emission by 2030, and for fleets to be zero emission by 2040.[63] New York plans to finance the purchase of more than 100 transit buses with VW settlement investment proceeds.[64] School buses are another attractive fleet to transition to zero emissions. State, utility, or local programs to offer incentives and technical assistance can help to quickly transition school bus fleets to run solely on electricity reduce children's exposure to pollution.
- **Procure Clean Vehicles and Fuels.** State, municipal, and utility fleets could procure the cleanest technologies and fuels, and retrofit older vehicles and equipment with the cleanest technologies. California government fleets are required to purchase an increasing amount of zero emission light- and heavy-duty vehicles, and use renewable diesel in diesel-powered vehicles and equipment. New York's Climate Smart Communities program provides

rebates to municipalities that purchase or lease zero emission vehicles and has funded 104 plug-in vehicles in the first two years of the program.

- **Partner with Fleets.** States could work with fleet operators to adopt best practices to reduce diesel pollution, including replacing or retrofitting diesel vehicles and equipment with clean technologies and operating vehicles more efficiently to yield significant cost savings. The EPA's SmartWay Program is a voluntary partnership to reduce diesel use and emissions from fleets.[65]
- **Reduce Emissions from Idling.** Colorado Revised Statute (C.R.S.) 42-4-1206, more commonly known as the "puffer" law, allows law enforcement officers across the state to immediately ticket individuals who have left a vehicle running unattended for any period of time, unless the car has a remote starter system and adequate security measures. In addition, some local jurisdictions have adopted anti-idling ordinances that limit idling of all motor vehicles operating in their community. In 2011, the Colorado trucking industry joined with local governments and clean air advocates in Colorado to create a set of recommendations for a statewide idling standard: C.R.S 42-14-101. Commercial diesel vehicles that weigh 14,000 pounds or more and are designed to operate on highways are limited to idling five minutes within a sixty-minute period unless the vehicle activity or circumstance is exempt under the statute. This consistent guideline enables commercial drivers to comply with the law and protect Colorado's air quality across the state, rather than having to follow a diverse patchwork of local regulations. The federal Diesel Emissions Reduction Act also provides funding for programs or projects to reduce long-duration idling. States could support zero emissions alternatives to idling by investing in truck stop electrification and other technologies.
- **Develop Inspection and Maintenance Programs.** Several states have smog check programs requiring annual or semiannual inspection to ensure that light-duty vehicles comply with emissions standards. States could develop similar programs for heavy-duty vehicles to ensure that emissions control systems are working properly and help identify "gross polluters" (akin to methane super emitters) to replace or repair.
- **Target Reductions at Ports, Railyards, Warehouses, and other High-Traffic Facilities.** Goods movement facilities with high traffic and high levels of diesel pollution are especially good candidates for rules, incentives, or other investments to reduce emissions. Improved logistics, like joint delivery and transport, can increase the efficiency of goods movement and reduce vehicle travel, congestion, diesel use, and emissions. Many local governments, port authorities, and railroad operators have programs to reduce diesel emissions and to shift to zero emissions technologies where possible. California has specific rules and incentive programs targeting drayage trucks that carry freight short distances at ports and railyards,[66]

requiring marine vessels to plug into shore power at berth in ports,[67] and supporting other activities to reduce emissions at these high traffic locations.[68,69]

- **Incentivize or Require Emission Reductions from Off-Road Vehicles.** Off-road vehicles are responsible for a significant amount of black carbon emissions in U.S. Climate Alliance states, and fewer programs address them. States can develop targeted regulatory or incentive programs to reduce particulate matter and black carbon emissions in off-road vehicles and equipment, such as installing diesel particulate filters, encouraging the use of alternative fuels, and replacing old vehicles and equipment with clean technologies. California's FARMER (Funding Agricultural Replacement Measures for Emission Reductions) Program offers $135 million to deploy cleaner agricultural trucks, pump engines, tractors, and more.[70] New Jersey has a clean construction program that provides funding for retrofits (covering 100 percent of the cost of the equipment and installation) or replacement equipment (covering 30 percent of costs).[71]
- **Enforce Rules.** Effective enforcement is necessary to ensure compliance with clean vehicle rules, realize expected climate and health benefits, and provide a level playing field for regulated companies. Enforcement efforts are important to ensure expected emissions reductions materialize.
- **Increase Access to Clean Fuels.** An evaluation of renewable diesel in California found it reduces particulate matter by about 30 percent,[72] which particularly helps reduce emissions in off-road and older vehicles without particulate filters. States could support transitions to cleaner alternative technologies like low-NO_x natural gas trucks or zero emissions vehicles by supporting infrastructure development to provide easy access to renewable natural gas, hydrogen fueling, or electric charging. Low Carbon Fuel Standards, like California and Oregon have, and state, utility, or local government infrastructure incentive or investment programs can help increase access to clean fuels. The Pacific Coast Collaborative has pledged to support emerging markets and innovation for alternative fuels in commercial trucks, buses, rail, ports and marine transportation.[73]

Stationary and Residential Fuel Combustion

Transition to Clean Energy and Increase Access to Cleaner Heating Technology

Stationary sources of black carbon emissions include industrial sources, power plants, and residential combustion, especially from woodstoves and fireplaces. Each of these sources can be an important source of local air pollution, including

in disadvantaged communities or rural communities that rely on wood burning for heat.

Utilizing the best available emissions controls and transitioning to cleaner sources of energy, as described below in the "Cross-Cutting Policies" section, can reduce black carbon emissions from the power and industrial sectors. Promoting the use of cleaner woodstoves and transitioning to cleaner heating technologies, like electric heat pumps, can help reduce CO_2 and black carbon emissions from the residential sector. To continue supporting the transition to clean energy, increasing access to cleaner heating technologies, and improving air quality from stationary and residential sources, U.S. Climate Alliance states could take a number of actions that include:

- **Improve Monitoring of Local Air Pollution.** Improved monitoring of air pollution at a local level, including particulate matter and black carbon levels, can help pinpoint sources of pollution, vulnerable communities, and identify targeted actions to improve public health. California's Community Air Protection Program aims to improve community air monitoring and reduce exposure to air pollution, including particulate matter and black carbon, in communities most impacted by air pollution.[74] This program includes requirements to improve transparency and access to air quality and emissions data.
- **Accelerate Emissions Reductions from Fuel Combustion at Stationary Sources.** Fabric filters, or baghouses, electrostatic precipitators, and diesel particulate filters can be used to reduce emissions of black carbon from stationary sources such as diesel engines, power plants, and industrial boilers. States could work to transition to clean sources of energy in the industrial and power sectors, and collaborate with local air districts to develop policies and deploy technologies to further reduce particulate matter and black carbon emissions. California's Community Air Protection Program requires accelerated retrofit of pollution controls on industrial sources, increases penalties for non-compliance, and includes funding to support community planning efforts and deployment of the cleanest technologies.[75]
- **Increase Access to Clean Heating Fuels and Technologies.** Many communities rely on wood, oil, or propane for heat. Providing grants or other funding to increase access to cleaner, lower cost, and more reliable sources of heat in these communities (including electric heat pumps, renewable gas or heating oil, or natural gas) can reduce CO_2 and black carbon emissions, while providing community benefits. California is exploring the economic feasibility of various options to bring affordable energy to residents in disadvantaged communities who lack access to natural gas and rely on propane and wood for cooking and heating.[76] Other programs, including

incentives, voluntary efforts, or building codes and standards, can support the transition to cleaner heating fuels in new or existing buildings.

