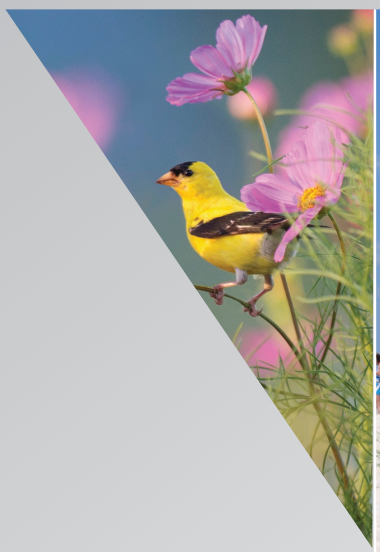
An Examination of Policy Options for

Achieving Greenhouse Gas Emissions Reductions

in New Jersey

September 2017



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Introduction

This report explores policy options for the State of New Jersey in advancing statutory limits to reduce greenhouse gas emissions. Recognizing that it has been a decade since the passage of the New Jersey Global Warming Response Act (N.J.S.A. 26:2C-37), this report examines five critical issues with respect to attainment of the statewide limits:

- Whether the limits are still appropriate limits reflecting scientific consensus;
- The status of New Jersey's current greenhouse gas emissions in relation to such limits;
- The status of New Jersey's legal and policy framework for addressing greenhouse gas emissions;
- Leading mitigation policies in other states that could be applicable to New Jersey; and
- What policies offer opportunities to improve conditions in communities that currently bear disproportionate environmental burdens in New Jersey that are likely to be exacerbated by a changing climate.

The report was developed as a collaboration among research staff at The Georgetown Climate Center, Rutgers Climate Institute, Rutgers Edward J. Bloustein School of Planning and Public Policy, and World Resources Institute. The research was conducted based on publicly available information to provide analyses of: New Jersey emission trends; existing New Jersey climate and energy policies; pathways to decarbonization and implications for New Jersey; current and emerging state policy models for reducing greenhouse gas emissions by sector, including where New Jersey has related policies; equity considerations in state climate actions; and existing New Jersey legal authorities to address greenhouse gas emissions. Within the chapter on current and emerging state policy models, summary tables not only note where New Jersey has related policies, but also tie to the New Jersey legal authority analysis. This report does not constitute legal advice. Consultation with a NJ attorney is recommended for further evaluation of state authorities and options.

The 2020 and 2050 statewide greenhouse gas emission limits established by the New Jersey Global Warming Response Act address all greenhouse gases, which include carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perflurorocarbons, sulfur hexafluoride, and any other gas or substance determined by the New Jersey Department of Environmental Protection to be a significant contributor to global warming. Provisions in the Act, including the development of a statewide greenhouse gas inventory, an emissions reporting program, and a requirement for the development of a statewide plan for achieving the statewide limits, are all consistent with the broad scope of an economy-wide greenhouse gas emissions reduction program. Therefore, the scope of this report addresses greenhouse gas emissions and their sources economy-wide. The term, *decarbonization*, —which is widely used in the climate change context, including in the Paris Agreement—is used to refer to reduction of all greenhouse gas emissions from all sources and not just CO_2. Given that the power sector and the transportation sector are New Jersey's two largest sectors of greenhouse gas emissions (they account for approximately 60 percent of emissions) this report presents a more in-depth snapshot of emissions and related trends from these sectors and, within those sectors, CO_2 is the dominant emission.

Resources constrained the ability to conduct three types of analyses that would further support the information contained in this report:

- Original scenario modeling of emissions reductions that would allow for quantification of anticipated emissions reductions based on specific policies;
- Cost-effectiveness modeling that would provide a better understanding of the relative emissions reduction impact of specific policies in relationship to the cost of policy implementation; and
- Assessment of workforce development opportunities associated with any particular policy option.

Nevertheless, by outlining current and emerging policies underway or under development by other states, this report offers insights for feasible policy options at the state level. Although the authors do not make recommendations or advocate for any particular policy option or suite of options for New Jersey, we hope that the information in the report will be helpful in furthering dialogue and discussion about greenhouse gas emissions policy options for New Jersey.

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I. Executive Summary

It has been a decade since the passage of the New Jersey Global Warming Response Act (N.J.S.A. 26:2C-37), which set statewide statutory limits on greenhouse gas emissions. New Jersey has already met its near-term limit of reducing greenhouse gas (GHG) emissions to 1990 levels by 2020. To address the challenge of climate change, however, deep levels of decarbonization will be needed in the long term. New Jersey has set a limit of achieving 80 percent reductions by 2050 from 2006 levels, or approximately 75 percent reductions from 2012 (the most recent year for which state-specific data are available). Meeting such dramatic levels of emission reduction will require significant new policies and enhancements of current strategies. In December 2015 in Paris, France, nearly all of the countries of the world reached an agreement that aims to prevent the worst harms of climate change by limiting global warming to well below two degrees Celsius. The Paris Agreement has since been signed by 195 countries. As part of a larger effort to withdraw federal climate actions, President Donald Trump is withdrawing the United States from its orignal commitment to the Paris Agreement. Given these developments at the federal level, states now have the opportunity to take leadership on advancing sound policies to address climate change.

This report, which was developed as a collaboration among research staff at The Georgetown Climate Center, Rutgers Climate Institute, Rutgers Edward J. Bloustein School of Planning and Public Policy, and World Resources Institute (WRI), identifies greenhouse gas emissions and energy trends in New Jersey, examines the levels of reduction that will be needed to achieve deep decarbonization and the types of policies that will be necessary to achieve those reductions, provides context regarding New Jersey's climate and energy policies, surveys policy models that other leading states are using to cut emissions, and assesses what kinds of policies could be implemented with existing legal authorities in the Garden State.

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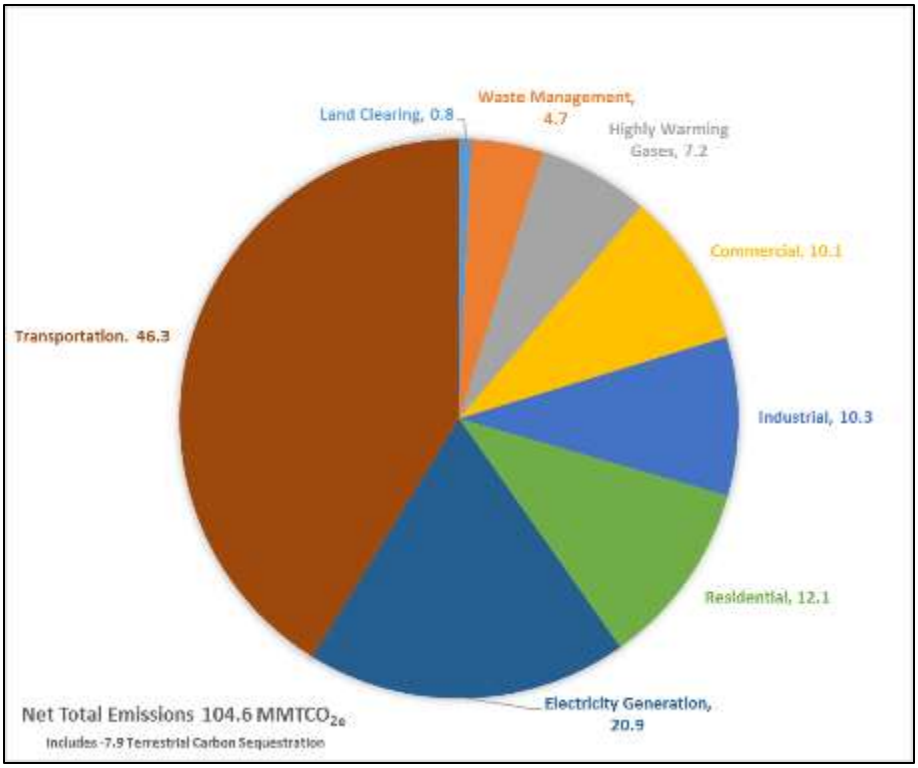
By outlining current and emerging policies underway or under development by other states, this report offers important insights for feasible policy options at the state level. Although the authors do not make recommendations or advocate for any particular policy option or suite of options for New Jersey, we hope that the information in the report will be helpful in furthering dialogue and discussion about greenhouse gas emissions policy options for New Jersey.

I.A. Background: Emissions, Trends, and Prior Climate Actions

GHG Emissions and Energy Trends

In 2015, the Rutgers Climate Institute and Bloustein School released the *2012 Update to New Jersey's Statewide Greenhouse Gas Emission Inventory,* which used the same methodology as New Jersey's previous Statewide Greenhouse Gas Emission Inventory. The report found that emissions fell from 112.7 million metric tons carbon dioxide (CO_2)-equivalent ($MMTCO_2e$) in 2010 to 104.6 $MMTCO_2e$ in 2012. New Jersey's level of emissions in 1990—also the limit for 2020—was 125.6 $MMTCO_2e$, and the state has been below that level since 2008. The report found that meeting the state's limit of an 80 percent reduction from the 2006 level by 2050 will require a 75 percent reduction from 2012 emissions. As shown in Figure I.A-1, the report also found that the transportation sector was the largest source of emissions in the state, followed by electricity generation and fossil fuel used in the residential, industrial and commercial sectors mainly for heating.

Figure I.A-1. Estimated NJ Statewide Greenhouse Gas Emissions, 2012.



Source: 2012 Update to New Jersey's Statewide Greenhouse Gas Emission Inventory (units are MMTCO2e).

Power Sector Trends. New Jersey has seen a dramatic reduction in CO_2 emissions from the power sector, driven in large part by a shift from coal-fired power plants to less carbon-intensive natural gas power plants.

- New Jersey's 2015 power-sector CO_2 represent a 27 percent decrease since 1990 and a 42 percent decrease since 2005, taking into account emissions associated with electricity imported into New Jersey (consistent with the methodology used in New Jersey's state GHG inventory). Coal-fired generation has decreased dramatically—in 2005, it accounted for 12.7 percent of in-state

generation, while in 2015 it accounted for just 2.3 percent. There are only two remaining coal-fired power plants that are not scheduled to retire or convert to natural gas.

- New Jersey has also reduced imports of out-of-state electricity, which has contributed to reduction in CO_2, SO_2 and NO_X emissions because the imported electricity is more emissions-intensive on average than what is produced in New Jersey.
- Natural-gas fired generation has correspondingly increased, rising from 16.8 percent in 2005 to 48.5 percent in 2015. Eleven new natural gas facilities have come online since 2005, representing 4,795 MW of additional nameplate capacity.
- Nuclear energy continues to provide a major portion of energy in the state, with New Jersey's four nuclear plants supplying 43 percent of electricity in 2015. One of these plants—Oyster Creek Generating Station—is scheduled to close in 2019. An important consideration for New Jersey's emissions will be what type of electricity generation replaces this nuclear plant—if the demand is met by electricity from fossil fuel-fired generation, then emissions will increase.
- Generation from renewables has increased substantially, particularly from solar resources. Renewable electricity generation jumped from 17,000 MWh in 2006 to nearly 2.1 million MWh in 2015—a more than 100-fold increase (total electricity generation in 2015 was 76 million MWh).
- Overall, New Jersey consumed less electricity in 2015 than it did in 2005, while at the same time increasing its GDP by 25 percent and increasing its population from 8.72 to 8.96 million.

Transportation Sector Trends. New Jersey has seen a significant increase in ground transportation emissions (i.e., consistent with the state inventory, not including aviation emissions) since 1990, although emissions have declined from their peak in 2007. The federal fuel economy and greenhouse gas standards for vehicles are yielding improvements in efficiency of the vehicle fleet, and can be expected to continue to yield reductions in future years. At the same time, the total number of vehicle miles driven each year in New Jersey—and in the nation generally—is on the rise again after falling during a period of recession and high fuel prices.

Core strategies to reduce greenhouse gas emissions from the transportation sector are often referred to as "three legs to the stool:" fuel efficiency for vehicles, reducing the carbon intensity of fuels, and reducing vehicle miles traveled (VMT). Overall trends in New Jersey indicate that CO_2 emissions from ground transportation (calculated based on quantities of fuel sold for consumption in New Jersey) increased 27.5 percent from 1990 to 2015 and decreased by 11 percent from 2005 to 2015. More specifically:

- Fuel efficiency of vehicles: Absolute consumption of gasoline and diesel fuel in New Jersey was 11 percent lower in 2015 than in 2005, demonstrating the impact of federal fuel economy standards on an increasingly efficient New Jersey fleet.
- Carbon intensity of fuels: Switching from vehicles that run on gasoline and diesel to vehicles that use electricity can reduce the carbon intensity of transportation fuels. While some states have achieved higher levels of EV penetration, in New Jersey, 3,980 battery electric and plug-in hybrid vehicles were sold in 2016 compared to 251 in 2011. Annual electric vehicle sales now represent a 0.48 percent market share in New Jersey, compared to a 3.2 percent market share in California and 0.66 percent market share in Connecticut.

- Vehicle miles traveled: VMT increased steadily in New Jersey from 1990 until 2007 when VMT fell during the recession. After 2011, VMT began to rise again both in New Jersey and the United States as a whole. Since the 2007 recession, New Jersey has seen a significant change in development patterns with population growth occuring mostly in already built-out communities, as opposed to through new development in exurbs that was typical during the 1990s.

Overall, if fully implemented at the state and federal levels, federal fuel economy standards and the state's zero emission vehicle (ZEV) policies could achieve a 30 percent reduction in transportation-sector emissions in New Jersey by 2030, according to a Georgetown Climate Center and Cambridge Systematics analysis. If recent development patterns continue, including population growth in already built-out communities, this could help to reduce VMT or slow VMT growth in the future.

Existing New Jersey Climate and Energy Policies

New Jersey has already implemented several important climate and energy policies and limits that are driving down GHG emissions, or have the potential to do so. These include:

- Establishing economy-wide limits through the New Jersey Global Warming Response Act to reduce GHG emissions to 1990 levels by 2020 and to 80 percent below 2006 levels by 2050;
- Requiring large stationary sources to report CO_2 and methane emissions and clarifying that CO_2 is an "air contaminant" that may be regulated under New Jersey's Air Pollution Control Act;
- Adopting California's Low Emission Vehicle Program in 2006, which includes a mandate requiring auto manufacturers to sell an increasing percentage of zero-emission vehicles;
- Establishing a Renewable Portfolio Standard (RPS) and increasing it over time, currently requiring 20.38 percent of electricity to come from renewable sources by 2021, with an additional set-aside requirement that 4.1 percent of that electricity come from in-state distributed solar resources by 2028;
- Enacting the Offshore Wind Economic Development Act, which directs the New Jersey Board of Public Utilities to develop a program through which the state supports a minumum of 1,100 MW in offshore wind power through an RPS carve-out;
- Establishing a net-metering program;
- Adopting an Energy Master Plan in 2008 and issuing updates in 2011 and 2015; and
- Participating in the multi-state Transportation and Climate Initiative (TCI), a collaboration among Northeast and Mid-Atlantic states to reduce GHG pollution from the transportation sector.