- **Require Cleaner Heating Oil.** Connecticut, Massachusetts, New Jersey, New York, Rhode Island, and Vermont require that heating oil be "ultra-low sulfur," or no more than 15 parts per million. Programs can support the use of renewable heating fuels, as well, which could further cut CO_2 and black carbon emissions.
- **Require Cleaner Wood Stoves.** As described in Appendix B, EPA has proposed delaying federal regulations to require cleaner wood stoves and wood-heating appliances. Washington State has set rules and guidelines for the sale, installation, and use of residential wood stoves and similar devices.[77] California, Massachusetts, and Vermont offer incentives to replace old wood stoves with cleaner ones. States could consider adopting similar regulations, or developing a model regulation, for states or local air districts to consider.
- **Support Education and Outreach.** Many states and air districts offer information regarding the public health impacts of wood smoke and particulate matter. States could support new or existing public awareness campaigns and efforts to educate the public about the health and environmental impacts of wood smoke, including EPA's Burn Wise program[78]. States could also consider partnering with wood and pellet stove manufacturers to improve their products and reduce black carbon emissions.

Wildfire and Open Biomass Burning

Mitigate Wildfire Risk and Create Value from Woody Biomass Waste

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The impacts of climate change are already apparent. They include increased frequency and severity of wildfires that are decimating forests throughout the western U.S. and elsewhere, putting lives and property at grave risk. Wildfires are a major source of black carbon, and are now a year-round threat in many Alliance states. The federal government and states urgently need to act to reduce the risk of wildfire and strengthen the resiliency of our natural and working lands. This includes increasing the application of techniques that reduce the risk of catastrophic wildfires, and make wildfires easier to contain and extinguish.

Agricultural burning is another major source of black carbon. By creating markets and value for utilizing woody wastes from agriculture and forestry, states could help support improved agricultural and forest management practices and reduce black carbon emissions.

Efforts to reduce black carbon from biomass burning deserve consideration in a broader context that considers forest health, agricultural sustainability, carbon storage in natural and working lands, and public health. Integrated planning can help identify the most effective strategies to achieve multiple priorities. U.S. Climate Alliance states are already taking action to address wildfire risk and natural and working lands, and could consider a number of additional actions that include:

- **Identify and Adopt Best Practices for Greenhouse Gas Reductions and Carbon Sequestration on Natural and Working Lands, Including Forest Management.** U.S. Climate Alliance states could advance programs, policies, and incentives to reduce greenhouse gas emissions and enhance resiliency and carbon sequestration in natural and working lands, including forests. In developing programs, states could recognize the importance of reducing black carbon and particulate matter emissions from catastrophic wildfire and woody biomass disposal. The Oregon Department of Forestry (ODF) recognizes prescribed burning as a means of reducing excess fuels, thereby lowering the risk of wildfires, and administers the Oregon Smoke Management Plan for prescribed burning in cooperation with landowners, land management agencies, and air quality agencies.[79] New Jersey has a similar program for private landowners, who are required to obtain permits before prescribed burning. Regulated prescribed burning provides a safe and cost-effective method of reducing fuels, vegetation, and leaf litter that could contribute to catastrophic wildfire.
- **Invest in Forest Resiliency and Health.** Many forests require active management to return them to health, reduce wildfire risk, and build resiliency. Several states have targeted forest management programs. Increased federal and state investment is necessary. Additional investment can help expand these programs and reach more acres quicker. California, for example, has invested in forest health and resiliency programs through its California Climate Investments Forest Health program. Partnering with federal and private landowners, especially in shared watersheds or firesheds, can help maximize the benefits of forest management efforts. New York encourages beneficial forest management activities on millions of acres of private forest land through a targeted property tax abatement program that requires active forest management for carbon sequestering forest products while at the same time restoring and maintaining forest health and resiliency.
- **Build Markets for Beneficial Use of Woody Waste.** Active forest management and timber harvest produce biomass, sometimes in excess of what can be left in the forest. Avoiding open burning of this or agricultural waste requires available alternatives to capture value from this potentially valuable resource. Developing markets for products from these sources, including bioenergy, biofuels, and a range of wood products supports efforts

to limit open burning and fosters investment in forest management activities. States could help build these markets through procurement programs, or partnerships, incentives, and voluntary efforts. California's Forest Carbon Plan calls for expanded and new programs to grow wood products markets and bioenergy capacity in a manner that both supports forest health and advances the state's climate change mitigation goals for both energy and natural and working lands. California is creating a Joint Institute for Wood Products Innovation and will review and update the California Public Utilities Commission's procurement programs for small bioenergy renewable generators to ensure long-term programmatic certainty for investor-owned utilities, projects developers, and ratepayers.[80] New York encourages the use of wood pellets from forest-sourced wood and forest products manufacturing residues for thermal space heating through its "Renewable Heat NY" Program". The program provides incentives to homeowners and commercial entities for installation of high-efficiency/low emissions gasification boilers. By replacing old wood stoves with new pellet stoves, it has reduced PM emissions by 50 tons annually.

- **Support or Require Alternatives to Agricultural Burning.** Although agricultural burning is still a common practice in the U.S., several states limit or restrict agricultural or other open burning practices because of the air quality impacts. Additional restrictions can help further reduce harmful emissions from these practices.

Cross-Cutting Policies – Clean Energy and Natural and Working Lands

Policies to reduce CO_2 emissions in the natural and built environment often help reduce methane, HFCs, and black carbon emissions, as well. For example, increasing energy efficiency reduces the need for energy production and methane emissions associated with coal mining or oil and gas production and distribution. Transitioning to cleaner sources of energy and away from fossil fuel combustion supports market development for projects that reduce methane and black carbon emissions. Increased energy efficiency in heating and cooling, including commercial refrigeration, can support HFC emission reductions.

Similarly, efforts to reduce greenhouse gas emissions and increase carbon sequestration in natural and working lands will also help reduce SLCP emissions. Healthy soils initiatives support market development for organics diversion and manure management strategies that reduce methane emissions. Efforts to improve the health and resiliency of forests and other natural landscapes can help to reduce black carbon emissions from wildfire. Designing energy policies in a manner that facilities low-emission pathways for woody biomass and agricultural waste will advance SLCP reduction goals system-wide.

As part of its comprehensive approach to addressing climate change, the U.S. Climate Alliance could continue supporting a broad array of clean energy and natural and working lands strategies. Alongside the SLCP actions identified in this Roadmap, these integrated policies can serve to reduce greenhouse gas emissions to levels needed to do our part to meet the goals of the Paris Agreement.

Efficiency and Clean Energy Policies

Continue Leading on Energy Efficiency and the Transition to Clean Energy

Improved energy efficiency in any sector helps reduce fossil fuel consumption, which reduces methane emissions from coal, oil, or natural gas supply. Renewable energy from non-combustion sources like wind and solar avoids black carbon emissions from stationary combustion, and to the extent it displaces fossil resources, helps to reduce demand and associated methane emissions from coal, oil, or natural gas supply. Clean energy policies often include biomass or biogas as eligible renewable resources, creating value that supports projects that may help avoid agricultural burning (black carbon) or methane emissions from the waste or agricultural sectors. Electrifying end use appliances in buildings or the transportation sector eliminates black carbon from stationary and mobile combustion.

U.S. Climate Alliance states are already leaders on clean energy and energy efficiency, and will continue to lead and benefit from these efforts.[81] States could support additional SLCP reductions by building on these leading efforts, including:

- **Adopt Market-Based Strategies.** Market-based policies that support transitions to clean energy and other efforts to reduce greenhouse gas emissions can also help reduce SLCP emissions. Several U.S. Climate Alliance states have cap-and-trade programs, which set declining caps on greenhouse gas emissions from a sector or group of sectors and creates a market for emissions reductions. California has a multi-sector cap-and-trade program, and Connecticut, Delaware, Maryland, Massachusetts, New York, Rhode Island, and Vermont participate in the power-focused cap-and-trade system called the Regional Greenhouse Gas Initiative (RGGI). New Jersey and Virginia are also in the process of becoming participants in RGGI. In some markets, “offsets” from sectors not covered by the program include specific SLCP projects. California’s program, for example, includes offsets for methane captured at coal mines and dairies.
- **Implement Building, Appliance or Industrial Efficiency Standards.** California, Connecticut, Hawaii, Oregon, North Carolina, Vermont, and

Washington have building efficiency standards in place. Some states are considering expanding the scope of standards to cover greenhouse gas emissions more broadly, which could include requirements to reduce HFC emissions from foams, air conditioning systems, or appliances.

- **Develop Energy Efficiency Plans.** Massachusetts and other states have robust multi-sector energy efficiency programs that have reduced the use of electricity and heating fuels, providing billions of dollars in benefits to program participants.[82,83,84] New York recently published its New Efficiency NY initiative, detailing a comprehensive approach to energy efficiency and designed to achieve 185 Trillion BTU of Efficiency across all furl uses, and which will provide one third of the greenhouse gas emission reductions necessary to meet the State's 40% emissions reduction goal by 2030.[85]
- **Defend Strong Vehicle Greenhouse Gas Standards.** Light-duty and heavy-duty vehicle greenhouse gas standards significantly reduce oil consumption as well as the methane emissions associated with oil production. California sets vehicle greenhouse gas standards that can be stronger than federal standards, and other states could choose to adopt California's standards or follow federal standards. Several U.S. Climate Alliance states, including Colorado, Connecticut, Delaware, Maryland, Massachusetts, New Jersey, New York, Oregon, Rhode Island, Vermont, and Washington, have adopted California's standards. Several U.S. Climate Alliance states have also joined in legal action to protect California's authority to set vehicle greenhouse gas standards.
- **Adopt Low Carbon Fuel Standards.** California and Oregon require fuel providers to increase the availability and use of cleaner, low carbon fuels based on a life cycle "carbon intensity" of fuel pathways. Projects that capture and convert methane emissions into transportation fuels often receive especially low carbon intensity scores. Most low carbon fuels – including renewable diesel, renewable natural gas, electricity, and hydrogen – also help reduce black carbon emissions compared to conventional vehicles and fuels in on-road and off-road vehicles, and in stationary equipment.
- **Expand Renewable Electricity/Portfolio Standards.** Most U.S. Climate Alliance states have targets for increasing renewable electricity generation and use. Some state programs further enable methane reductions by classifying captured methane from coal mines as renewable (Colorado) or requiring a portion of electricity to come from swine manure (North Carolina). California, Colorado, Connecticut, Hawaii, Massachusetts, Minnesota, New York, North Carolina, Oregon, Vermont, Washington all require increasing levels of renewable power.

- **Develop Renewable Gas Standards.** Similar to a low carbon or renewable standard for the transportation or electricity sector, some states are considering requiring increasing use of renewable or low carbon gas supplies to replace use of fossil natural gas. Clean fuel requirements in the natural gas sector may especially support methane reductions, as most available sources of renewable gas include capturing and utilizing methane that may otherwise reach the atmosphere. Directly replacing fossil natural gas reduces methane emissions associated with its supply, as well. California, Oregon, and Washington are considering renewable natural gas potential and policies.
- **Implement Feed-in Tariffs and Net Metering Programs.** California, Vermont, and Washington have feed-in tariff programs that offer fixed-price standard contracts and include small bioenergy renewable generators, including biogas from wastewater treatment, organic waste diversion, dairy and other agricultural bioenergy, or the byproducts of sustainable forest management. Most states have net metering policies for solar power, where excess distributed renewable power that is exported to the grid (rather than used onsite) is credited at the full retail rate, as opposed to the wholesale electricity price. Some state programs also include bioenergy, anaerobic digesters, or energy storage.
- **Electrify Transportation.** California's Zero Emission Vehicle rule requires automakers to sell an increasing number of zero emission vehicles. Connecticut, Maryland, Massachusetts, New Jersey, New York, Oregon, Rhode Island, and Vermont have adopted this rule. Several states have incentive programs to support the purchase of zero emission light-duty or heavy-duty vehicles and are investing in hydrogen fuel or electric charging infrastructure. Education and outreach campaigns can help inform consumers about new technologies and support increased sales.
- **Electrify Buildings.** Building codes, incentive programs, or other efforts supporting net zero energy/carbon buildings can require or incentivize transitions away from natural gas and oil in buildings. Electrifying building appliances can help reduce natural gas and oil use, and methane leaks from natural gas and oil production and distribution.
- **Account for Life Cycle Climate, Health, and Other Impacts.** Expanding accounting frameworks to include life cycle greenhouse gas emissions and other impacts associated with our energy and resource use can be an important tool for states as they plan SLCP mitigation and other climate strategies. Providing a full understanding of the impacts of our policy decisions enables more precise planning, more complete accounting of progress towards plan, and connects local, regional and global actions and impacts. Integrating life cycle accounting into standards can help states engage more effectively with private sector stakeholders. Some state

programs, like Low Carbon Fuel Standards, include life cycle emissions accounting. Regulatory processes for climate programs often include accounting for health and social cost impacts, including co-benefits associated with non-CO_2 pollutants. States could consider adopting other accounting standards, as well.[3] A consensus-building process for integrating new scientific knowledge over time can support effective implementation.

Natural and Working Lands Strategies

Protect Natural and Working Lands and Maintain them as Resilient Carbon Sinks

Efforts to increase ecosystem health, resiliency, and carbon storage in natural and working lands can help reduce black carbon and methane emissions across forested, agricultural, and other natural and working lands.

- **Reduce Risk of Catastrophic Wildfire.** Wildfire is a large source of black carbon emissions in U.S. Climate Alliance states and a threat to communities in expanding wildland-urban interfaces. Managing forests to reduce wildfire risk is necessary to protect these communities and will also reduce greenhouse gas and black carbon emissions from forests and improve the resiliency of carbon stocks.
- **Optimize Biomass Utilization.** Diverting woody biomass waste away from open burning and to biofuels, bioenergy, wood products, or soil amendments reduces black carbon and methane emissions. Using agricultural waste for compost and other soil amendments can support efforts to reduce methane in the waste and agricultural sectors, and may reduce the need for petroleum-based fertilizers and associated methane emissions. Biomass-based energy and product markets can also support activities to improve land management.
- **Improve Soil Health.** Healthy soils initiatives offer agricultural, climate, and water benefits. Agricultural practices designed to improve soil health like New York's Climate Resilient Farming Program[86] can increase soil carbon, enhance water retention, lower greenhouse gas emissions from agriculture, and support markets for products associated with methane reductions, like compost.

[3] For example, the 2015 update of the International Standards Organization (ISO) 14001 Life Cycle Assessment standard, developed under the American National Standards Institute (ANSI) process, provides a life cycle accounting framework that includes updated climate metrics, climate impacts across the full life cycle (both indirect and upstream climate impacts) and is designed to address all other environmental and human health trade-offs. ISO 14001 now provides updated life cycle accounting climate metrics, reflecting the projections of the Intergovernmental Panel on Climate Change IPCC. https://blog.ansi.org/2015/08/iso-14001-life-cycle-assessment/#gref

THE PATH FORWARD

This Roadmap lays out a set of achievable strategies for reducing SLCP emissions, and steps that states could take to achieve them. Undoubtedly, new ideas and information will improve our understanding of SLCP emissions, potential for reductions, and present new opportunities for action. The U.S. Climate Alliance will track new developments and maintain an up-to-date assessment of progress and state-level policy options for cutting emissions of methane, HFCs, and black carbon.