New Jersey was also a founding member of the Regional Greenhouse Gas Initiative (RGGI), an emission budget program for the power sector established by states in the Northeast and Mid-Atlantic. The program sets a regional cap on power-sector CO_2 emissions and creates allowances (effectively permits to emit CO_2) equal to the cap. States participating in the program auction the allowances and states invest significant portions of the proceeds into energy efficiency and clean energy programs. The Global Warming Solutions Fund Act (GWSFA), enacted in 2008, provided New Jersey with the authority to create an allowance auction program and to reinvest the funds, and New Jersey promulgated

implementing regulations later that year. After three years of participating in RGGI, New Jersey withdrew from the program in 2012.

I.B. Pathways to Decarbonization and Implication for New Jersey

Deep Decarbonization Targets

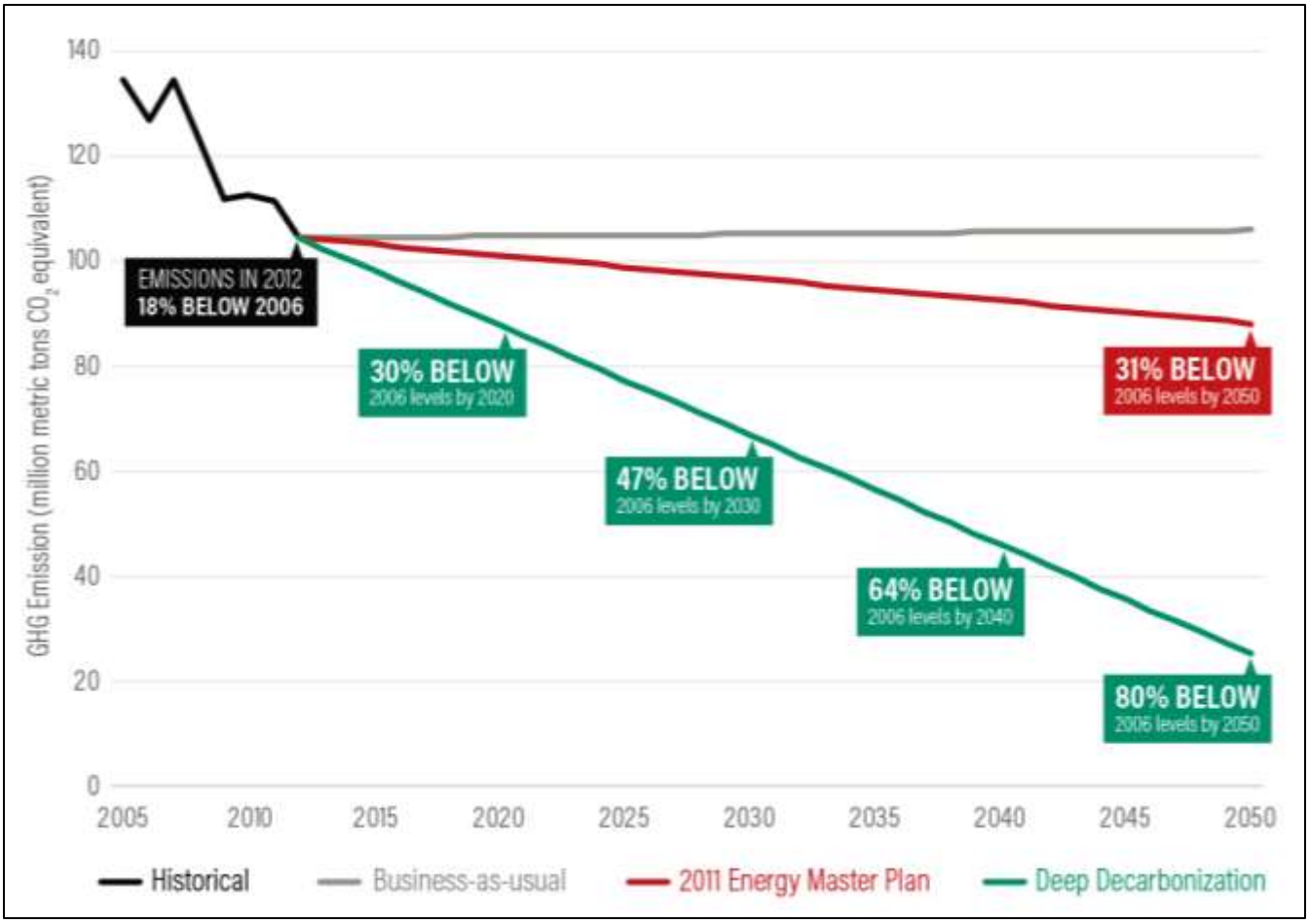
In December 2015, nearly all countries of the world reached an agreement in Paris to avoid the most severe risks of climate change by limiting the increase in the global average temperature to "well below" 2 degrees Celsius above pre-industrial levels, and "pursuing efforts to limit the temperature increase to 1.5 degrees" Celsius. Achieving the goals of the Paris Agreement will require a rapid decline in global GHG emissions to or near "net zero global emissions" (i.e., the balancing of emissions sources and sinks). Recent modeling suggests that if global emissions peak in 2030 and decline at a consistent pace thereafter until achieving net zero emissions by 2080, that pathway will result in a roughly two-thirds probability of limiting warming to two degrees Celsius.

The international community has long recognized that all countries cannot be expected to decarbonize at the same pace, and the Paris Agreement states that countries have "common but differentiated responsibilities and respective capabilities, in light of different national circumstances." Simply put, this means if the world is going to decarbonize successfully, relatively wealthy countries like the United States will need to lead the way. The United States under President Barack Obama committed to achieving emissions reductions of 26 to 28 percent below 2005 levels by 2025, and charted pathways for achieving reductions of 80 percent or more below 2005 levels by 2050, putting the country on a pathway to achieve net zero GHG emissions before 2060. Many other developed countries have outlined similarly ambitious long-term emissions objectives. However, the United States is not currently on a trajectory to achieve these targets, and President Donald Trump has announced that he will withdraw the United States from the Paris Agreement and has taken action to roll back federal climate policies. Given these trends, there are significant opportunities for U.S. states and cities to lead development of sound climate mitigation policy. (Many states, cities, and business leaders have declared their commitment to action on climate change and the goals of the Paris Agreement.)

No "rule of thumb" exists for how to apportion a U.S. state's responsibility to reduce GHG emissions, but if the country as a whole is to achieve deep decarbonization by mid-century, dramatic cuts in emissions in all states over the coming decades are needed—a trajectory of flat or incremental emissions reductions is insufficient. Fourteen U.S. states have adopted mid-century targets to reduce emissions by 75 percent or more, but few have developed comprehensive plans, nor implemented specific policies, designed to drive the emissions reductions needed to achieve those mid-century targets.

As described above, New Jersey has established a statewide limit to reduce emissions 80 percent below 2006 levels by 2050; New Jersey's 2050 limit is similar to the low end of the U.S. long-term vision to reduce GHG emissions by 80 percent or more below 2005 levels by 2050. Although the New Jersey Department of Environmental Protection has described a broad vision for an emissions pathway consistent with the 2050 limit, that vision does not have a detailed and comprehensive long-term strategy, and its emissions trajectory under current policies is inconsistent with the 2050 limit (see Figure I.B.-1).

Figure I.B.-1: New Jersey Greenhouse Gas Emissions Pathways to 2050



Notes: Historic data from the 2012 Update to New Jersey's Statewide Greenhouse Gas Emission Inventory.

Each of the three projections scenarios are straight-line pathways from 2012 emissions to the 2050 results from the NJ Department of Environmental Protection's 2050 GHG Emissions Scenario Report. "Business-as-usual" is the grey scenario; "2011 Energy Master Plan" (EMP) pathway is the red scenario; Deep Decarbonization Pathway is the green scenario.

Deep Decarbonization Pathways

Absent a policy that places an economy-wide cap on emissions, detailed planning, such as that envisioned in New Jersey's Global Warming Response Act, is required to understand the set of policies, technologies, and economic conditions that will combine to achieve a given long-term emissions limit, such as New Jersey's 2050 limit. For this reason and others, the Paris Agreement encourages countries to develop pathways to deep decarbonization, and in recent years the United States, other governments, and independent analysts have conducted such studies.

The United States Mid-Century Strategy for Deep Decarbonization (U.S. MCS), submitted by the U.S. Government to the United Nations in November 2016, demonstrates various ways the country can achieve a low-GHG emissions pathway while meeting the growing demands on its energy system and lands, maintaining a thriving economy, and ensuring a just transition for Americans whose livelihoods are connected to fossil fuel production and use.

The U.S. MCS emphasizes three broad categories of action: (1) transitioning to a low-carbon energy system; (2) sequestering carbon through forests, soils, and CO_2 removal technologies; and (3) reducing non-CO_2 emissions. The energy system pathway consists of an initial focus on improving energy efficiency and decarbonizing the electricity sector, where many low-cost and low-carbon opportunities exist today and more will become cost effective as low carbon generation sources and enabling technologies (e.g., energy storage, grid flexibility) continue to progress. The energy transition is propelled by policies that promote innovation, encourage more efficient energy production and use, and put a price on carbon dioxide emissions. The strategy for sequestering carbon focuses on policies and incentives that create larger and more productive forests, but also stresses the importance of improving crop yields and soil carbon sequestration, as well as smarter urban development. Strategies for reducing non-CO_2 GHG emissions vary due to the diversity of emissions sources, but a common theme is the need for technological innovation to identify low-carbon and low-cost alternatives to major sources of methane, nitrous oxide and hydrofluorocarbon (HFC) emissions.

From the U.S. MCS and other decarbonization studies, general themes have emerged that are applicable regardless of jurisdiction:

- There are many pathways to deep decarbonization, including pathways that do not require major technological breakthroughs.
- Innovation in low-carbon technologies leads to a more rapid pace and a lower cost of decarbonization.
- Certain low-carbon technologies and strategies are emphasized in nearly all pathways to decarbonization, including energy efficiency improvements across the economy, increased usage of solar, wind and sustainable bio-energy, and increased electrification of energy end-uses.
- Technological innovation alone will not lead to deep decarbonization. Strong policies, such as a price on greenhouse gas emissions and/or regulations of major emitters, are needed to drive deep reductions in greenhouse gas emissions.
- The economic costs of decarbonization are highly dependent on policy structures, with strategies that include flexible and comprehensive policies such as economy-wide carbon prices producing the most beneficial economic outcomes.
- The sooner climate policy action is implemented, the cheaper it is to achieve a given emissions target.

While each of the general lessons listed above apply to New Jersey, the pathways to deep decarbonization in New Jersey will depend on the specific circumstances of the state, including differences in sources of emissions. For example, emissions from electricity generation were responsible for just 20 percent of total emissions in New Jersey in 2012, compared to 35 percent for the United States, largely due to the state's reliance on nuclear power for electricity. In contrast, New Jersey emissions come more heavily from mobile sources and from direct fossil fuel use in homes and businesses than in many other states.

New Jersey also has distinct opportunities to achieve deep decarbonization. About half of electricity production is already from zero carbon sources (primarily nuclear energy) and the coastline gives New Jersey the opportunity to generate electricity with off-shore wind. While off-shore wind is not a contributor to the state's electricity system today, the New Jersey Department of Environmental

Protection (NJDEP) projects the state could deploy up to seven to eight GW of electricity capacity by 2035, representing nearly 40 percent of the state's current total electricity capacity. Moreover, as a densely-populated state, New Jersey is seeing benefits from pursuing "smart growth" strategies such as improved urban development, well-developed mass transit, and shared mobility, which can reduce demands on both the energy system and lands and yield important co-benefits including advancing livable communities, and promoting environmental justice.

By implementing strong, comprehensive and flexible policies that encourage reductions in GHG emissions, and by supporting the emergence of a broad range of low-carbon technologies, New Jersey can take important and cost-effective strides toward a pathway to deep decarbonization. While it has proven difficult for New Jersey and other states to adopt ambitious climate change policies in the past, rapid advances in clean energy technologies have made decarbonization increasingly cost-effective and politically feasible, and these trends are likely to continue going forward.

I.C. State Policy Models and New Jersey Legal Authority

In the United States, states have historically been leaders in developing and implementing climate and clean energy policies. States have led the way by developing policies to cap GHG emissions, promote renewable energy and energy efficiency, drive cleaner vehicles and fuels, support more compact land use, and reduce methane and other highly warming gas emissions, among others.

In Section IV, this report highlights different state policy models in a variety of areas that may be of interest to New Jersey policy makers, and highlights notable implementations, recent developments, and types of benefits that may accrue. The strategies for emissions reductions center on those sectors that are the largest contributors to GHG emissions in New Jersey.[1]

The report also considers in Section V what types of policies New Jersey may be able to implement or strengthen within the authority of existing laws. This includes analysis of New Jersey's Global Warming Response Act (GWRA), Global Warming Solutions Fund Act (GWSFA), the Department of Environmental Protection's enabling legislation, Air Pollution Control Act, and the Electric Discount and Energy Competition Act. This analysis provides a high-level review of these authorities, and does not analyze whether any specific policy proposal could be implemented. It should not be taken as an authoritative legal opinion.

In this executive summary, we have combined the two elements below, highlighting notable state policy models that may be of interest to New Jersey and identifying opportunities that New Jersey may have to implement policies under existing authority under the laws analyzed in Section V.

Setting Interim Reduction Targets and Establishing GHG Planning Processes

Like many states, New Jersey set a near-term limit for 2020 and a long-term limit for 2050. Setting interim goals—as well as planning how to meet those goals and reporting on progress—can be important steps for identifying and implementing policies that will be necessary to achieve long-term decarbonization by mid-century.

[1] Sectors not addressed herein include: agriculture; industrial non-fuel emissions (other than halogenated gases, which are addressed in this report); and waste management.

Ten states and the District of Columbia have recently established interim GHG emission reduction goals for years 2025 to 2035, and the New England Governors and Eastern Canadian Premiers have set a 2030 regional goal. Several states, including California, Maryland, and Massachusetts, have established processes that require comprehensive planning and reporting on progress.

State Policy Model	*Notable Implementations*[2]	*Related New Jersey Actions?*	*Notes*
Interim GHG goal	CA, CO, DC, DE, MD, MN, NH, NY, RI, VT, WA have set interim targets, as has the New England region	No	
Comprehensive GHG planning, reporting, and progress tracking	CA, MA, MD	GWRA requires GHG emissions monitoring and biennial reporting and progress tracking	NJ did not adopt the GHG emissions monitoring and reporting regulations called for by the GWRA

Emission Budget and Carbon Pricing Policies

Policies that limit emissions of greenhouse gases by establishing an emission budget or setting a price on emissions introduce a market-based approach rather than specifying how reductions will be achieved. These policies drive private-sector changes to reduce emissions to meet the budget or respond to the carbon price. Most of these programs either directly require emitters to pay a price for each ton of GHG pollution they emit, or indirectly create such a price.

Among these policies is the Regional Greenhouse Gas Initiative, which has helped participating states in the northeast and mid-Atlantic achieve dramatic reductions in power sector emissions— a 45 percent reduction in emissions from 2005 levels—with one study finding that the program has also provided net economic benefits of $1.3 billion, a net gain for consumers of $460 million saved through lower energy bills. Other states are implementing variations on this model. California has implemented an economy-wide cap-and-trade program that includes the transportation sector and large industrial sources, and Washington has implemented caps on large sources as well. Recently, Virginia Governor Terry McAuliffe directed the state to develop an electric power sector GHG emission reduction program that could potentially link with existing cap-and-trade programs, such as RGGI. Several northeast and mid-Atlantic states are also exploring regional market-based policies to reduce transportation-sector emissions through the Transportation and Climate Initiative. New Jersey has existing legal authority under the Global Warming Response Act and Global Warming Solutions Fund Act and other statutes to rejoin RGGI, or potentially to join another cap-and-trade program or create a stand-alone program.