Implementing Actions

Building from this Roadmap and the momentum of the 2018 Global Climate Action Summit, the U.S. Climate Alliance will continue to work to reduce SLCPs. We will develop state-level strategies to reduce SLCP emissions and work toward the shared goals of this Roadmap. To support state-specific efforts and leadership, the U.S. Climate Alliance will continue to:

- **Improve State-Level Emissions Inventories.** U.S. Climate Alliance states are committed to improving individual and collective understanding of SLCP emissions at the state level, and will continue to collaborate to share best practices and improve state SLCP emissions inventories based on updated information. The U.S. Climate Alliance has developed preliminary tools to help estimate emissions of HFCs, methane, and black carbon for all 50 states using consistent methods, data, and assumptions. This is not a replacement for state-specific inventory development, but offers helpful insights to assist with planning efforts and policy development. In the coming months, the U.S. Climate Alliance will work to complete a state-level HFC inventory tool and make it publicly available.
- **Provide Technical Assistance.** Partnerships like the U.S. Climate Alliance provide valuable opportunities to share best practices and participate in technical exchanges with staff in other states. These valuable information exchanges sometimes include external experts or organizations, as well, and offer critical insights for states considering new programs. U.S. Climate Alliance states will continue regular technical exchanges to help states as they develop state-level SLCP strategies and implement actions identified in this Roadmap.
- **Develop Model Regulations and Incentives.** Several states have developed or are considering regulations and incentives to reduce SLCPs in their state, including backstopping against federal actions to delay or rollback

existing rules. States will continue to share best practices and lessons learned in developing SLCP regulations, which will inform new efforts to do so. Building on existing state rules and pulling from federal regulations identified in Appendix B, the U.S. Climate Alliance may also develop model regulations for states to consider adopting to help cut SLCPs. Over the coming months, the U.S. Climate Alliance will identify priority regulations, and incentives that states could use as model rules. Interested U.S. Climate Alliance states will collaborate to develop such rules, which any state may consider adopting. Likely near-term priorities include rules to backstop the federal SNAP rules and transition away from HFCs, reduce particulate matter and black carbon from wood stoves, and limit methane from oil and gas production, natural gas pipelines, and landfills.

- **Expand Partnerships.** The U.S. Climate Alliance consults with a diverse set of non-governmental organizations, foundations, international organizations, and others to provide technical expertise and help connect states to other related activities. It will continue engaging partners to support states in their efforts to cut SLCP and other greenhouse gas emissions. Over the next year, the U.S. Climate Alliance will also seek new opportunities for collaboration and will develop an outreach strategy to secure additional commitments related to the SLCP Challenge (#SLCPChallenge).
- **Report on Progress Annually.** The U.S. Climate Alliance reports annually on our progress toward reducing emissions of greenhouse gasses. Future annual reports will include inventories of methane, HFCs, and black carbon; track progress in reducing SLCP emissions and achieving the potential identified in this Roadmap; and summarize new SLCP activities in U.S. Climate Alliance states.

Let's Go Already

The impacts of climate change are frighteningly apparent in U.S. Climate Alliance states and all around the world. Our response to climate change must be comprehensive and urgent, encompassing all we can do to minimize the mounting risks we face. Critically, we need a global effort to drastically reduce SLCP emissions by 2030. It is the best way to reduce climate risks in the near-term, while we also work to slash CO_2 emissions and manage climate change risks over the long term.

Fortunately, opportunities to reduce SLCP emissions match the need. Capturing and utilizing methane, avoiding waste, supporting agriculture and strengthening food security, transitioning to more efficient and lower impact refrigeration, and cutting particulate matter pollution and black carbon to improve public health are all worth doing in their own right. The overlap with climate change only increases the reason and need to act on SLCPs. Each sector can, and must, contribute.

The U.S. Climate Alliance is fully committed to doing what we can, and must, to contribute to the global climate response, including reducing SLCPs. We have no time to waste, and all the opportunity we need. Join us. #SLCPChallenge

APPENDIX A: SLCPS IN U.S. CLIMATE ALLIANCE STATES

States could take advantage of significant opportunities to build on existing actions to further cut SLCPs in line with levels needed to meet the goals of the Paris Agreement and beyond. Each state has shared and unique opportunities to reduce SLCPs and capture local benefits.

Many U.S. Climate Alliance states have developed state-level greenhouse gas inventories that include SLCPs. Some rely on different methods, assumptions, or reference years. This Roadmap presents emissions inventories for methane and HFCs, aggregated across the U.S. Climate Alliance, based on state-level estimates from the Rhodium Group's U.S. Climate Service.[87] They may not exactly match official state inventories, but offer a consistent and useful method for estimating emissions and reduction potential across states, and in line with national emissions inventories. There is also interest from many U.S. Climate Alliance states to develop black carbon inventories. The states are in early stages of exploring methodologies for black carbon inventories.

Sources of SLCP emissions are more difficult to track than for CO_2. Methane comes from diffuse sources that can be difficult to monitor (e.g. pipeline leaks) and living systems with distinct characteristics (e.g. cow burps). Bottom-up inventories do not always match atmospheric measurements, and may not account for the contributions to emissions from a relatively small number of "super emitters." Black carbon is one element in a toxic mix of pollution, which has variable climate impacts depending on source and other parameters. Data for these sources can be limited as well – like animal populations and their distribution among farms, or pollution from household heating appliances.

The inventories and reduction potentials identified in this section represent conditions in the U.S. Climate Alliance as best as possible. They do not represent official estimates for states, who ultimately maintain their own inventories, plans, and targets. But they do clearly indicate both a significant opportunity and need to reduce SLCPs. As they continue taking action to reduce SLCP emissions, U.S. Climate Alliance states will also keep working to improve SLCP inventories and our understanding of emissions, sources, and opportunities for further reductions.

Methane

U.S. Climate Alliance states account for an estimated 20 percent of national methane emissions. Agriculture is responsible for nearly half of methane emissions in the U.S. Climate Alliance as whole, with remaining methane distributed about evenly between the energy and waste sectors. Compared to the rest of the U.S., methane emissions from agriculture and waste are larger in the U.S. Climate Alliance states, while energy systems, in particular oil and gas production, represent a larger source of methane in other states (Figure 2).

Figure 2. Comparison of methane emissions in U.S. Climate Alliance states and other states.

Figure 2a: Methane Sources in U.S. Climate Alliance

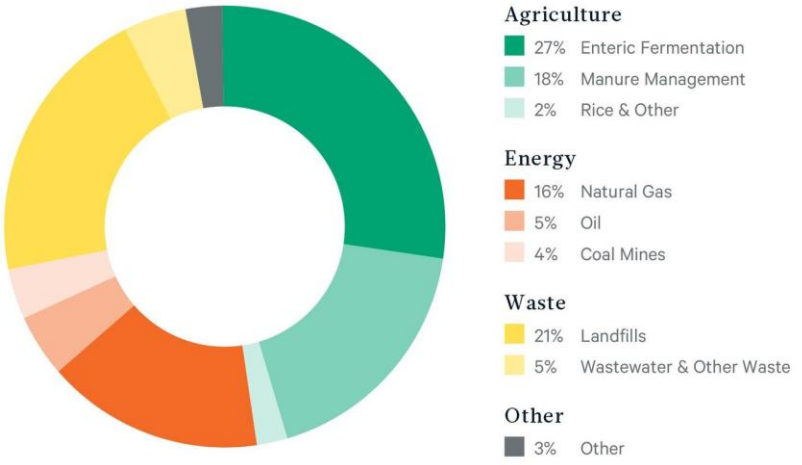
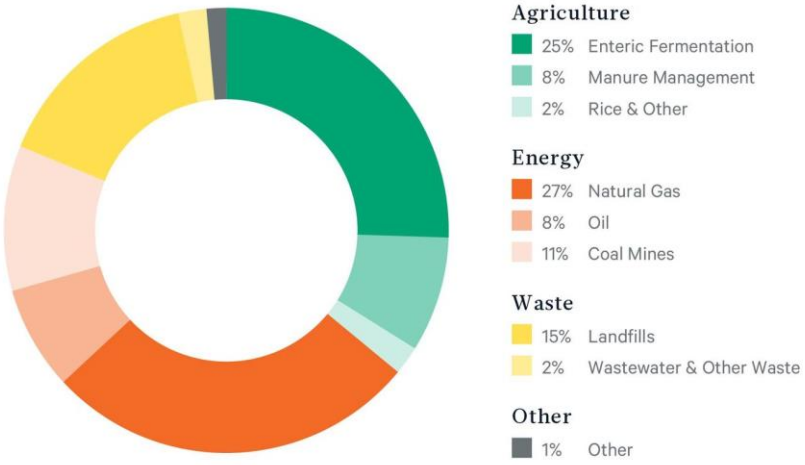


Figure 2b: Methane Sources in Rest of United States



Several opportunities exist to reduce methane significantly from all its major sources. Capturing these opportunities could reduce overall methane emissions in the U.S. Climate Alliance by about 40-50 percent by 2030.