Another potential policy model, a carbon tax, has been implemented in Canada and has been proposed in several northeastern states. The organization operating the PJM electricity grid—which New Jersey is a part of—has put forward a proposal to implement a carbon price on the wholesale electricity market. Several states are now incorporating the social cost of carbon (SCC) emissions into regulatory proceedings. The SCC is a metric that estimates in dollars the long-term climate-related costs of an

[2] Note that "notable implementations" shown here – and throughout this report – do not represent a global picture; rather, they are limited to example policies and programs in the United States and Canada.

incremental ton of carbon dioxide in a give year and includes impacts such as changes in agricultural productivity, human health, property damages from increased floods, and energy system costs.

Finally, the federal Clean Power Plan (CPP), promulgated in 2015, requires states to adopt an emissions budget to reduce the absolute level of power-sector GHG emissions – or an emissions rate-based program in order to reduce the carbon emissions intensity of electric power generation. The CPP includes provisions allowing programs that could be linked with other states. The Supreme Court has stayed this rule, however, and President Trump issued an energy independence executive order that instructed EPA to review the CPP and take steps to roll back or rescind the rule.

State Policy Model	*Notable Implementations*	*Related New Jersey Actions?*	*Notes*
Emissions budget programs	RGGI; CA's economy-wide cap-and-trade program; WA's clean air rule	NJ joined RGGI in 2009, but withdrew in 2012	Under existing authority, New Jersey could rejoin RGGI or another emission budget program VA is developing a power sector emission budget program that is able to trade with other states
Taxing carbon emissions	British Columbia, Alberta and Canadian federal government; Boulder, CO Legislative proposals in CT, MA, RI, and NY	No	
Emerging policy ideas	TCI work on market-based policies PJM's electricity grid carbon pricing proposal	No	New Jersey participates in the Transportation and Climate Initiative but did not join a 2015 announcement of work on market-based policies New Jersey is part of the PJM electricity grid, which is considering this proposal
Social cost of carbon in regulatory and planning processes	IL, CA, CO, MA, NY, MN	No	New Jersey does not consider social cost of carbon currently but could explore establishment in regulatory planning processes (e.g., Executive Order 215; BPU regulatory programs, Economic Impact Analysis under NJ Administrative Procedures Act)

Power Sector Strategies for Reducing Emissions

The electric power industry, referred to here as the power sector, generates the electricity that provides power to homes and businesses. The power sector in the United States is largely powered by carbon-emitting fossil fuels, such as coal and natural gas, and the sector is the second largest source of carbon emissions in the U.S. economy. Transitioning to a low-carbon energy system is one of the primary strategies for achieving deep decarbonization described in Section III, and decarbonizing the electricity system is a critical pathway within that strategy. Policy options for decarbonizing the power sector include encouraging deployment of clean energy and energy efficiency and reforming the electricity grid. States are moving forward with a number of policies that could be models for New Jersey to promote clean energy and energy efficiency in the power sector, including the following:

Strengthened Renewable Portfolio Standards (RPS). States around the country are now increasing the ambition of their RPS policies, for example: with California setting a 50 percent renewable goal by 2030, Oregon a 50 percent goal by 2040, Vermont a 75 percent target by 2032, and Hawaii a 100 percent target by 2045. New Jersey has an RPS of 20.38 percent with a 4.1 percent solar carve out. The New Jersey Board of Public Utilities (NJBPU), has authority under the Electric Discount and Energy Competition Act to increase the RPS through rulemaking.

Policies to support nuclear as a zero-emitting electric power source. Two states that rely on nuclear power as part of their generation mix have recently implemented policies to maintain the operation of these units in what would otherwise be a challenging economic environment. New York and Illinois have both recently implemented "Clean Energy Standard" (CES) policies that will effectively provide compensation to nuclear generators reflecting the zero-emission nature of these generating resources. Other policies that set a carbon price on the power sector—including cap-and-trade—can similarly help nuclear power plants remain economically viable in competetive wholesale markets if the carbon price is high enough.

Energy Efficiency Portfolio or Resource Standard (EEPS). New Jersey has been successful in achieving energy savings while growing its population and its economy, but other states are achieving higher levels of energy savings. One policy states are using to achieve savings are EEPSs—twenty-three states have implemented mandates requiring utilities to conserve a certain percentage of energy beyond business as usual every year. The Electric Discount and Energy Competition Act authorizes the NJBPU to implement an efficiency standard for electricity use and gas, but the NJBPU has not used this authority to date.

Other Policies to Support Clean Electricity and Energy Efficiency Technologies. The power sector is undergoing a dramatic transformation, thanks in part to the maturation of new technologies and innovations in service. States are using a variety of policies to drive change toward a cleaner grid. This includes policies that facilitate adoption of residential and commercial distributed energy resources (e.g., net metering and community solar policies), mandates for grid-scale energy storage that can help accommodate higher levels of renewable energy, and incentives for offshore wind. Some states have also changed the way that electric utilities are compensated, "decoupling" a utility's revenue from the quantity of electricity sales. One way that a number of states are seeking to comprehensively address these issues are through grid-of-the-future proceedings in Public Utility Commissions—proceedings that broadly consider how to revise electricity regulations to account for new technologies and opportunities, including the behind-the-meter electricity generation, smart appliances, electric vehicles, and energy storage.

State Policy Model	*Notable Implementations*	*Related New Jersey Actions?*	*Notes*
RPS	CA, NY, VT, and HI have established RPSs of 50 percent+	20.38 percent RPS + 4.1 percent solar carve out and a carve out for offshore wind	Pending legislation to increase solar carve out goal. NJPBU has a pending rulemaking to implement the offshore wind carve out.
CES/ZES	NY adopted CES; IL passed ZES; MA considering adopting CES	No	The NJ utility PSEG has said it may need a CES/ZES to keep its nuclear plants operating
Distributed generation	41 states have net metering policies MN expects to have 400 MW of community solar power by the end of 2017	New Jersey has a net metering regulation; BPU has discretion to cap at 2.9 percent of sales NJ has not implemented state level polices for community solar	As distributed generation deployment increases, PUCs are considering how to revise net metering policies—including the rate of revenue provided to distributed renewable owners and the size of the programs—to continue promoting distributed renewable deployment but also create a sustainable financial model
Energy efficiency as a resource	23 states have EEPS; CA, DE, and MA make efficiency highest priority resource	EDECA requires NJBPU to determine amount of energy efficiency to fund each year through social benefit fund proceeds	
EEPS	CA and IL recently strengthened EEPSs	NJBPU has statutory authority to adopt an EEPS through 2020, but has not adopted an EEPS	NJBPU declined in 2014 to adopt EEPS
Decoupling utility rate structure	19 states have electricity decoupling policies.	NJ has adopted decoupling for natural gas but not electricity	NJ may have authority to adopt decoupling for electricity. See discussion in Section V.
Grid of the future proceeding	NY, MD, MN, RI, CA have begun proceedings	No	NJ has authority through its Energy Master Plan statute and GWRA to address decarbonization of the electricity sector.
Energy storage	CA energy storage target for state's three largest utilities	New Jersey has implemented Renewable Electric Storage Program under EDECA authority	NJ program has led to installation 6,625 kWh of capacity; funded for $3 million in FY 2017.

Transportation Sector Strategies for Reducing Emissions

The transportation sector has consistently been the largest source of GHG emissions in New Jersey. In the United States as a whole, carbon dioxide emissions from transportation now exceed those from electric power for the first time since the 1970s.

Cutting emissions from the transportation sector presents unique challenges, in large part because of the large number and diversity of individual vehicles producing emissions. Strategies to reduce emission from the transportation sector include the following:

Support for electric vehicles and infrastructure. Electrification of the transportation sector represents one of the greatest opportunities for reducing transportation-sector emissions. In 2006, New Jersey adopted California's Zero-Emission Vehicle (ZEV) mandate, which requires automakers to sell an increasing percentage of electric vehicles through 2025. However, the California regulations are effectively non-binding in non-California states until 2018, so New Jersey has the opportunity to see more impact from this policy in the near future. To provide additional certainty regarding the growth of the EV market, California and seven other states signed the ZEV Memorandum of Understanding and established an EV adoption target for each state. New Jersey has not signed the ZEV MOU. One of the most effective policies to increase ZEV sales is a consumer purchase incentive. Twenty-one states and DC have implemented a vehicle purchase incentive (some, like New Jersey, have a sales tax exemption, and others offer purchase rebates or tax credits). Some states have designed incentives to increase equitable access to clean transportation by offering additional ZEV purchase incentives for low-income residents. To lead by example, many states have set public fleet electrification goals or requirements through multi-state initiatives or through executive order. To grow the network of EV charging infrastructure, states provide incentives for the installation of EV chargers in homes, workplaces, and for public use. New Jersey implemented the *It Pay$ to Plug In* workplace charging incentive program, but the program has disbursed all available funding and is no longer providing rebates. To prepare for widespead electrification, many electric utilities are increasing support for EV charging by proposing utility investments in EV charging infrastructure through approval of public utility proceedings through approval of public utility proceedings.

Clean fuels policies that promote less carbon-intensive fuels. California and Oregon have both implemented programs that require fuel manufacturers to sell increasingly less carbon-intensive fuels on a life-cycle basis. These policies promote the use of advanced biofuels and reduce reliance on high-carbon-intensity petroleum fuels (i.e., tar-sands oil) while also minimizing life cycle emissions for all transportation fuels.

Policies that reduce carbon intensive travel. Encouraging more compact land use (i.e., smart growth), installing bike lanes and pedestrian paths, expanding public transportation, and promoting the shared usage of vehicles all have the effect of reducing the carbon intensity of travel (by reducing *vehicle miles traveled*—or VMT—for passenger vehicles). New Jersey has policies that have the effect of reducing VMT, such as a Complete Streets Policy, and engages in long-term transportation and land use planning at the state, regional, and local levels, but some states have established policies that go further to link such strategies with GHG outcomes. For example, California and Oregon (for the Portland region) have established GHG emission goals for metropolitan regions and require that governments develop transportation and land use plans to meet these goals, building on the transportation planning

requirements established by federal law. California also supports implementation of these plans with funds from its cap-and-trade program. In another model, New York has developed a $100 million grant program to promote regional and local planning that is consistent with its economy-wide GHG goal, funded through RGGI proceeds. States have also implemented policies intended to target state funding or incentives in a way that is consistent with state plans or policies, and which aim to promote infill and avoid sprawl. Finally, some states have implemented environmental reviews of infrastructure projects that require developers to take into account transportation-related GHG emissions, with a notable program in Massachusetts.

Reducing Freight Emissions. Emissions from freight can be reduced by shifting from trucks to cleaner modes such as rail or ship, using lower-carbon fuels such as electricity, adopting policies, such as speed limits, to promote fuel conservation, and increasing on-road fuel efficiency through automated truck platooning. Both New Jersey's Statewide Freight Rail Strategic Plan and its 2007 Statewide Freight Plan include priorities that would shift freight from truck to rail or ship. Eight states have lower highway speed limits for trucks than for light-duty vehicles, which has the effect of conserving fuel.

Black Carbon, a contributor to climate warming, is a major component of soot emitted in the form of fine particulate matter, known as PM 2.5. Since most U.S. emissions of Black Carbon are from mobile sources, especially diesel engines in onroad vehicles (e.g., trucks and cars) and nonroad equipment (locomotives, small generators, and construction equipment), reducing Black Carbon through reductions in diesel emissions and other co-pollutants including air toxics have substantial benefits to public health that often exceed the costs of control.

State Policy Model	*Notable Implementations*	*Related New Jersey Actions?*	*Notes*
Adopt CA GHG, ZEV standards and join MOU	CA, MD, MA, NY, OR, RI, VT adopted GHG, ZEV standards and joined MOU	NJ adopted GHG and ZEV standards but has not signed ZEV MOU NJ does participate in the TCI EV workgroup which is collaborating on increasing EV charging capacity in the region	ZEV MOU establishes EV deployment goals for each participating state and states jointly work to support meeting goals
Electric vehicle incentives	Drive Clean Rebate in New York State. California Clean Vehicle Rebate Project Maryland's Electric Vehicle Supply Equipment Tax Credit Program. Colorado's Innovative Motor Vehicle Credit	NJ does not offer a consumer rebate, but does exempt ZEVs from sales tax New Jersey implemented *It Pay$ to Plug In* workplace charging incentive program, but the program has allocated all available funding and is no longer providing rebates	Many states provide funding for residential, workplace, and public vehicle charging. The California Clean Vehicle Rebate Project is designed to provide more equitable access to clean transportation by providing an additional vehicle purchase incentive for lower-income residents and limiting the rebate for high-income earners.
Low-Carbon or Renewable Fuel Standard	CA's Low Carbon Fuel Standard (LCFS); OR Clean Fuels Program	No	The CA LCFS complements CA's cap-and-trade system by promoting development of low-carbon-emission transportation fuels Northeast Clean Fuels Standard not currently moving forward.
State transportation and land use planning policy that identifies regional GHG targets and provides support for implementation	CA's Sustainable Communities and Climate Protection Act (S.B. 375) NY Cleaner, Greener Communities	NJ has a long history of growth management and smart growth, but has not integrated GHG considerations to the extent of other states	Despite robust state planning law, NJ state plan has only been updated once. NJ a leader in "complete streets"
Environmental review policy that incorporates GHG impacts	MA Environmental Policy Act	No	New Jersey Department of Environmental Protection's NJDEP permit readiness checklist used to implement NJ Executive Order 215 addresses green design, air quality and renewable energy considerations but does not address GHG impacts.

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State Policy Model	Notable Implementations	Related New Jersey Actions?	Notes
Freight improvement	Lower highway speed limits for freight trucks in 8 US states	No	Mode-shifting freight from truck to train or ship has been proposed in several NJ government plans, but not implemented
EV-ready building codes	New York City	No	New York City amended its building code in 2013 to require any parking garage or parking lot that is expanding electrical service to install electrical capacity sufficient to support EVSE to 20 percent of parking spaces
Programs to inventory and address black carbon emissions in onroad and offroad mobile sources	CA has developed a statewide emission inventory for black carbon in support of its proposed Short-Lived Climate Pollutant Reduction Strategy and a goal of 50 percent reduction in anthropogenic black carbon from 2013 levels by 2030. In 2017, CA adopted regulations to accelerate efforts to turn-over on-road diesel engines to cleaner engines by requiring diesel trucks and buses that operate in California to be upgraded to reduce emissions.	New Jersey implemented the 2005 New Jersey Diesel Retrofit Law to address school buses, solid waste vehicles, commercial buses, publicly owned onroad vehicles and large publicly owned nonroad vehicles. In 2011, New Jersey Governor Christie signed Executive Order 60 which established a pilot program to reduce emissions from private nonroad diesel powered equipment used in selected publicly funded state construction contracts	Black Carbon emissions are not included in the New Jersey GHG inventory, New Jersey Global Warming Response Act defines Greenhouse Gas to include an identified list of gases as well as *"any other gas or substance determined by the Department of Environmental Protection to be a significant contributor to the problem of global warming."* Black Carbon is not monitored as an individual pollutant as part of New Jersey's National Ambient Air Quality Standard monitoring network

Strategies for Reducing Emissions Through Building Efficiency and Systems

According to the 2012 New Jersey Greenhouse Gas Inventory, commercial and residential buildings together accounted for 22.2 mmtCO2e or 21.2 percent of New Jersey's greenhouse gas emissions. There are many possible policies that New Jersey could undertake to help reduce emissions through improving the energy performance of its building stock, including benchmarking, point of sale measures, code changes, and formation of an Energy Code Collaborative.

For example, one emerging practice in strengthening building energy code compliance is to form statewide collaborative efforts focused on code compliance such as state Energy Code Compliance Collaboratives, developed by the non-profit Building Codes Assistance Project (BCAP). The benefits of these Collaboratives include providing: a source of local experts to support state entities that are struggling with declining resources, a forum for dialogue among stakeholders affected by energy codes, and enhanced capacity to advance full compliance with energy codes.

Additionally, benchmarking serves as a mechanism by which the energy performance of a single building can be measured over time relative to similar buildings or a specific standard. Jurisdictions with mandatory benchmarking ordinances include New York City; Philadelphia, Washington, DC; Austin, TX; and the states of California and Washington, among others. New Jersey has not adopted mandatory benchmarking provisions.

State Policy Model	*Notable Implementations*	*Related New Jersey Actions?*	*Notes*
Building energy benchmarking disclosure ordinance – typically for existing commercial buildings including multi-family, but can include single-family or multi-family low-rise residential buildings.	New York City; Philadelphia, Washington, DC; Austin, TX; California; Washington have established mandatory benchmarking provisions	New Jersey's Clean Energy Program (NJCEP) offers a free voluntary benchmarking program for commercial (including multifamily) & industrial building sectors. As a result, limited building performance data are available on NJCEP's website	Benchmarking disclosure ordinances are considered transformational in that they generate publicly-available data on energy use and costs by building, which in turn informs real estate market decision-making. This is an example of a regulation that helps markets to function more efficiently. Additionally, these detailed building baseline studies provide data that can target public investment and other policy strategies.
Point of sale measures –typically implemented for single-family or low-rise multi-family residential buildings	Kansas; Ann Arbor, Michigan; Davis, California	Some listing services and real estate brokers are beginning to share more energy performance information with potential buyers of properties	This is essentially energy disclosure for the residential marketplace, providing better information to real estate market decision-makers typically framed in code compliance terms.
Building regulations to curtail energy use during peak load. Beyond voluntary/market-based measures, building code regulations can help manage peak energy demand. Relevant measures include demand response smart grid building systems, and renewable energy requirements, either grid-tied or distributed (e.g., battery storage). An additional area of focus in newer building codes, which can help address peak load, is building energy plug load.	14 states and the District of Columbia have adopted the International Green Construction Code (IgCC), a model code for new and existing buildings. The IgCC includes a provision for demand response and for renewable energy at the building or site level. These provisions are more practical for new buildings, although can be applied in some cases of existing building improvements.The IgCC also includes provisions to help manage plug load.	NJ has a voluntary market-based demand response program and also incentivizes the use of building-tied renewable energy systems. In January 2008, NJ enacted legislation mandating the use of high performance green building standards in new construction of state-owned commercial facilities. This legislation did not directly address demand response or other peak load strategies	NJ does not have a green building code to govern private sector buildings. However, the NJ Legislature authorized the creation of the New Jersey Green Building Manual to define baseline performance for green buildings and to provide best practice guidance to owners and builders. Associated policy recommendations included expedited permitting for privately-owned buildings that adhere to green building guidelines or a green building code, including the IgCC. A version of this recommendation was introduced on May 8, 2017 to the NJ Legislature as S3129.
Adoption of a building code amendment concerning energy saving opportunities that may result when the use of a building changes (in commercial buildings). Change of occupancy is a natural inflection point for public policy seeking to reduce energy use by leveraging significant building investment.	Jursidictions that adopt the IECC model code for existing commercial buildings have a "change of occupancy" requirement for when a change in building use involves increased use of fossil fuel or electrical energy. However, this provision is poorly defined, poorly understood and inconsistently enforced. Rutgers Center for Green Building developed alternate language for this requirement that can be use to amend either the IECC or ASHRAE 90.1 An example of a jurisdiction that is adopting this improved language and requirements for the "change of occupancy" provision is Washington, DC. Seattle, Washington also has amended this area of its building code.	NJ's Rehabilitation Subcode for existing commercial buildings, which is based on ASHRAE 90.1, does not contain a change of occupancy requirement nor does it require an existing buiding to which work is being done to meet the new building requirements of the current code (e.g., ASHRAE 90.1), with the exception of 4 specific alterations	At the time that the NJ Rehabilitation Subcode was written, a main concern was to incentivize the use of existing assets, without overly burdening the property owner in terms of cost. Thus, many energy code requirements were excluded. Change of occupancy is one of several areas of the existing building code for commercial buildings in NJ that could be re-considered in seeking further energy savings opportunities.
Energy Code Collaborative to increase compliance with energy codes and promote market transformational policies.	There are many examples of codes collaboratives – e.g., TX, PA, DE, NH, VT, KY, MN. Additionally, there are 6 Regional Energy Efficiency Organizations (REEOs) that address energy codes, of which NEEP is the organization that covers the mid-Atlantic and New England states.	NJ does not have a dedicated codes collaborative. Some NJ stakeholders (including members of the NJ DCA Division of Codes and Standards and Rutgers Center for Green Building) participate in broader regional codes meetings organized by NEEP or US DOE	Energy code collaboratives require dedicated funding. Typically, this is provided by utilities, a board of public utilities, and/or foundation(s) interested in energy conservation. REEOs receive some portion of their funding from the US Department of Energy. The Building Codes Assistance Project (BCAP), also funded by US DOE, works closely with the energy code collaboratives and the REEOs. Other organizations that collaborate with BCAP and the REEOs include the Institute for Market Transformation and the New Buildings Institute.

Methane Emissions

States currently take a variety of approaches to reducing methane emissions from oil and natural gas infrastructure. However, the motivations for and approaches to policy vary depending on the characteristics of emissions sources and the nature of underlying regulatory authorities. Whether motivated by a desire to increase public safety, improve air quality, or reduce greenhouse gas emissions, existing state policies address methane emissions from all four major stages of the natural gas supply chain—production, processing, transmission and storage, and distribution. While an estimated 80 percent of life-cycle GHG emissions from the natural gas sector are released in the form of CO_2, at the point of combustion, methane emissions from the supply chain represent a significant, and often cost-effective, opportunity for GHG emissions abatement.

State rules to reduce emissions from the oil and natural gas sectors are designed primarily to improve air quality through reductions in volatile organic compound (VOC) emissions; however, methane emissions abatement is also a stated goal for the policies in California and Colorado. Furthermore, utility commissions in California and New York have recently approved new programs in which local distribution companies (LDCs) are using advanced sensing technologies to help identify the largest leaks and prioritize pipeline repair and replacement programs. In California, the new program is part of a broader set of mandatory standards for reducing leaks from natural gas transmission and distribution infrastructure.

While New Jersey does not produce or process natural gas, the state has several high-pressure natural gas transmission pipelines and four natural gas LDCs. From the transmission segment of the natural gas supply chain, most emissions occur at compressor stations. From the distribution segment, most emissions are from pipelines made of leak-prone materials. New Jersey is home to 12.6 percent of the total remaining inventory of cast iron distribution main pipelines in the U.S., more than any other state in the country. There may be opportunities to achieve methane emissions mitigation through two strategies: 1) standards for emissions from new and existing transmission and distribution equipment, including compressor stations (e.g., leak detection and repair; LDAR) and 2) deployment by LDCs of advanced methane sensing technologies to help prioritize ongoing natural gas distribution infrastructure replacement efforts.

State Policy Model	*Notable Implementations*	*Related New Jersey Actions?*	*Notes*
LDAR and other requirements for new and existing transmission and distribution facilities	CA has mandatory standards for reducing leaks from natural gas infrastructure. CO requires LDAR at natural gas compressor stations		NJ has the authority to develop such regulations
Prioritize replacement of distribution pipelines	Utility commissions in NY and CA have approved such programs	PSE&G collaboration with EDF and Google	NJBPU has the authority to approve similar programs proposed by LDCs

Strategies for Other Highly Warming Gases

Highly warming gases trap heat in the atmosphere more effectively than CO_2 and scientists use the concept of *Global Warming Potential* (GWP) to compare the relative global warming effects of different gases. While these gases are only emitted in small amounts compared to CO_2, they have a significant and measurable contribution to climate change because of their high GWP. Highly warming gases accounted for 7.2 mmt CO_2e, or 6.9 percent of New Jersey's total greenhouse gas emissions in 2012 and include methane (discussed above), nitrous oxide and fluorinated gases. Fluorinated gases include hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF_6), and nitrogen trifluoride (NF_3). Fluorinated gases also include chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs), both of which are scheduled for phase out under the 1987 Montreal protocol. In New Jersey, most of the emissions of halogenated gases are associated with their uses in, and releases from, air conditioning and refrigeration systems. Sulfur hexafluoride (SF_6) is also a halogenated gas but has been treated separately in New Jersey GHG emission inventories due to its specialized uses as an insulating fluid in high voltage electrical equipment. Increases in HFCs, PFCs, and SF_6 and NF_3 emissions have been the fastest growing source of greenhouse gases globally, given their use as a replacement for CFCs and HCFCs. In October 2016, nearly 200 countries adopted an amendment to the Montreal Protocol in Kigali, Rwanda, to globally phase down HFCs not previously covered under the 1987 Montreal protocol, namely HFCs, PFCs, SF_6 and NF_3. Some states have instituted policies to mitigate emissions of highly warming gases. Those policy types include multisector greenhouse gas emissions standards, reporting regulation, pollution-specific regulations, and offset programs. Of note is a comprehensive strategy developed by California in 2017 to address highly warming gases which lays out a range of options to accelerate emission reductions including regulations, incentives, and mechanisms to transition markets to other gases.

State Policy Model	*Notable Implementations*	*Related New Jersey Actions?*	*Notes*
Multisector greenhouse gas emissions standards that include highly warming gases	WA Clean Air Act, CA Global Warming Solutions Action	No	Not all cap-and-trade programs include highly warming gases under the cap (e.g., RGGI only covers CO_2).
Highly warming gas pollution-specific regulations	MA Global Warming Solutions Act regulations on SF_6 emission from insulated switchgear	No	
Offset programs for highly warming gases	RGGI offset protocol for highly warming gas capture, storage, destruction, and recycling	No	
Reporting regulations	WA, MA, CA	GWRA requires GHG emissions monitoring and biennial reporting and progress tracking	NJ did not adopt the GHG emissions monitoring and reporting regulations required under the GWRA. Reporting regulations are usually a necessary precursor to policies to reduce highly warming gas emissions.
Comprehensive HWG reduction strategy	California has adopted a comprehensive Short Lived Climate Pollutant Reduction Strategy which sets statewide targets of reducing methane and HFCs by 40 percent below 2013 levels by 2030 and reducing anthropogenic black carbon 50 percent below 2013 levels by 2030.		

Forestry Practices

Carbon sequestration is the process in which forests and other natural systems remove CO_2 from the atmosphere and absorb and store it. Natural systems that serve as carbon "sinks" by sequestering CO_2 include trees and coastal wetlands. According to the US Forest Service, U.S. forests serve as carbon sinks offsetting approximately 13 percent of U.S. fossil fuel emissions in 2011 and from 10 to 20 percent of U.S. emissions annually. The 2015 New Jersey Greenhouse Gas Inventory indicates that 7.6 percent of New Jersey's total greenhouse gas emissions are sequestered terrestrially each year.In general, states, including New Jersey, maintain programs that are designed to restore and steward natural resources such as New Jersey's Green Acres and Community Forestry programs but there are limited programs in which policies to create and/or steward natural carbon sinks are specifically established with a nexus to GHG emissions reduction.

However, several states have implemented policies that promote new forests (i.e., afforestation) or support reforestation, improve forest management with the specific intention of increasing carbon stocks on forested land, help avoid conversion of forest land to non-forest land, and reduce forest fire risk. For example, the California Greenhouse Gas Reduction Fund (GGRF) was established by statute in 2012 to deposit and distribute proceeds from cap-and-trade auction allowances. To date, $49 million has been invested in the Forest Health Program that includes: stewardship, reforestation and fire risk reduction. An additional $33 million has been invested in urban and community forestry that includes planting and maintaining trees in disadvantaged communities. RGGI states such as Delaware and Massachusetts have broad statutory authorization to expend auction proceeds on initiatives that result in verifiable and quantifiable emission reductions under which forestry related practices could be applied; New Jersey's GWSFA provides statutory provisions for forest and tidal marsh restoration. Washington State's Wildlife and Recreation Program has adopted a forestland preservation grant fund, which provides funding for forest projects, including land acquisition and enhancement and restoration initiatives. Some states are beginning to use their environmental quality review laws to address impacts on GHG emissions from land clearing as well as carbon sequestration potential. Additionally, development of policies to promote carbon sequestration through creation and stewardship of natural resources is an active area of research and policy interest in several states.

State Policy Model	*Notable Implementations*	*Related New Jersey Actions?*	*Notes*
Financial incentives	WA's Wildlife and Recreation Program funds forest land conservation and restoration.	NJ Global Warming Solutions Fund Act provides statutory funding provisions for forest and tidal marsh restoration	Washington's program is based on the amount of carbon stored by forest trees.
Forestry offsets	CA's Cap-and-Trade program. RGGI has a forestry offset protocol, but has not been used.	No	Forestry offsets under RGGI have not been used due to low allowance prices; a higher offset price is available by selling into the California market
State Environmental Quality Review for forests	MA Global Warming Solutions Act requires that projects that result in extensive land alteration or forest clearing to plant new trees.	No	New Jersey Department of Environmental Protection's NJDEP permit readiness checklist used to implement NJ Executive Order 215 addresses impacts to over ½ acre or more of forested lands owned or maintained by a state entity but does not address GHG impacts.

Incorporating Equity Considerations and Addressing Needs of Vulnerable Populations

Several states are exploring ways to engage with stakeholders around environmental justice issues and address environmental justice (EJ) impacts as part of their climate policies. EJ stakeholders have voiced concerns that greenhouse gas reduction programs that include emission trading may lead to increases of conventional local pollutants—like ozone, nitrogen dioxide, and mercury—in areas that already have a disproportionate share of air pollution. In 2015, the USEPA issued a report in which it conducted a proximity analysis to assess demographic information in proximity of facilities that would have been regulated by the proposed Clean Power Plan. EPA found that a higher percentage of minority and low-income communities live near power plants than national averages. A 2017 study by the California Office of Environmental Health Hazard Assessment found that a disproportionate number of facilities subject to the state's Cap-and-Trade Program are located in disadvantaged communities and that GHG facilities that emit higher levels of GHGs tend to have higher emissions of toxic air contaminants and criteria air pollutants. National EJ advocates have outlined principles to advance climate change strategies that ensure that climate change policies address disproportionate environmental burdens that will be exacerbated by climate change. In addition, the New Jersey Environmental Justice Alliance has reported on the intersection of climate change and environmental justice in the state. Addressing environmental justice issues in the context of climate change mitigation is a relatively new area, but there are examples of federal and state action. These include establishing environmental justice policies that apply to climate actions, establishing advisory groups, identifying EJ communities, designing and implementing inclusive public processes, implementing programs designed to promote equitable benefits of clean energy and climate actions, and implementing programs designed to mitigate potential disparate impacts of climate actions.