Agriculture

Livestock operations are responsible for nearly half of the methane emissions in the U.S. Climate Alliance. Of this, about 60 percent comes from enteric

fermentation, with the remainder from manure management, especially on some large dairy and swine farms that flush manure out of barns and store it under anaerobic conditions in lagoons. Rice cultivation is a small source of methane emissions, accounting for about two percent of methane emissions in U.S. Climate Alliance states and nationally.

While the U.S. Climate Alliance is responsible for about 20 percent of the methane emissions in the U.S., the Alliance generates one-third of the U.S.'s methane emissions from manure management. There is significant opportunity to reduce methane from manure management, by removing manure solids before the lagoon, capturing and utilizing methane generated in a lagoon for energy or fuel (dairy digesters), or converting to dry manure management practices or pasture-based operations. One estimate suggests changes in manure management on confined dairy and swine operations can reduce methane emissions by 50 percent nationally.[88] This might be low, especially considering state and federal grant programs, utility investments, and other clean energy and fuel policies that offer significant potential value for dairy digester or other projects. Indeed, California estimates that a significant amount of its manure methane emissions can be reduced under current programs.[89] Estimates from the EPA suggest the U.S. Climate Alliance could reduce manure methane by about 70 percent or more.[90]

Markets for energy, soil, and other products from improved manure management offer a significant economic opportunity in U.S. Climate Alliance states. Products from dairy digesters, for example, may represent a $3 billion annual market in the U.S.,[91] and possibly much higher under current policy regimes like Low Carbon and Renewable Fuel Standards. About one-third of this opportunity is in California, Colorado, New York, and Washington.[92] North Carolina and Minnesota are home to about 30 percent of swine farms nationally that are candidates for methane capture and energy generation.[93] These opportunities are beginning to materialize quickly. California, for example, has dozens of projects under development to reduce manure methane and scores more on the way.

U.S. livestock operations are among the most efficient in the world, with low enteric fermentation methane emissions per unit of product. Breeding, feeding, and other strategies have continually improved production efficiency over the past decades, reducing enteric fermentation emissions on a per-gallon-of-milk basis. These strategies are likely to continue providing incremental methane intensity improvements over time.

Many promising strategies are emerging that could reduce enteric fermentation emissions about 30 percent or more. Various feed additives are undergoing trials in the U.S. and other countries that might reduce emissions to those

levels.[94] Extracts from citrus, garlic, and grapes all show promise to reduce methane.

While these strategies all need more testing to verify performance, food production, animal health, and feasibility in the U.S., it is reasonable to expect new products and practices will soon emerge that can reduce enteric methane emissions by 30 percent or more. This is generally in-line with conservative estimates for the global potential,[95] as well as a voluntary target set by the dairy industry in the U.S., to reduce the greenhouse gas intensity of milk production by 25 percent below 2007 levels by 2020.[96,97]

Energy

Fossil energy systems are the largest source of methane emissions in the U.S., but energy-related methane emissions are relatively small in the U.S. Climate Alliance, representing about 12 percent of the national share. Within the U.S. Climate Alliance, natural gas systems represent about 16 percent of methane emissions, oil systems represent about 5 percent, and coal mines represent about 4 percent of methane emissions.

There are significant opportunities to cut methane from the oil and gas sector. The U.S. Department of Energy has identified four U.S. Climate Alliance states among the top six states with the most leak-prone distribution mains,[98] and the Environmental Defense Fund estimates that the U.S. loses $2 billion worth of natural gas each year to leaks.[99] The EPA estimates that oil and gas methane can be cut by 45 percent, with 60 percent of those reductions coming at negative cost.[100] Another study suggests that methane from onshore oil and gas operations in the U.S. can be reduced by 40 percent in 2018 at a cost of a penny per thousand cubic feet of gas produced, while saving the U.S. economy and consumers more than $100 million per year.[101]

This loss-reduction and cost-saving opportunity may be even larger globally, where as much as $34 billion in gas is lost each year.[102] A recent study by the International Energy Agency found that global oil and gas methane emissions can be cut by about 75 percent, with as much as 50 percent at negative cost.[103] Capturing these negative cost reductions would have the same climate impacts in 2100 as immediately shutting down all coal power plants in China.[104]

In addition to the enormous global climate benefits, cutting oil and gas methane provides local benefits by improving pipeline safety and capturing lost revenue for businesses and taxpayers. In 2016, the U.S., Canada, and Mexico agreed to each develop regulations to reduce emissions from the oil and gas sector by 40-45 percent below 2012 levels by 2025.[105] Canada and Mexico have proposed regulations on oil and gas methane. The U.S. currently has a partial, but uncertain, regulatory framework in place (see Appendix B). Some states,

including California and Colorado, already have their own oil and gas regulations in place.

The U.S. Climate Alliance is home to about 11 percent of U.S. active and inactive coal mines.[106] Those states already have projects in place to capture methane from some of them, but other opportunities may exist for low cost reductions at additional mines.[107] In addition to reducing greenhouse gas emissions, capturing methane at coal mines improves mine safety and generates new revenue for coal mines. Various programs exist in U.S. Climate Alliance states to support coal mine methane capture projects, including eligibility for the renewable portfolio standard in Colorado and carbon offsets under California's Cap-and-Trade Program. The EPA estimates that coal mine methane can be reduced by about 45 percent by 2030.[108]

Waste

Landfills account for about 21 percent of U.S. Climate Alliance methane emissions, making them the third largest source after enteric fermentation and manure management. Federal regulations are in place that could reduce methane from landfills by an estimated 30 percent in U.S. Climate Alliance states, and nationally, by 2030.[109] However, these reductions are somewhat uncertain, as EPA has proposed delaying or not enforcing landfill regulations. Several U.S. Climate Alliance states are suing the federal government or developing their own regulations to ensure continued emissions reductions from landfills.