State Policy Model	*Notable Implementations*	*Related New Jersey Actions?*	*Notes*
State environmental justice (EJ) policy, advisory council plan	MN, NY, CA have policies and advisory councils MN developed an environmental justice framework for 2015-2018	2009 NJ Exec. Order No. 131 (not rescinded) EO created Environmental Justice Advisory Council (EJAC)	EO required "appropriate opportunities" for input on decision making for all people; directed periodic EJ reviews of policies EJAC now meeting as NJDEP internal advisory council after charge in EO expired
Identify or define environmental justice communities	CA CalEnviroScreen 3.0 uses 20 indicators to identify census tracts most impacted based on pollution burden and population characteristics to inform delivery of climate change policies.		In 2009, the NJDEP developed an analytical methodology to determine communities disproportionately burdened by pollution but the methodology was not adopted.
Programs designed to promote equitable benefits of clean energy and climate actions	California law requires that a minimum of 25 percent of the proceeds from its cap-and-trade program be invested in projects that are located within and benefiting individuals living in disadvantaged communities; an additional 5 percent of funds benefit low-income households or communities statewide; and an additional 5 percent benefit low-income households or communities that are within a 1/2 mile of a disadvantaged community.		
Programs designed to mitigate potential disparate impacts of climate actions.	CA's AB 617 requires the California Air Resources Board to work with local air districts on the development of community-focused air quality monitoring networks, including plans to reduce emissions from stationary and mobile sources in neighborhoods with existing air quality burdens. It also requires large industrial facilities in communities with significant existing air quality burdens to upgrade equipment to reduce emissions.		

I.D. Discussion

New Jersey has already met its 2020 limit of returning to 1990 levels of emissions. This is due in part to significant reductions from the power sector, where a shift from coal to natural gas generation and an increase in renewables has cut emissions 42 percent since 2005. New Jersey's largest sector of emissions is the transportation sector, however, and transportation-sector emissions have increased 27.5 percent since 1990. This long-term increase is due largely to the continued rise in vehicle miles traveled, as the vehicles themselves are becoming more fuel-efficient. These two sectors account for approximately two-thirds of New Jersey's emissions—the next largest categories for emissions are from direct fossil fuel use in the residential, industrial, and commercial sectors, mainly for heating.

New Jersey has already taken some important steps toward addressing climate change. In addition to setting 2020 and 2050 limits, the state has promulgated regulations requiring large stationary sources to report CO_2 and methane emissions, and clarifying that CO_2 is an air pollutant that may be regulated under its Air Pollution Control Act, adopted California's GHG and ZEV standards for vehicles, established and then strengthened an RPS, authorized an offshore wind target, established a net metering program, adopted an energy master plan, and participates in the Transportation and Climate Initiative. The state was also a founding member of RGGI, but withdrew from the program in 2012.

In the United States, states have historically been leaders in developing and implementing climate and clean energy policies, and states have developed policy models for reducing emissions in every sector, as well as comprehensive policies for the entire economy. New Jersey may want to consider a variety of these policies in order to put itself on track to meet its 2050 limits. New Jersey may also be able to implement some of these policies through existing legal authorities. The reader should remember that this report is not an authoritative legal opinion; however, based on the review of existing authorities noted within this report, New Jersey may have latitude to advance some or many of the policy options discussed below.

Below are a set of suggested categories that may serve as a framework to guide consideration of the many policy options presented in this report. Note that **examples** from those policy options are cited to demonstrate how policy options can coincide with the categories; the authors are not making recommendations nor advocating for any particular policy option or suite of options.

1. Mid-term and long-term economy-wide planning.

Examples:

- Set an interim GHG emissions limit (e.g. 2030);
- Update the 2009 Global Warming Response Recommendations Plan[3] to meet a new statewide interim limit and long-range (2050) statewide limits;
- Establish a system for monitoring emissions and reporting on progress, such as the economy-wide emissions reporting provisions included in the Global Warming Response Act.

[3] New Jersey Department of Environmental Protection. 2009. Meeting New Jersey's 2020 Greenhouse Gas Limit: New Jersey's Global Warming Response Act Recommendations Report. http://www.nj.gov/dep/aqes/docs/njgrwa_final_report_and_appendices_dec2009.pdf (last visited July 21, 2017).

2. New statutory initiatives.

Examples:

- Economy-wide carbon pricing, such as legislation under consideration in Massachusetts that would return portions of the revenue to households and invest in actions that reduce greenhouse gas emissions and increase communities' preparedness for a changing climate;
- Constitutional dedication of revenues from the Societal Benefit Charge to efforts that reduce energy use, and/or greenhouse gas emissions, including in sectors such as energy, transportation, and natural resource stewardship;
- Explore the need for statutory decoupling provisions or determine other mechanisms necessary to remove the pressure on utilities to sell as much energy as possible by eliminating the relationship between revenues and sales volume to incentivize efficiency and conservation measures by utilities.
- Expanded authority to establish a binding economy-wide GHG enforceable emissions limit under which state policies, performance standards, and other programs operate.

3. Standard setting with opportunities for innovation and economic development.

Examples:

- Increase the state Renewable Portfolio Standard;
- Rulemaking pursuant to the Offshore Wind Economic Development Act to establish Offshore Wind Renewable Energy Credits;
- Establishment of an energy efficiency portfolio standard;
- Maximize use of existing authorities to address Highly Warming Gases in industrial, energy and refrigeration operations and monitor and address sources of Black Carbon;
- Align and enforce the state's current building codes with energy efficiency and demand response best practices as well as EV readiness (enforce code compliance, green building codes, energy benchmarking, point of sale disclosure, update change of occupancy requirement).

4. Multi-state approaches.

Examples:

- Join the ZEV memorandum of understanding with the other nine ZEV states and increasing incentives for ZEV purchase and use;
- Rejoin RGGI;
- Participate in the Transportation and Climate Initiative's ongoing consideration of multi-state market-based efforts to reduce greenhouse gas emissions in the transportation sector.

5. Climate change considerations in rulemaking and planning.

Examples:

- Establish a metric for monetizing the social cost of carbon and applying that metric in state rulemaking;

- Consider climate change impacts in statewide planning efforts (e.g., State Development and Redevelopment Plan, the Water Supply Master Plan, the Long-Range Transportation Plan, the Comprehensive Statewide Freight Plan, and the Energy Master Plan) for attaining any new interim and the 2050 limits;
- Consider climate change impacts, the social cost of carbon, and contributions to attaining any new interim and the 2050 limits in major investments of public monies, including infrastructure and economic development investments, development and redevelopment of state facilities, and Executive Order 215 Reviews;
- Consider climate change impacts, attainment of any new interim and the 2050 limits, and a social cost of carbon metric in review of filings at the Board of Public Utilities.
- Establish a program that could require or incentivize Metropolitan Planning Organizations to meet state or regional GHG emissions limits;
- Establish leak detection and replacement requirements for natural gas compressor stations and prioritize replacement of distribution pipelines.

6. Equity for populations especially vulnerable to climate change, including socially vulnerable populations and communities that are disproportionately burdened by environmental pollution.

Examples:

- Establish a more formal environmental justice policy and create programs that target benefits to environmental justice communities;
- Identify populations that are especially vulnerable to a changing climate and ensure that climate change mitigation programs, including but not limited to public investment in strategies to reduce greenhouse gas emissions and the establishment of regulatory standards, specifically address the needs of those socially vulnerable populations;
- Establish monitoring programs to ensure that state climate policies contribute to reductions of emissions in communities already disproportionately burdened by pollution.

I.E. Conclusion

Meeting the challenge of climate change will require dramatic reductions of emissions by mid-century, as recognized by 195 countries in the Paris Agreement. New Jersey's 2050 limit of reducing emissions 80 percent below 2006 levels by 2050 is consistent with the 2050 targets of other leading states and generally consistent with the Paris Agreement's standard of limiting global warming to well below two degrees Celsius. Achieving these reductions will require approximately 75 percent emission reductions from 2012 levels (the most recent year for which data are available).

The Paris Agreement encourages countries to develop pathways to deep decarbonization, and in recent years the United States, other governments, and independent analysts have conducted such studies. The deep decarbonization analysis conducted by the United States emphasizes three broad categories of action that will also apply to New Jersey: (1) transitioning to a low carbon energy system by cutting energy waste, decarbonizing the electricity system and shifting other energy uses to clean electricity or

other low carbon fuels; (2) sequestering carbon through forests, soils, and CO_2 removal technologies; and (3) reducing non-CO_2 emissions that contribute to global warming. New Jersey has certain unique emissions reduction opportunities, including the potential to generate energy from off-shore wind and to implement smart growth, transit, and shared mobility strategies. Another valuable opportunity for New Jersey is its location within the Mid-Atlantic and Northeast where there is considerable multi-state activity in addressing climate emissions (such as the Transportation and Climate Initiative and RGGI) which magnifies an individual state's impact on moving private markets to reduce GHG emissions.

New Jersey has an opportunity to build upon existing programs and authorities and incorporate thinking from current and emerging policies under development by other states to achieve the deep decarbonization necessary to reach a 75 percent reduction of its current GHG emissions necessary to meet its statutory limits for 2050.

II. Background: Emissions, Trends, and Prior Climate Actions

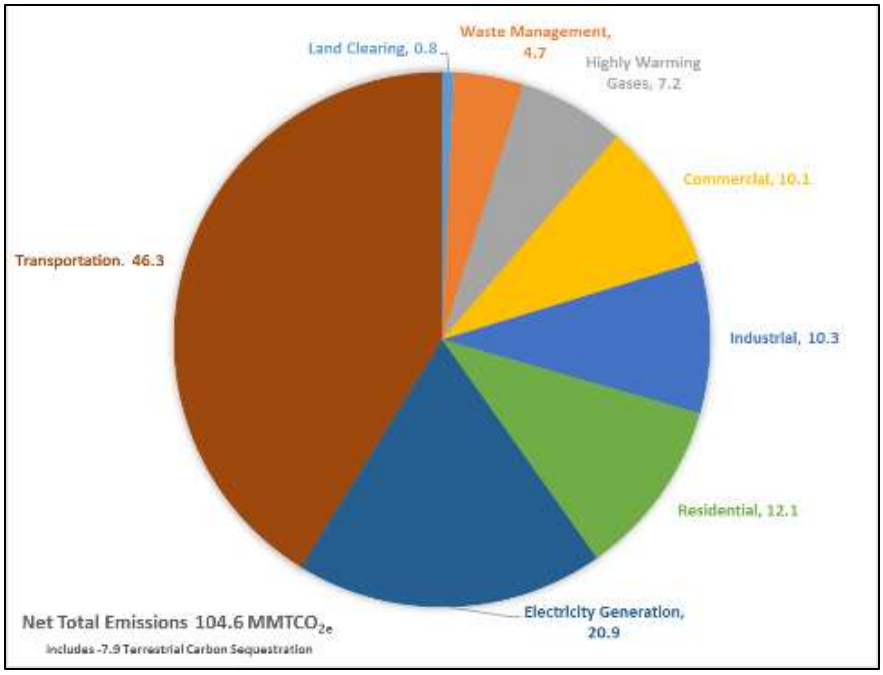
This section provides an overview of New Jersey GHG emissions and related energy trends for the power and transportation sectors, and also provides a summary of prior state actions to address climate change and promote clean energy and energy efficiency.

II.A. GHG Emissions from 2012 Inventory

In 2015, the Rutgers Climate Institute and Bloustein School released the *2012 Update to New Jersey's Statewide Greenhouse Gas Emission Inventory,* which used the same methodology as New Jersey's Statewide Greenhouse Gas Emission Inventory.[4] The 2012 inventory estimated statewide greenhouse gas emissions for 2010, 2011, and 2012, which were not yet available in state government documents. The 2012 inventory also discussed progress towards achieving the 2020 and 2050 greenhouse gas limits established by New Jersey's Global Warming Response Act.

The report found that emissions fell from 112.7 million metric ton CO_2-equivalent ($MMTCO_2e$) in 2010 to 104.6 $MMTCO_2e$ in 2012.[5] New Jersey's emissions in 1990—also the limit for 2020—were 125.6 $MMTCO_2e$, and the state has been below that level since 2008.[6] The report found that meeting the state's limit of an 80 percent reduction from the 2006 level by 2050 will require a 75 percent reduction from 2012 emissions.[7]

Figure II.A-1. Estimated NJ Statewide Greenhouse Gas Emissions, 2012.



Source: 2012 Update to New Jersey's Statewide Greenhouse Gas Emission Inventory (units are MMTCO2e).

As shown in Figure II.A.-1, the report also found that in 2012, the transportation sector was the largest source of GHG emissions in the state, followed by electricity generation and fossil fuel used in the residential, industrial and commercial sectors mainly for heating. Estimates of methane emission leaks from the natural gas transmission and distribution sector are accounted for in Figure II.A.-1—under "Highly Warming Gases"—however, it is acknowledged in the statewide inventory report that these estimates do not

[4] Michael Aucott et al., *2012 Update to New Jersey's Statewide Greenhouse Gas Emission Inventory*, Rutgers University (2015), http://climatechange.rutgers.edu/docman-list/special-reports/354-2012-update-to-new-jersey-s-statewide-greenhouse-gas-emission-inventory/file.

[5] *Id.* at 3.

[6] *Id.* at 6.

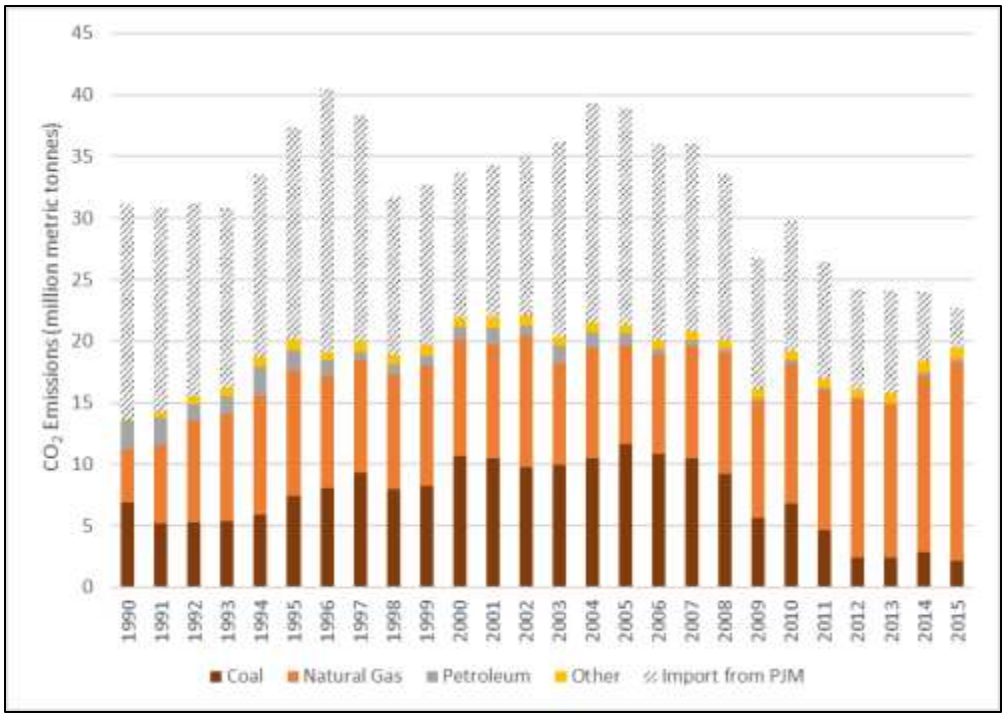
[7] *Id.*

account for additional emissions from natural gas distribution to consumers or leaks elsewhere in the system.[8]

II.B. Recent Power Sector Trends

New Jersey's power sector emissions have decreased 27 percent since 1990 and 42 percent since 2005, taking into account emissions associated with electricity imported into New Jersey.[9] In 2015, power sector CO_2 emissions[10] were lower than at any time since at least 1990 (see Figure II.B.-1).