A key opportunity in the waste sector is to collect and capture methane, and once upgraded to meet pipeline standards, use it to generate energy in exactly the same way fossil natural gas is used. The EPA estimates that there are 632 operational landfill gas energy projects in the U.S., with an additional 470 candidate projects, which could collectively reduce methane emissions by 39 $MMTCO_2e$/year. In the U.S. Climate Alliance, there are an estimated 250 operational projects and opportunities for more than 100 additional projects, which could reduce methane emissions an estimated 8.3 $MMTCO_2e$/year, or by about 30 percent.[110]

Table 1. Landfill gas energy projects in U.S. Climate Alliance states.[111]

	Operational projects	Candidate landfills	Projected methane reductions ($MMTCO_2e$)
California	73	23	1.8
Colorado	2	14	1.1
Connecticut	3	2	0.1
Delaware	4	N/A	N/A
Hawaii	0	5	0.3
Maryland	12	8	0.5
Massachusetts	17	4	0.3
Minnesota	7	5	0.2
New Jersey	19	1	0.0
New York	28	2	0.1
North Carolina	33	14	1.4
Oregon	7	3	0.2
Puerto Rico	2	6	0.7
Rhode Island	3	N/A	N/A
Vermont	3	N/A	N/A
Virginia	31	13	1.1
Washington	6	8	0.5
USCA Total	250	108	8.3
U.S. Total	632	470	39.2

Another key strategy for reducing waste methane is to divert organic wastes from landfills and put them to better use as food, compost, or energy. Food rescue and recovery programs can improve public health by increasing access to healthy foods in food insecure communities. Generating compost or creating energy from organic waste can create value that may make diversion projects profitable without other support.[112] Suitably, the EPA established a food recovery

hierarchy that prioritizes source reduction and food recovery to feed people, then animals, composting, and ultimately landfilling as a last resort.[113]

Among U.S. Climate Alliance states, California and Vermont have laws in place or under development that will dramatically reduce disposal of organics in landfills. As states increase organics diversion, methane emissions from static non-aerated compost operations, which currently represent about one-half of one percent of methane emissions in the U.S. Climate Alliance, may increase. Reductions in methane from reduced landfilling of organics dwarfs any increase in methane from composting, however. California, for example, estimates its efforts to divert organic waste will cut methane from waste by an additional 20 percent by 2030, with an increasing impact in future years.[114]

Wastewater treatment represents about 4 percent of U.S. Climate Alliance methane, and significant opportunity exists to reduce methane from this source, as well. In the U.S., more than 2,000 wastewater treatment plants can add biogas capture equipment,[115] and many other plants could utilize excess capacity for diverted organic wastes, often cost effectively.[116] Methane reductions of about 40-50 percent are likely achievable from the sector by 2030.[117]

Methane Super Emitters

Like many pollution sources, a relatively small fraction of methane "super emitters" are likely responsible for a very large fraction of emissions. For natural gas systems, for example, studies have found that one percent of sources are responsible for 44 percent of methane emissions, five percent of leaks responsible are for more than half methane emissions, and 10-20 percent of sources are responsible for 80 percent of methane emissions.[118,119,120]

The same concept holds in other sectors, too. A poorly controlled landfill (or a well-controlled one that happens to spring a large leak) will contribute disproportionately to waste-sector emissions. One manure lagoon may have very different emissions from another, depending on farm management practices and a host of other factors. Indeed, preliminary results from a joint study by California and NASA's Jet Propulsion Laboratory found that a very manageable number of point sources are responsible for a significant fraction of total emissions.

Identifying and targeting super emitters could provide important opportunities to achieve deep methane reductions very quickly. Many efforts are underway to improve monitoring of methane emissions, which promise to make actionable data available in the near future on super emitters and other sources of methane.[4] A targeted effort to reduce emissions from super emitters could

[4] For example, ARPA-E has an active program focused on developing low-cost methane detection technologies, EDF has announced efforts to launch a methane satellite, and several companies and the state of California are exploring options to launch satellites capable of pinpointing methane leaks globally.

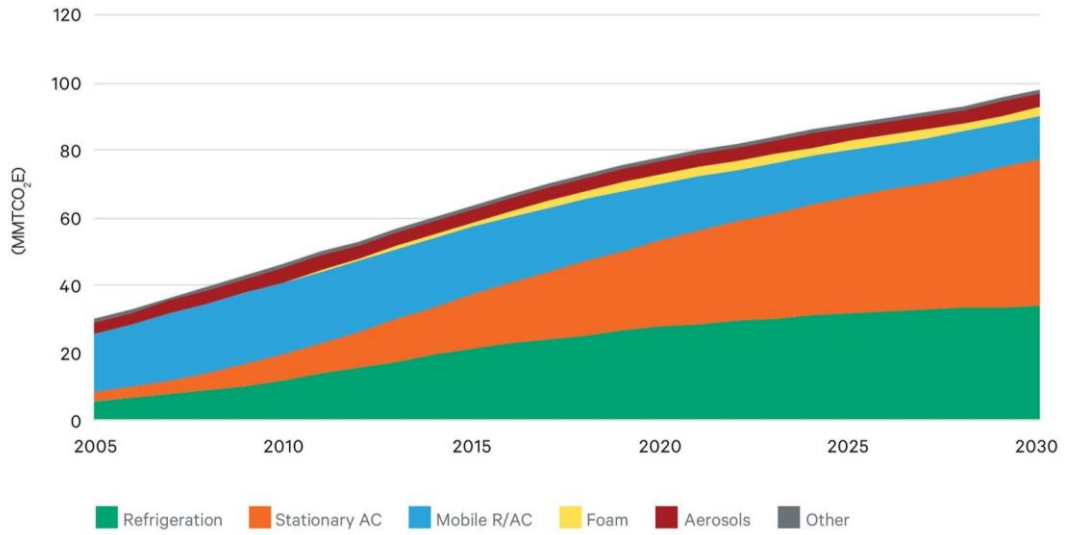
reduce methane from affected sources by perhaps an additional 30 percent, and could lead to reductions in excess of 1,000 MMTCO_2e/year globally.

Hydrofluorocarbons (HFCs)

HFCs are potent short-lived climate pollutants, with global warming potentials hundreds to thousands of times greater than CO_2, and with a lifespan of about 15 years. For example, just one *pound* of R-404A, an HFC refrigerant used in supermarkets, has the same climate impact over 100 years as almost two *tons* of CO_2. HFCs are often used in commercial refrigeration, stationary and mobile air conditioning, heat pumps, foams, and aerosols. They are the fastest growing source of greenhouse gas emissions, both nationally and globally. Without further controls, HFC emissions could double in 20 years.

The U.S. Climate Alliance has developed preliminary HFC inventories and projections through 2030 for all 50 states (Figure 3). It is based on a peer-reviewed, bottom-up fluorinated gas emissions inventory developed by the California Air Resources Board,[121] which utilized over $2.5 million in research and surveys relating to equipment counts, leak rates, and atmospheric measurements.[122] It includes state-specific data as available, including numbers of retail food markets, air conditioning and heat pump units, vehicles, and cold storage warehouses. The tool includes a range of mitigation scenarios and will help states better understand emissions and opportunities for reductions. The U.S. Climate Alliance plans to make the inventory tool publicly, so all states in the U.S. will be able to gain a better understanding of SLCP emissions in their states and the reduction potential from various policies.

Figure 1. Estimated HFC emissions and "business as usual" growth in U.S. Climate Alliance states.



HFC emissions correlate well with population, and accordingly, the U.S. Climate Alliance is responsible for about 40 percent of U.S. HFC emissions. Commercial refrigeration systems, including those in grocery stores and restaurants, are the largest source of HFC emissions, representing about one-third of the total. Mobile air conditioning is the next largest, representing one-quarter of emissions. They mostly come from the light-duty vehicle sector, but also result from the heavy-duty sector – including buses, off-road vehicles, and transport refrigerated units. Emissions from air conditioning in buildings, including residential heat pumps, is the fastest growing source of HFC emissions in U.S. Climate Alliance states and nationally. Under current trends, stationary air conditioning could become the largest source, representing over 40 percent of HFC emissions by 2030.

Transitioning away from HFCs can help reverse these trends and significantly reduce emissions. Many HFC alternatives with a much lower climate impact are available, or expected to be available soon. There are a number of natural refrigerant alternatives to HFCs, including CO_2, ammonia, and hydrocarbons. Hydrofluoroolefins (HFOs) are non-ozone depleting substances and have global warming potential values of less than six. In some applications, these alternatives offer energy efficiency benefits, and in most, emissions reductions are either negative cost or very low cost. Indeed, the EPA estimates that emissions from refrigeration and air conditioning can be reduced by 77 percent

below baseline levels by 2030, and that over half of those reductions can be had at negative cost.[123]

Fortunately, these transitions are underway in many places. The European Union has adopted regulations to phase down the production and import of HFCs by almost 80 percent below 2014 levels by 2030. In North America, more than 300 stores use transcritical CO_2 as a refrigerant (global warming potential of 1), and another 260 use a hybrid system of CO_2 and HFCs.

Under the Kigali Amendment to the Montreal Protocol, the world has agreed to transition away from HFCs. It begins to phase down the production and use of HFCs starting in 2019, reaching 85 percent reduction by 2050. This action alone will reduce average global temperatures by an estimated 0.5°C this century, compared to current HFC emission trends.[124] The U.S. signed the Kigali Amendment in November 2016, but has not taken action to ratify it through the Senate.

Once ratified, the EPA needs to implement the Kigali Amendment, but the mechanism to do so is uncertain, as well. The Significant New Alternatives Policy, known as SNAP, implements Section 612 of the amended Clean Air Act of 1990, which requires EPA to evaluate replacements for ozone-depleting substances to reduce overall risk to human health and the environment. These replacements include HFCs. EPA applied this authority to prohibit high-global warming potential (GWP) HFCs in new equipment and materials as viable, lower-GWP alternatives became available. However, last year the federal D.C. Circuit Court of Appeals ruled that EPA cannot require replacements of HFCs in many circumstances.

Given federal uncertainty on transitioning away from HFCs, there is a strong need for states to lead. California has adopted much of the SNAP program into state law, and is considering additional rules to cover the remaining categories. Other states are considering similar steps. By adopting these rules into law themselves, states can create a market for a large variety of efficient equipment using low-GWP refrigerants and continue the transition away from HFCs in the U.S., while supporting American companies and jobs.

In the U.S., the Kigali Amendment and recent SNAP program would have HFC emissions fall about 25 percent below current levels by 2030, and continue declining thereafter. States can work to lock in those reductions and ensure the U.S. benefits from the global phasedown in HFC emissions.

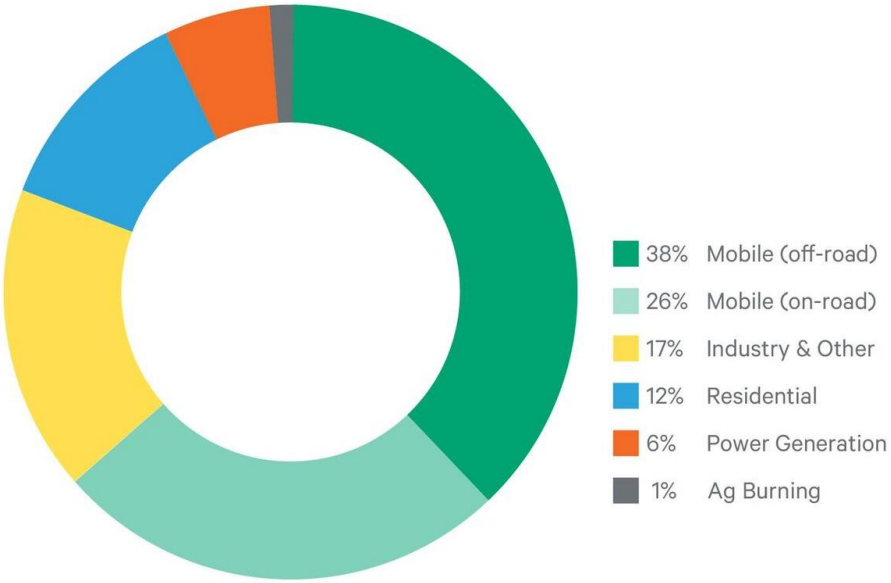
Additional steps could help reduce HFC emissions by 40-50 percent below current levels by 2030. This includes improving refrigerant management in existing systems, transitioning away from HFCs in end uses not covered by the recent regulations, collecting and destroying used refrigerants, reducing the global warming potential value of replacement refrigerants in existing systems,

and creating incentive programs to accelerate the transition away from HFCs. California is doing many of these things, and it and other states are considering additional steps to reduce HFC emissions faster.

Black Carbon

U.S. Climate Alliance states are working to develop and maintain black carbon inventories to guide their planning efforts. California has developed a black carbon inventory,[125] and the EPA has developed state level black carbon emissions inventories, as well. Estimates from the most recent EPA inventory are summarized in Figure 4. Mobile sources account for nearly two-thirds of non-forest black carbon emissions. Cars and trucks account for about a quarter of non-forest black carbon emissions. Trains, planes and ships comprise another 10 percent, and other off-road vehicles and equipment comprise nearly 30 percent of non-forest emissions. Residential wood burning is another large source of emissions in some states.

Figure 3. Black carbon emissions in U.S. Climate Alliance states in 2014, excluding black carbon from wild and prescribed fire.[126]



Wildfires and prescribed fires are a significant source of black carbon in many Climate Alliance states, and forests are burning at an increasing rate and with increasing levels of severity. According to EPA estimates, wild and prescribed fire accounted for nearly half of black carbon in 2014 in U.S. Climate Alliance states, including about 60 percent in California, Oregon and Washington, combined.[127] Due to the volatile nature of wildfires and the scientific uncertainty of the composition of particulate matter emissions from open biomass burning, planning efforts related to black carbon often exclude these sources.

Black carbon emissions have declined significantly in the U.S. over the past decades, largely due to reductions from on-road and off-road heavy-duty diesel vehicles and equipment. These gains will continue, as new trucks and equipment with diesel particulate filters displace older, dirtier equipment. Non-forest black carbon emissions in the U.S. are expected to fall 49 percent below 2013 levels by 2025.[128]

States can accelerate and deepen these reductions and their benefits by accelerating the transition away from older polluting vehicles and equipment to "soot free" and zero emissions technologies. The International Council on Clean Transportation defines soot free vehicles as diesel vehicles with a particulate filter that run on ultra-low sulfur fuel, or cleaner alternatives, such as those

powered by renewable natural gas, electricity, or hydrogen.[129] Accelerating this transition and achieving soot free transportation by 2030 might reduce non-forest black carbon emissions in U.S. Climate Alliance states by about another 20-30 percent below already declining levels.

The transition to soot-free on-road transportation could go faster. In California, for example, all on-road trucks will have a particulate filter by 2023. After that point, brake and tire wear will generate more black carbon than on-road engines.[130] These efforts are directly reducing climate change impacts in the state.[131] According to EPA, the public health benefits of reductions from the use of diesel particulate filters on new diesel engines, used in conjunction with ultra-low sulfur diesel fuel are estimated at $290 billion annually in 2030.[132] If the rest of the world matched California's success on reducing diesel black carbon, global warming for the coming decades could be reduced by about 15 percent.[133]

Black carbon from other sources is not projected to decline significantly in the future in the U.S. without additional policy interventions.[134] Climate Alliance states are taking additional steps, however, to reduce these emissions. Many Climate Alliance states have air quality programs in place to address particulate matter from stationary and mobile sources, which will reduce black carbon as well. Non-attainment air districts in California will require stationary sources to deploy best available retrofit control technology by 2024.[135] Washington and other states are working to reduce emissions from woodstoves. Several states have rules related to residential and agricultural burning. U.S. Climate Alliance states are committed to addressing natural and working lands, as well, and developing goals and strategies to increase carbon sequestration, and the health and resiliency of our forests and other landscapes.