Figure II.B.-1. New Jersey Power Sector CO_2 Emissions.



Source: Data from EIA Electric Power Annual and PJM.

One major source of these emission reductions is the shift from coal-fired generation to natural gas-fired generation in the state. Electricity from natural gas is much lower in greenhouse gas emissions per megawatt-hour than electricity from coal.[11] In 2005, coal accounted for 12.7 percent of electricity and natural gas 16.8 percent of electricity; in 2015, coal use fell to 2.3 percent while natural gas rose to 48.5 percent (see Figure II.B.-2).[12] While in 2005, nine coal plants were operating in New Jersey, New Jersey

[8] *Id.* Appendix A, page 16.

[9] Figure II.B.-2 data comes from *EIA Detailed 923*, Energy Information Administration Electric Power Annual (November 21, 2016), http://www.eia.gov/electricity/data.cfm#elecenv. Annual PJM emissions factors taken from *PJM System Mix-System Mix By Fuel*, Environmental Information Services Generation Attribute Tracking System, https://gats.pjm-eis.com/gats2/PublicReports/PJMSystemMix/Filter (last retrieved August 3, 2017) and from the methodology of the 2012 New Jersey Emissions Inventory.

[10] This figure only shows CO_2 emissions and does not include methane or other GHG emissions.

[11] U.S. Energy Information Administration, Annual Energy Outlook 2007 (January 5, 2007), http://www.eia.gov/forecasts/aeo/pdf/0383(2016).pdf.Naturalhttp://www.eia.gov/forecasts/aeo/pdf/0383(2016).pdf (stating that natural gas has approximately 55 percent the carbon emissions intensity per unit of energy as coal); U.S. EPA, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2015 at 3-7 (2017), https://www.epa.gov/sites/production/files/2017-02/documents/2017_complete_report.pdf.

[12] Data from EIA Net Generation by State and EIA Electric Power Annual.

now only has two coal power plants with no plans to retire or convert to natural gas: one in Gloucester County with a nameplate capacity of 242 MW and one in Salem County with a nameplate capacity of 285 MW (slightly larger than the average size coal plant).[13] As of 2015, there were 45 natural gas power facilities in New Jersey, 11 of which had come online since 2005— representing an additional 4,795 MW of nameplate capacity added.[14] This change reflects a national trend, driven in large part by the abundance of inexpensive natural gas due to hydraulic fracturing.[15]

New Jersey has also reduced the amount of electricity it imports from outside the state, cutting electricity imports from 32 percent of consumed electricity in 2005 to 9 percent in 2015. This has helped reduce overall power-sector emissions (including CO_2, SO_2 and NO_X), as electricity imported from outside of the state is more emissions-intensive than the New Jersey average.[16] Overall, New Jersey consumed less electricity in 2015 than it did in 2005, while at the same time increasing its GDP by 25 percent and increasing its population from 8.72 to 8.96 million.[17]

Nuclear power has historically provided a significant portion of baseload electricity in the state, with New Jersey's three nuclear plants supplying 43 percent of electricity consumed in the state in 2015. One of these plants—Oyster Creek Generating Station—is scheduled to close in 2019.[18] The electricity generation that replaces this plant will be an important consideration for New Jersey's emissions—if the demand is met by electricity from fossil fuel-fired generation, then emissions will increase.

[13] *27 gigawatts of coal-fired capacity to retire over next five years*, U.S. Energy Information Administration (July 27, 2012), https://www.eia.gov/todayinenergy/detail.php?id=7290.

[14] Derived from EIA Form 860 data, Units Operating in 2015.

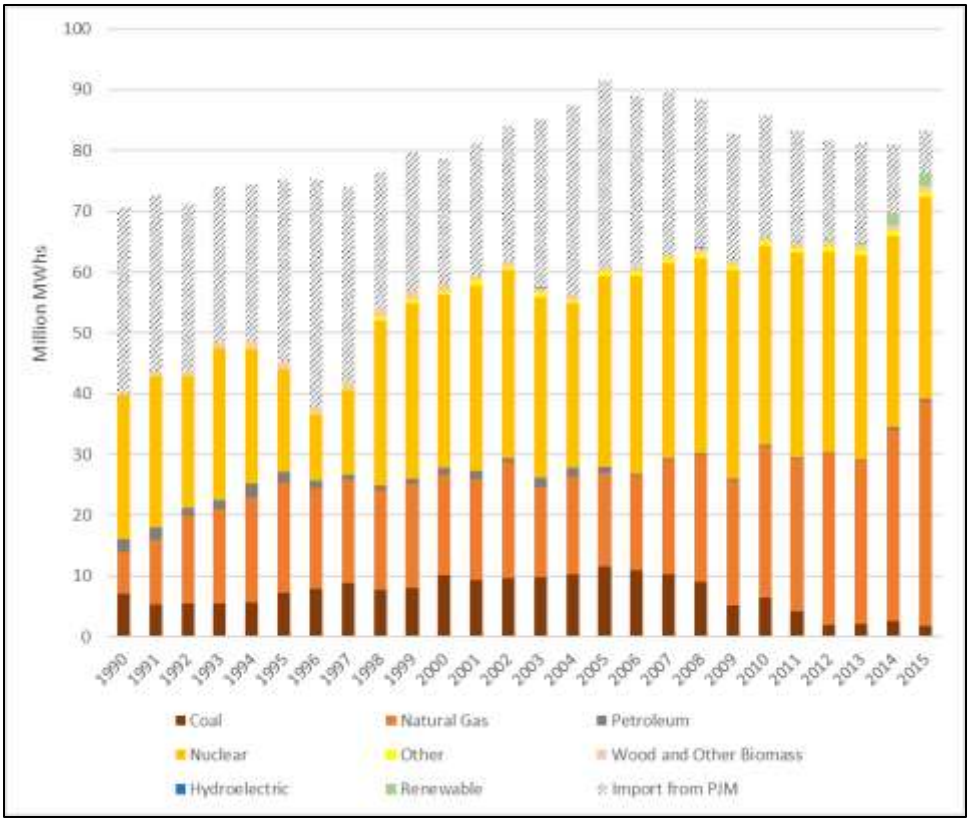
[15] U.S. Energy Info. Admin., Annual Energy Outlook 2016 at ES-3(2016), http://www.eia.gov/forecasts/aeo/pdf/0383(2016).pdf.

[16] *See e.g. 2012-2016 CO_2, SO_2 and NO_X Emission Rates*, PJM (March 17, 2017), http://www.pjm.com/~/media/library/reports-notices/special-reports/20170317-2016-emissions-report.ashx (stating that the New Jersey electricity grid is within the PJM Interconnection, a regional transmission organization. New Jersey's electricity imports from outside the state would from the PJM Interconnection. PJM releases reports on emissions per megawatt-hour in its transmission region, and the average PJM grid CO_2/MWh are considerably higher than the New Jersey-only portfolio).

[17] New Jersey Electricity Profile 2015, U.S. Energy Information Administration (January 17, 2017), https://www.eia.gov/electricity/state/NewJersey/; U.S. Energy Info. Admin., State Electricity Profiles 2005 152 (March 6, 2017), https://www.eia.gov/electricity/state/archive/062905.pdf; *Total Gross Domestic Product for New Jersey*, Federal Reserve Bank of St. Louis (May 11, 2017), https://fred.stlouisfed.org/series/NJNGSP.

[18] *Exelon to Retire Oyster Creek Generating Station in 2019*, Exelon (December 8, 2010), http://www.exeloncorp.com/newsroom/Pages/pr_20101208_Nuclear_OysterCreekRetirement.aspx.

Figure II.B.-2. New Jersey Electricity Sector Sources.



Source: EIA Net Generation by State and EIA Electric Power Annual.

New Jersey has also seen substantial growth in renewable energy in recent years, amounting to 2.5 percent of electricity generation in 2015 (see Figure II.B.-3).[19] In recent years, New Jersey has also seen dramatic growth of distributed solar capacity—solar photovoltaic cells on residential and commercial buildings, as opposed to larger utility-scale power generation facilities. In the past 10 years, renewable generation has grown from 17,000 MWh produced in 2006 to nearly 2.1 million MWh in 2015—more than a 100-fold increase.[20] Figure II.B.-3 only begins showing Distributed Solar PV in 2014 because that is the earliest year for which the EIA has data; generation from these sources was estimated to have been negligible in 2006.[21] Due to low prices, federal tax credits, and state policies, renewable energy is increasing substantially throughout the United States, with solar installed capacity increasing 36 percent in 2015.[22] As a result, other states—including those that receive more intense sunlight—have caught and surpassed New Jersey. In 2009 New Jersey had the second most solar capacity in the U.S.,[23] in 2016, New

[19] *Electricity- Net Generation by State*, U.S. Energy Information Association (October 12, 2016), https://www.eia.gov/electricity/data/state/; *Electricity- Electric Power Annual*, U.S. Energy Information Association (November 21, 2016), http://www.eia.gov/electricity/annual/archive/2015/.

[20] *Id.* Compare this to the level of total electricity generation in 2015, which was 76 million MWh.

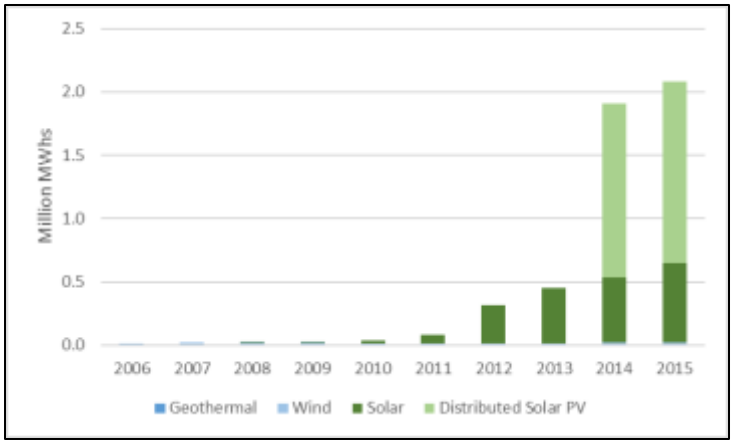
[21] *Id.*

[22] US Department of Energy, 2015 Renewable Energy Data Book (2015), http://www.nrel.gov/docs/fy17osti/66591.pdf.

[23] *New Jersey Ranks Second for Solar Power Installations*, Solar Energy News (April 20, 2010), http://www.cleanenergyauthority.com/solar-energy-news/new-jersey-ranks-second-for-solar-power-installations/.

Jersey had the fifth most solar capacity installed in the country.[24] As shown in Figure II.B.-3, very little electricity is generated by utility-scale wind or geothermal plants within the state of New Jersey.

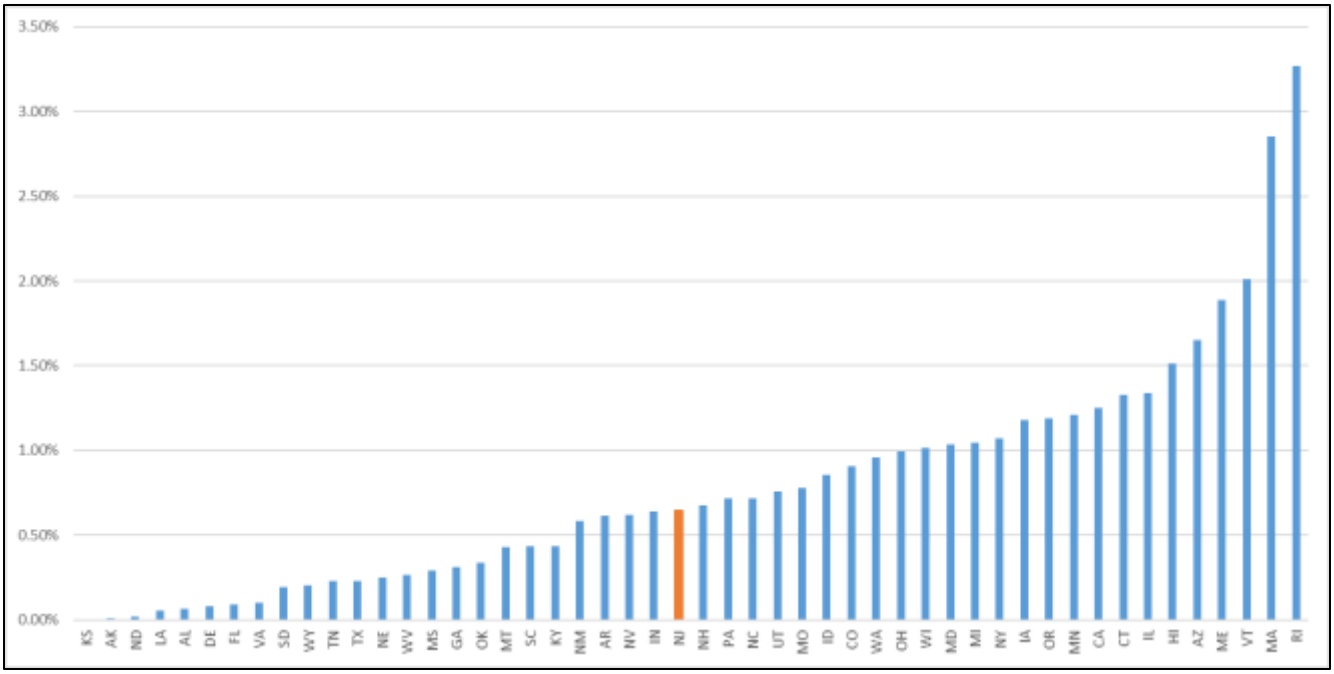
Figure II.B.-3. Growth of Renewable Electricity in New Jersey.



Source: EIA Net Generation by State and EIA Electric Power Annual. EIA has only published distributed solar PV data since 2014 (i.e., data for years prior is limited to generation from utility-scale solar facilities).

According to EIA data, New Jersey is in the middle of the pack when it comes to the amount of electricity the state conserves (see Figure II.B.-4). EIA finds that New Jersey's energy savings are approximately 0.7 percent per year when compared to a business-as-usual estimate,[25] while some states manage to achieve savings higher than 1.5 percent annually compared to business as usual. For example in 2015, Vermont achieved 2.01 percent, Massachusetts achieved 2.85 percent, and Rhode Island achieved 3.27 percent.

Figure II.B.-4. US States Incremental Energy Saving vs Business As Usual, 2015.



Source: EIA Form 861 Data.