APPENDIX B:
STATUS OF FEDERAL POLICIES
(AS OF AUGUST 2018)

Methane

Bureau of Land Management (BLM) Waste Prevention Rule.[136] Limits venting, flaring, and leaking of natural gas from oil and gas leases on BLM-managed federal and tribal lands. A federal district court in Wyoming has suspended the rule's requirements indefinitely, which California, New Mexico, and several non-profit organizations are appealing to the Tenth Circuit Court of Appeals. Previously, federal district courts in California struck down BLM's two earlier attempts to suspend the rule's January 2018 compliance deadlines. BLM has proposed a replacement rule that would rescind most of the rule's substantive requirements.

EPA New Source Performance Standards (NSPS) for oil and gas.[137] Limits methane emissions from oil and gas sector sources constructed or modified since September 2015. The rule is formally in effect. In June 2017, EPA granted industry requests for reconsideration and proposed to stay the rule's compliance deadlines from 2017 until 2019, in which case industry would not have to comply with the existing rule while EPA reconsiders and rescinds or revises rule requirements. The stay has not been finalized. EPA is expected to propose a rule rescinding or replacing the New Source Performance Standard, but the proposal date is unknown.

EPA Non-Regulation of Existing Oil and Gas Sources. EPA has not proposed or finalized emission guidelines for methane emissions from *existing* oil and gas sector sources, which the Clean Air Act (section 111(d)) and implementing regulations required the agency to do once it finalized the oil and gas methane New Source Performance Standard. The EPA previously began this process by issuing an Information Collection Request to gather industry data that it said was needed to develop emission guidelines, but withdrew the request in March 2017 and has taken no other steps toward promulgating an existing

source rule. In April 2018, several jurisdictions[e] sued the EPA for unreasonable delay in promulgating an existing source rule; the case is in procedural stages.

EPA Control Techniques Guidelines. The Clean Air Act requires EPA to issue Control Technique Guidelines for new and existing sources of criteria pollutants, including ground-level ozone precursors. Control Techniques Guidelines do not directly regulate sources; they instead provide baselines and recommendations for states and local air agencies to consider as they develop their own regulations to ensure compliance with national ambient air standards. EPA finalized Control Technique Guidelines for oil and gas sector emissions of ozone precursors in October 2016 and estimated that, if fully adopted by applicable states, they would help reduce methane by 200,000 tons. EPA has proposed to withdraw the Control Technique Guidelines, which the agency is expected to finalize soon.

Municipal Solid Waste Landfill Emission Guidelines (Existing Facilities).[138] On August 29, 2016, EPA published updated final Emission Guidelines under 111(d) of the Clean Air Act for existing landfills in 40 CFR Part 60, Subpart Cf, requiring owners or operators of existing landfills that have design capacities equal to or greater than 2.5 million megagrams (Mg) by mass and 2.5 million cubic meters by volume to install a gas collection and control system at each landfill that accepted waste at any time since November 8, 1987; commenced construction, reconstruction, or modification on or before July 17, 2014; and has a NMOC emission rate greater than or equal to 34 Mg per year (50 Mg for landfills in the closed landfill subcategory) or reaches a surface methane concentration of 500 parts per million or greater, according to optional Tier 4 surface emissions monitoring. States were required to submit "State Plans" by May 30, 2017. California and New Mexico filed their state plans by the deadlines. Several industry members petitioned EPA to revisit the rules. EPA indicated in a letter it is reconsidering the rule and will not be prioritizing approval of state plans or issuing federal plans and that it expects the review of the rule to be completed in the 2020 timeframe. California filed suit against EPA for failure to perform a non-discretionary duty, and several U.S. Climate Alliance states, including Maryland, Oregon, Rhode Island, and Vermont joined. There are three cases that the D.C. Circuit held in abeyance while EPA reconsiders the rule: Nat'l Waste Recycling Assoc. v. EPA (16-1371 and 16-1372), Utility Air Regulatory Group v. EPA (16-1374).

Municipal Solid Waste Landfill New Source Performance Standards (New Facilities).[139] On August 29, 2016, EPA published a New Source Performance Standard under section 111(b) of the Clean Air Act for new, modified and

[e] The jurisdictions that filed suit are New York, California, Connecticut, Illinois, Iowa, Maine, Maryland, New Mexico, Oregon, Rhode Island, Vermont, Washington, Massachusetts, Pennsylvania, the District of Columbia, and the City of Chicago. The Environmental Defense Fund later became a plaintiff as well.

reconstructed municipal solid waste landfills. Similar to the Emission Guidelines, the New Source Performance Standard require installation of the gas collection control system at 34 Mg per year for landfills that commenced construction, reconstruction or modification after July 17, 2014, among other requirements. The final rule would achieve an estimated 44,300 Mg/yr of methane reductions (1.1 $MMTCO_2e$/year). Industry petitioned EPA to revisit this rule. EPA has indicated it will be opening up this rule but has indicated that it is in effect on a recent teleconference. It is expecting to align the revisions of this rule with the Risk and Technology Review rule. In recent court decision (Community In-Power & Development Assoc. v. Pruitt), D.C. Circuit said EPA had to finish revisions to the rule by 2020.

HFCs

EPA Significant New Alternatives Policy (Refrigerants) (Section 612). A longstanding rule limits the use of ozone-depleting substances and lists substitutes as either acceptable, unacceptable, or acceptable subject to use limits or conditions. In 2015, the rule removed HFCs from acceptable alternatives list because of their climate impact. In Mexichem v. EPA, the D.C. Circuit vacated the 2015 Rule to the extent it requires manufacturers to replace HFCs with a substitute substance. Under this rationale, EPA is authorized to require "replacement" only once for a given compound and use, and could not require a previously authorized substitute such as HFCs to be replaced, even if that substitute was shown to be dangerous. EPA issued a Guidance Document stating it will not be enforcing the 2015 Rule in its entirety.[140] NRDC, Chemours, and Honeywell filed petitions with the U.S. Supreme Court for certiorari, but EPA has asked the Court not to hear the case. HFC phase-down has bipartisan and industry support, and bipartisan bills have been introduced in the House and Senate (S. 2448). New York, joined by California's Office of the Attorney General, Vermont, Delaware, Massachusetts, Maine, Oregon, Pennsylvania, and D.C. filed suit in the D.C. Circuit challenging EPA's actions.[141] There are two cases held in abeyance while the Supreme Court considers Mexichem I: Compsys v. EPA (15-1334), and Mexichem v. EPA (Mexichem II)(17-1024).

EPA Refrigerant Management Regulations (Section 608). EPA issued a final rule updating its refrigerant management regulations and extending the refrigerant management requirements to some HFCs. EPA is planning to issue a proposed rule to revisit aspects of rule's extension of the regulation to cover substitute refrigerants, such as HFCs. EPA released a letter dated August 10, 2017 indicating it is planning to revise the rule.[142] The 2016 rule and compliance dates currently remain in effect. There is one case, held in abeyance while EPA reconsiders the rule.[143]

Black Carbon

EPA Residential Woodstove Regulations.[144] In February 2015, EPA strengthened the existing (1988) New Source Performance Standards for newly manufactured residential wood heaters sold in the U.S., and established federal standards for certain previously unregulated types of new wood heaters (wood-fired boilers, indoor wood-fired air furnaces, single burn-rate woodstoves, and most pellet stoves). EPA did not finalize standards that it had proposed for new indoor fireplaces, and never proposed standards for existing woodstoves or new outdoor fireplaces or fire pits. The New Source Performance Standard provides for a readily-achievable emissions limit by 2015 and a more rigorous emissions limit by 2020. On March 7, 2018, the House of Representatives passed H.R. 1917, a bill that would postpone implementation of the 2020 New Source Performance Standard until 2023. A parallel bill has been introduced in the Senate (S. 2461) but has not yet received a committee vote. EPA sent a draft rule to the White House Office of Management and Budget, which would allow retailers “a period of time” after May 2020 to keep selling appliances made before that date.

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