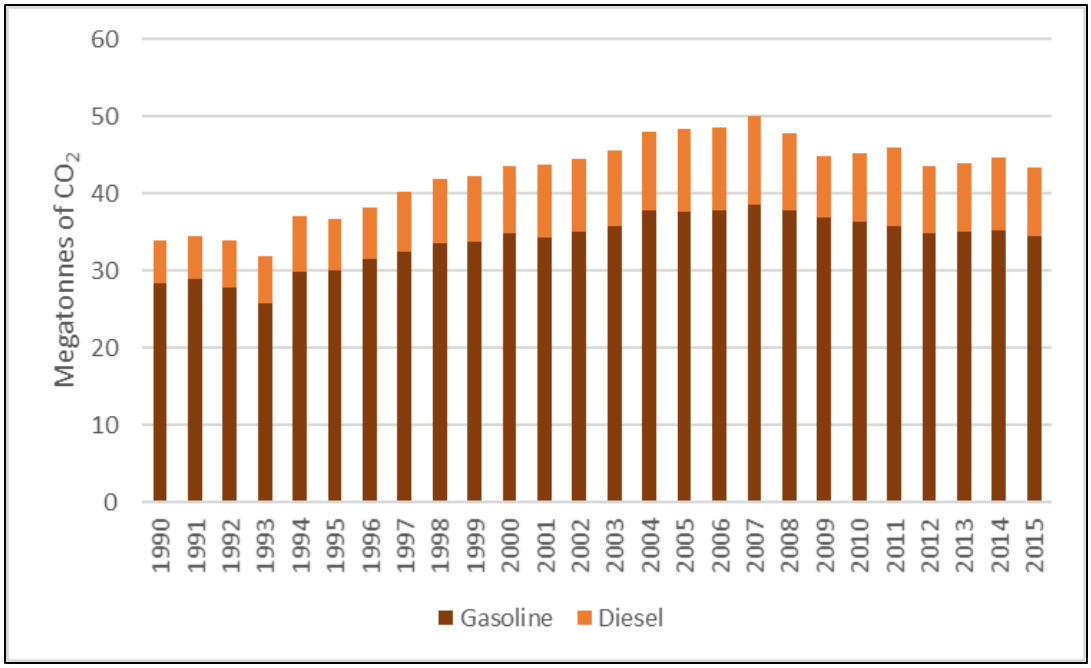
[24] *Top 10 Solar States*, Solar Energy Industries Association (2016), http://www.seia.org/research-resources/top-10-solar-states.

[25] *Form EIA-861 Annual Electric Power Industry Report Instructions*, U.S. Energy Information Association, https://www.eia.gov/survey/form/eia_861/instructions.pdf (defining as Total Reporting Year Incremental Annual Savings, and reported by utilities); See *Electric power sales, revenue, and energy efficiency Form EIA-861 detailed data files*, U.S. Energy Information Association (October 6, 2016), https://www.eia.gov/electricity/data/eia861/ (presenting energy efficiency and energy saving data); *Energy Consumption Estimates by Year*, U.S. Energy Information Administration (2017), https://www.eia.gov/consumption/.

II.C. Recent Transportation Sector Trends

As shown above (see Figure II.A.-1), the transportation sector makes up the largest source of New Jersey's GHG emissions. The state's CO_2 emissions from ground transportation—measured based on the quantities of fuel sold for consumption in New Jersey—increased 27.5 percent over the 1990-2015 period (see Figure II.C.-1).[26] Transportation emissions peaked in 2007, prior to the 2007-2009 recession. Between 2005 and 2015, emissions fell by 11 percent.

Figure II.C.-1 New Jersey Ground Transportation Emissions.



Data from EIA SEDS, CO2 emissions factors from EPA.

Emissions from transportation are based on several factors, including the fuel efficiency of vehicles, the carbon-intensity of fuels, and the total distance that vehicles are driven, referred to as vehicle miles traveled (VMT). As shown in Figure II.C.-2, the VMT of New Jersey's vehicles in 2005 was very similar to 2015. Nationwide VMT peaked in 2007 before the recession and then dropped, and this trend is visible in New Jersey.[27] After 2011, VMT began rising again, both in the state and in the United States overall.

Despite these trends in VMT, absolute consumption of gasoline and diesel fuel was 10 percent lower in 2015 than it was in 2005; 4,800 million gallons.[28] This demonstrates greater overall efficiency in the New Jersey vehicle fleet, reflecting federal GHG and fuel economy standards discussed in Section IV.D. The

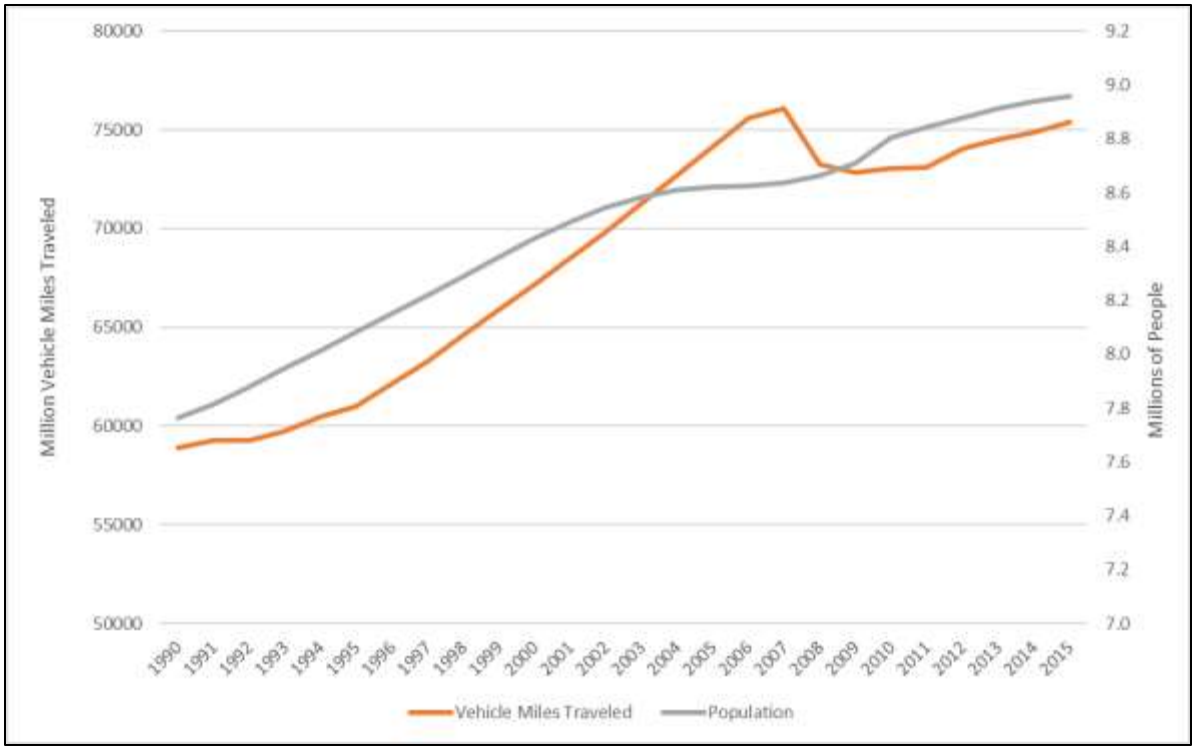
[26] Data comes from the Energy Information Administration State Energy Data System, multiplied by EPA default emissions factors; *New Jersey State Energy Data System (SEDS): 1960-2015 (complete)*, U.S. Energy Information Administration (June 30, 2017), https://www.eia.gov/state/seds/seds-data-complete.php?sid=NJ (defining emissions that will result from combustion of motor gasoline and diesel sold in New Jersey for use in the transportation. Aviation fuel has been excluded because it was not included in the 2012 New Jersey GHG Inventory update.); *Emissions Factors for Greenhouse Gas Inventories*, U.S. Environmental Protection Agency (April 4, 2014), https://www.epa.gov/sites/production/files/2015-07/documents/emission-factors_2014.pdf.

[27] Data from *Roadway Information and Traffic Monitoring System Program*, State of New Jersey Department of Transportation (September 1, 2016), http://www.state.nj.us/transportation/refdata/roadway/vmt.shtm.

[28] Data from *New Jersey State Energy Data System (SEDS): 1960-2015 (complete)*, U.S. Energy Information Administration (June 30, 2017), https://www.eia.gov/state/seds/seds-data-complete.php?sid=NJ.

long-term increase in transportation emissions, since 1990, is therefore primarily attributable to the concurrent rise in VMT.

Figure II.C.-2. Total VMT versus Population in New Jersey.



Source: New Jersey Department of Transportation and New Jersey Department of Labor. (Please note that the vertical axis does not begin at zero in order to better show the year-to-year variation).

Since the 2007 recession, New Jersey has already seen a significant change in development patterns. Population growth is taking place mostly in already built-out communities, as opposed to through new development in exurbs that was typical during the 1990s.[29] This change is consistent with evidence of a nationwide increase in preference for transit-accessible neighborhoods and walkable communities, among other factors.[30] This change in development patterns can help reduce VMT or slow VMT growth, as residents do not need to travel as far for work, school, shopping, or other trip purposes. It is notable, however, that vehicle travel in New Jersey has continued to increase post-recession despite these beneficial trends, albeit at a slower rate than in the years leading up to the recession.[31]

As discussed later in this report, the switch to electric vehicles can be a key strategy in reducing GHG emissions. The adoption of electric vehicles in New Jersey has increased significantly, but not as fast as in some states. In 2016, 3,980 electric vehicles were sold in New Jersey, compared to 251 in 2011, a 15-fold

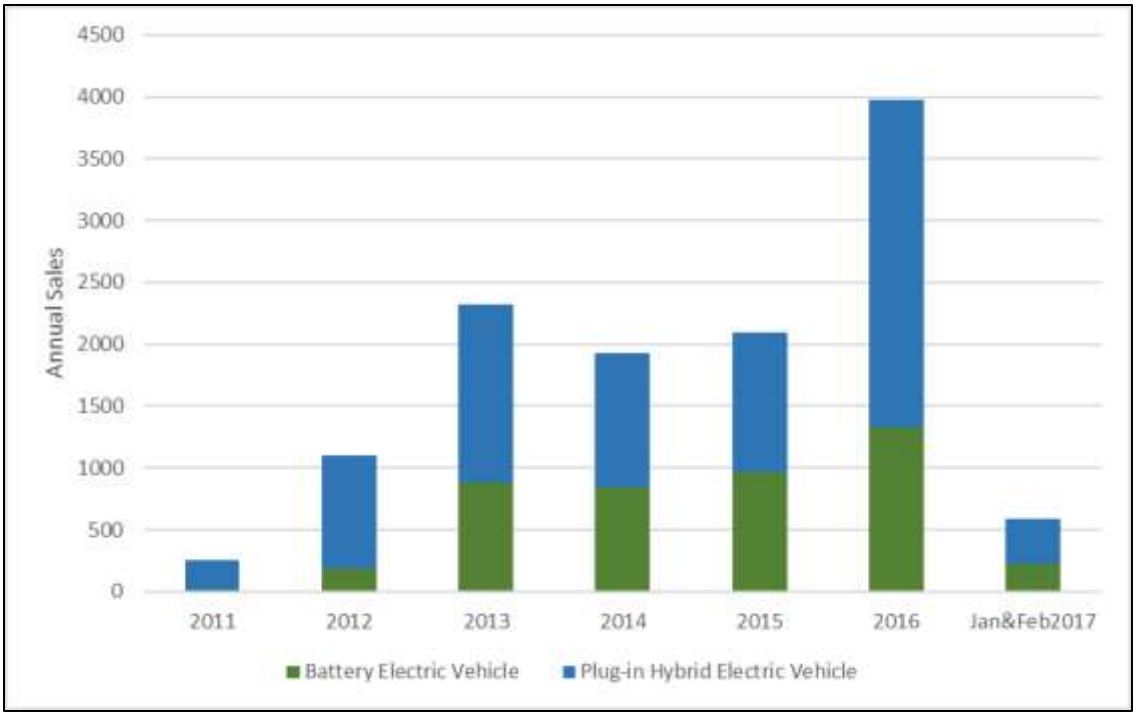
[29] According to analysis by New Jersey Future, the 271 municipalities that were at least 90 percent built out as of 2007 (meaning that they have already built on most or all of their buildable land) accounted for a full two-thirds (66.8 percent) of total statewide population growth between 2008 and 2016. Tim Evans, *Census Numbers Confirm Renewed Growth in Urban Areas*, New Jersey Future, May 26, 2017, http://www.njfuture.org/2017/05/26/census-urban-growth/.

[30] *See* Tim Evans, New Jersey Future, Special Report: Is Transit-Oriented Demand on the Rise? (2016), http://www.njfuture.org/wp-content/uploads/2016/03/New-Jersey-Future-Analysis-of-Population-Growth-in-Transit-Areas-March-2016.pdf.

[31] Between 1996 and 2006 VMT grew between 1.79 and 2.11 percent a year. In contrast, VMT has grown between 0.25 and 1.27 percent between 2010 and 2015. New Jersey Department of Transportation, Public Roadway Mileage and Vehicle Miles Traveled, http://www.state.nj.us/transportation/refdata/roadway/vmt.shtm. The increased VMT reflects in part increased population. New Jersey population increase 1.7 percent from 2010 to 2016. U.S. Census, New Jersey Quick Facts, https://www.census.gov/quickfacts/NJ.

increase in annual EV sales (see Figure II.C.-3).[32] Annual electric vehicle sales now represent a 0.48 percent market share in New Jersey.[33] For comparison, electric vehicles have a 3.2 percent market share in California and 0.66 percent market share in Connecticut.[34]

Figure II.C.-3. New Jersey Electric Vehicle Sales.



Source: Alliance of Automobile Manufacturers.

New Jersey also has a growing number of publicly accessible charging stations for electric vehicles, infrastructure that will be necessary to support widespread EV adoption. Figure II.C-4 below shows the location of public electric vehicle charging stations in New Jersey.[35] As of spring 2017, New Jersey had 208 publicly available charging stations with 454 charging outlets. This map includes 348 level 2 charging outlets, and 106 DC fast charging outlets.

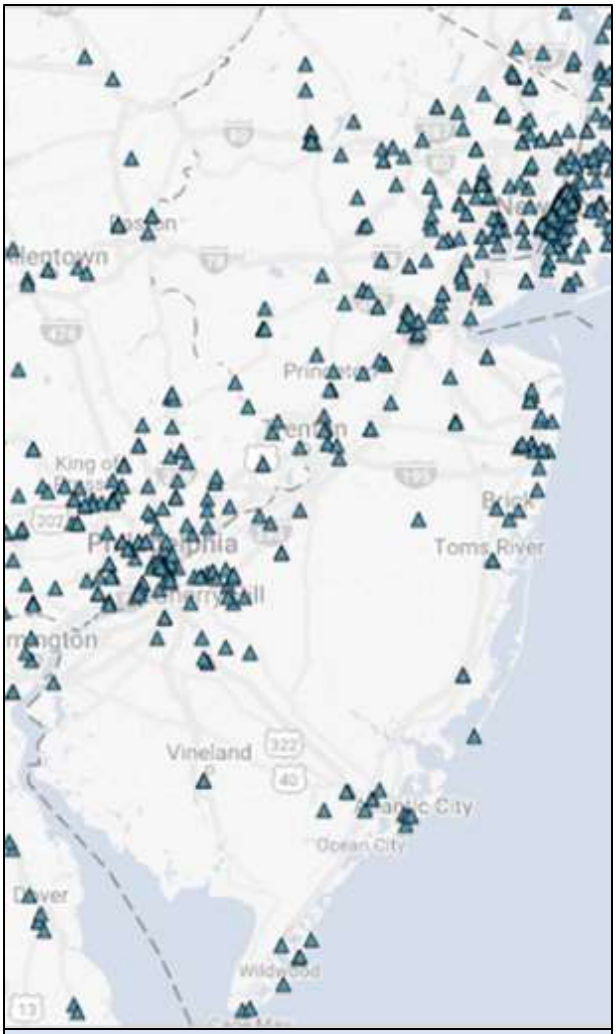
[32] *U.S. Light-Duty Zero Emission Vehicle (ZEV) Sales (2011-2017)*, Auto Alliance (2017), https://autoalliance.org/energy-environment/zev-sales-dashboard/ (selecting data for plug-in hybrid, battery electric, and fuel cell vehicles but not including hybrid vehicles without plug-in functionality.) (underlying sales data provided by R.L. Polk & Co, 2017).

[33] *Id.* (selecting data for market share as of March 2017).

[34] *Id.*

[35] *Map and data from Alternative Fuels Data Center*, U.S. Department of Energy (August 3, 2017), http://www.afdc.energy.gov/locator/stations/.

Figure II.C-4. New Jersey Electric Vehicle Charging Stations.



208 Public Electric Vehicle Charging Stations

454 Charging Outlets

Source: Map and data from the US Department of Energy Alternative Fuels Data Center.

A final factor to consider is that New Jersey already has a high rate of transit ridership—over 11 percent of New Jersey commuters use transit, second only to New York.[36] The share of transit commuters has increased significantly over the past 20 years.

II.D. New Jersey's Actions to Address Climate Change and Clean Energy

Since 2003, New Jersey has taken several significant actions to reduce GHG emissions and promote clean energy.

In 2003, NJDEP promulgated regulations requiring large stationary sources to report CO_2 and methane emissions.[37] In 2005, NJDEP promulgated additional regulations clarifying that CO_2 was an "air

[36] Public Transit Share, based on Census American Community Survey. AASHTO, Commuting in America 8 (2013), http://traveltrends.transportation.org/Documents/B13_Transit%20Commuting_CA13-4_web.pdf.

[37] 35 N.J.Reg. 1059(a) (Feb. 18, 2003), *codified at* N.J. Admin. Code § 7:27-21.3.

contaminant" that could be regulated by NJDEP under New Jersey's Air Pollution Control Act (APCA) along with the other five GHGs.[38]

In December 2005, Governor Richard Codey joined with governors of Connecticut, Delaware, Maine, New Hampshire, New York, and Vermont to sign a memorandum of understanding to establish the Regional Greenhouse Gas Initiative (RGGI),), a CO_2 cap-and-trade program for the power sector.[39] The memorandum of understanding identified a carbon emission budget for each of the states for the years 2009 through 2014.[40]

In 2007, New Jersey enacted the New Jersey Global Warming Response Act (GWRA) signed by Governor Jon Corzine.[41] The GWRA requires the state to reduce economy-wide GHG emissions to 1990 levels by 2020 and to 80 percent below 2006 levels by 2050, and directs state agencies to take steps to reduce GHG emissions.[42] The Act also requires the state to establish a GHG monitoring and reporting program, to prepare plans for meeting the 2020 and 2050 limits, and to integrate GHG reduction planning into an energy master plan, among other provisions.[43]

One year later, in 2008, New Jersey enacted the Global Warming Solutions Fund Act.[44] The legislation authorized NJDEP to implement regulations to join RGGI, and specifically provided authority to create and auction allowances.[45] It also directed that allowance proceeds be used for specific purposes, such as to promote renewable energy and energy efficiency and to benefit low- and moderate-income electricity ratepayers.[46] Later that year, NJDEP promulgated regulations under this authority to establish a cap-and-trade program as part of RGGI.[47]

In 2009, in consultation with other state agencies and informed by an extensive stakeholder engagement process, DEP issued a report with three core recommendations for achieving the state's 2020 GHG emission limit.[48] The first recommendation was to implement the 2008 New Jersey Energy Master Plan, which included achieving statewide energy reductions of at least 20 percent by 2020 and "striv[ing]" to meet 30 percent of the state's electricity needs from renewable sources by 2020.[49] The second recommendation was to continue with the implementation of a low-emission vehicle program. New

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[38] 37 N.J.Reg. 4415(a) (Nov. 21, 2005).

[39] *Memorandum of Understanding*, Regional Greenhouse Gas Initiative (Dec. 20, 2005), https://rggi.org/docs/mou_final_12_20_05.pdf [hereinafter Memorandum of Understanding].

[40] *Id.*

[41] 2007 N.J. ALS 112; Governor Jon Corzine Exec. Order No. 54 (Feb. 13, 2007), http://nj.gov/infobank/circular/eojsc54.htm (indicating that earlier in 2007, then Governor Jon Corzine issued an executive order that established GHG emission reduction targets for 2020 and 2050—at the same levels later enacted in the GWRA—and also requiring NJDEP to recommend actions for meeting the 2020 target and developing a permanent system for monitoring the states GHG emissions and progress toward targets); 2007 N.J. ALS 112; 2007 N.J. ALS 112.

[42] N.J. Stat. Ann. §§ 26:2C-38 to 40 (2016).

[43] N.J. Stat. Ann. §§ 26:2C-40 to 43, § 48:3-87 (2016).

[44] N.J. Stat. Ann. § 26:2C-47(a).

[45] An emission allowance is a tradable instrument that authorizes a regulated power plant to emit a specific quantity of the regulated pollutant. In RGGI, these allowances are distributed predominantly through an auction process. See discussion in Section IV.B.

[46] N.J. Stat. Ann. §§ 26:2C-47, 26:2C-51.

[47] 40 N.J. Reg 3792(a) (July 7, 2008).

[48] N.J. Dep't of Envtl. Prot., Meeting New Jersey's 2020 Greenhouse Gas Limit: New Jersey's Global Warming Response Act Recommendations Report 7 (2009), http://www.state.nj.us/dep/sage/docs/njgrwa_final_report_and_appendices_dec2009.pdf [hereinafter 2009 Report].

[49] *Id.* at 7-8.

Jersey adopted California's Low Emission Vehicle program in 2005, and 2009 was the first year that new passenger vehicles were required to meet the standard.[50] The third recommendation was to reduce greenhouse gas emissions through participation in RGGI.[51] The 2009 report also identified policies to help meet 2050 limits.[52]

In May 2011, Governor Chris Christie announced his intention to withdraw from RGGI, and New Jersey subsequently withdrew from the program effective January 1, 2012.[53] NJDEP formally rescinded the implementing regulations of the Global Warming Response Act in 2014.[54] The New Jersey legislature twice passed bills that would have revised language in the GWRA to "clarify" that the statute *required* New Jersey to participate in RGGI, but Governor Christie vetoed both bills.[55]

New Jersey has also supported the use of clean energy to meet the state's energy needs and to reduce GHG emissions. In 1999, New Jersey enacted the Electric Discount and Energy Competition Act (EDECA), which restructured regulation of the electricity industry to create a competitive market for retail electricity generation services.[56] EDECA also directed the NJBPU to adopt a renewable portfolio standard (RPS), which the the board subsequently adopted and strengthened on several occasions.[57] Most recently, in 2006 the board set the core RPS target at 20.38 percent by 2021.[58] In 2009, the New Jersey legislature established a solar carve out—an additional requirement that a certain amount or percentage of electricity in the state come from distributed solar power[59]—and in 2012 increased the solar carve out to 4.1 percent by 2028.[60] The same 2012 legislation created an offshore wind carve out to support at least 1,100 MW of generation capacity from qualified offshore wind projects.[61] EDECA also authorized the establishment of a societal benefits charge to be used in part to fund demand-side energy efficiency programs and renewable energy projects, and the development of a net metering program that credits owners of distributed renewable resources for electricity provided to the grid,[62] both of which have been implemented.

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[50] N.J. Admin. Code § ***7:27-29.1 et seq. (2016); 38*** N.J. Reg. ***497(b) (Jan. 17, 2006).***

[51] 2009 Report at 8.

[52] *Id.* at 98-111.

[53] *Video and Transcript: Governor Christie: New Jersey's Future is Green*, State of New Jersey (May 26, 2011), http://www.nj.gov/governor/news/news/552011/approved/20110526a.html; N.J. Dept of Envt'l Conservation, Notice of Withdrawal of Agreement to the RGGI Memorandum of Understanding (2011), https://www.rggi.org/docs/Documents/NJ-Statement_112911.pdf.

[54] *See In re Regional Greenhouse Gas Initiative*, 2014 WL 1228509 (N.J. Super. Ct. App. Div. 2014) (indicating that the repeal of regulations was in response to a ruling from a court case, which found that the existing regulation could authorize a stand alone cap-and-trade program even if New Jersey was no longer participating in RGGI).

[55] Gov. Christie absolute veto of Senate Bill No. 2946 (2011), http://www.njleg.state.nj.us/2010/Bills/S3000/2946_V1.PDF; Gov. Christie absolute veto of Senate Bill No. 1322 (2012), http://www.njleg.state.nj.us/2012/Bills/S1500/1322_V1.PDF.

[56] Electric Discount and Energy Competition Act, 1999 N.J. Laws 23, § 5.

[57] Electric Discount and Energy Competition Act, 1999 N.J. Laws 23, § 38(d)-(e).

[58] N.J. Reg. 2176(a) (May 15, 2006).

[59] A.B. 3520 § 38(d)(3), 2009 Reg. Sess. (N.J. 2009).

[60] S.B. 1925 § 38(d)(3), 2012 Reg. Sess. (N.J. 2012) (changing the target back to a percentage of electricity. The solar target had been increased several other times; the most recent target prior to the 2012 legislation was to achieve an additional 5,316 GWh from solar-electric facilities by 2026).

[61] *Id.* § 38(d)(4); However, there is no timeline set to require the BPU to implement or utilities to comply with this requirement, and no contracts have yet been signed. See discussion of net metering in Section IV.C. *Id.* § 38(d)(4). *Id.* § 38(d)(4).

[62] Electric Discount and Energy Competition Act, 1999 N.J. Laws 23, § 12; The legislature passed laws in 2010 and 2015 amending the approach to limiting the scope of the program (See discussion of net metering in Section IV.C).

To help reduce emissions from the transportation sector, New Jersey has been a participant in the Transportation and Climate Initiative (TCI), which is a regional collaboration among 11 Northeast and Mid-Atlantic states and the District of Columbia. While New Jersey has actively participated in the related Northeast Electric Vehicle Network,[63] it opted not to join a 2015 announcement by DC and five states in the region that they would work together to develop potential market-based policies to cut greenhouse gas emissions from transportation.[64]

Finally, the GWRA included a provision that provided NJBPU the discretionary authority to implement an energy efficiency portfolio standard (EEPS). The statute provides authority for NJBPU to require each electric or gas public utility to implement efficiency measures that reduce electricity or natural gas usage to a level 20 percent below the amount of electricity or gas that would be used in the absence of an EEPS by 2020.[65]

In addition to the 2008 Master Energy Plan described above, the New Jersey governor's office has released two energy plan updates. A 2011 update emphasized driving down the cost of energy for consumers; promoting a diverse portfolio of new, in-state clean energy resources; incentivizing energy efficiency and energy conservation and reducing peak demand; and maintaining support for meeting the state's electricity needs from renewable sources consistent with its RPS goal.[66] A 2015 update tracked the progress the state had made on the goals in the 2011 energy master plan.[67]

[63] NJ Department of Environmental Protection. "Supporting New Jersey's Clean Transportation Strategies." Visited on August 31, 2017. http://www.nj.gov/dep/aqes/opea-trans-strategies.html

[64] Georgetown Climate Center. "Press release: Five Northeast States and DC Announce They Will Work Together to Develop Potential Market-Based Policies to Cut Greenhouse Gas Emissions from Transportation." Nov. 24, 2015. http://www.georgetownclimate.org/articles/five-northeast-states-and-dc-announce-they-will-work-together-to-develop-potential-market-based-policies-to-cut-greenhouse-gas-emissions-from-transportation.html

[65] N.J. Stat. Ann. §§ 48:3-87(g)-(h).

[66] State of New Jersey, 2011 New Jersey Energy Master Plan (December 6, 2011), http://www.nj.gov/emp/docs/pdf/2011_Final_Energy_Master_Plan.pdf.

[67] State of New Jersey, 2015 New Jersey Energy Master Plan Update (December 2015), http://nj.gov/emp/docs/pdf/New_Jersey_Energy_Master_Plan_Update.pdf.

Examples of Economic Benefits of State Clean Energy Policies

Actions to reduce carbon emission can produce measurable economic benefits. State programs have delivered significant economic and health benefits by driving investments in energy efficiency and renewable energy. Over time, the emissions of carbon dioxide and harmful traditional air pollutants have declined, as have costs to consumers. Clean energy companies in states like California, Colorado, and Washington have created tens of thousands of jobs in recent years.[68] This has produced a direct benefit to consumers. As an example, since 2002, the Energy Trust of Oregon has made more than $1 billion in clean energy investments,[69] saving customers more than $1.3 billion on utility bills. In the eastern United States, independent studies have found that the Regional Greenhouse Gas Initiative (RGGI) is generating billions of dollars in economic benefits, and is creating energy bill savings and thousands of new jobs.[70] New York State is working on a Clean Climate Careers Initiative in partnership with The Worker Institute at Cornell University's School of Industrial Labor Relations which has published an analysis of GHG emissions reductions and job creation potential with key recommendations for the building, energy and transportation sectors.[71] Economic analyses published by the State of Maryland pursuant to implementation of Maryland's Greenhouse Gas Emissions Reduction Act, estimated net economic benefits of between $2.5 billion and $.35 billion in increased economic output by 2020 and maintenance and creation of between 26,000 and 33,000 new jobs.[72] These efforts demonstrate the economic benefits that low-carbon and clean energy policies can have when implemented on the state level.

[68] *2017 U.S. Energy and Jobs Report State Charts*, U.S. Department of Energy (2017), https://energy.gov/sites/prod/files/2017/01/f34/2017%20US%20Energy%20and%20Jobs%20Report%20State%20Charts%202_0.pdf.

[69] Energy Trust of Or., 2015 Annual Report 1 (2015), http://assets.energytrust.org/api/assets/reports/PublicAnnualReport_2015_Final.pdf.

[70] Paul J. Hibbard, et al, *The Economic Impacts of the Regional Greenhouse Gas Initiative on Nine Northeast and Mid-Atlantic States*, Analysis Group (2015), https://www.c2es.org/docUploads/rggi-mou.pdf.

[71] J.M. Cha & L. Skinner, *Reversing Inequality, Combatting Climate Change. A Jobs Program for New York State*, The Worker Institute, Cornell University, ILR School (2017), https://www.ilr.cornell.edu/sites/ilr.cornell.edu/files/InequalityClimateChangeReport.pdf; Governor Cuomo Announces Major *Climate and Jobs Initiative in Partnership with the Workers Institute at Cornell University's ILR's School and Climate Jobs NY to Help Create 40,000 Clean Energy Jobs by 2020*, New York State (June 2, 2017), https://www.governor.ny.gov/news/governor-cuomo-announces-major-dimate-and-jobs-initiative-partnership-worker-institute-cornell.

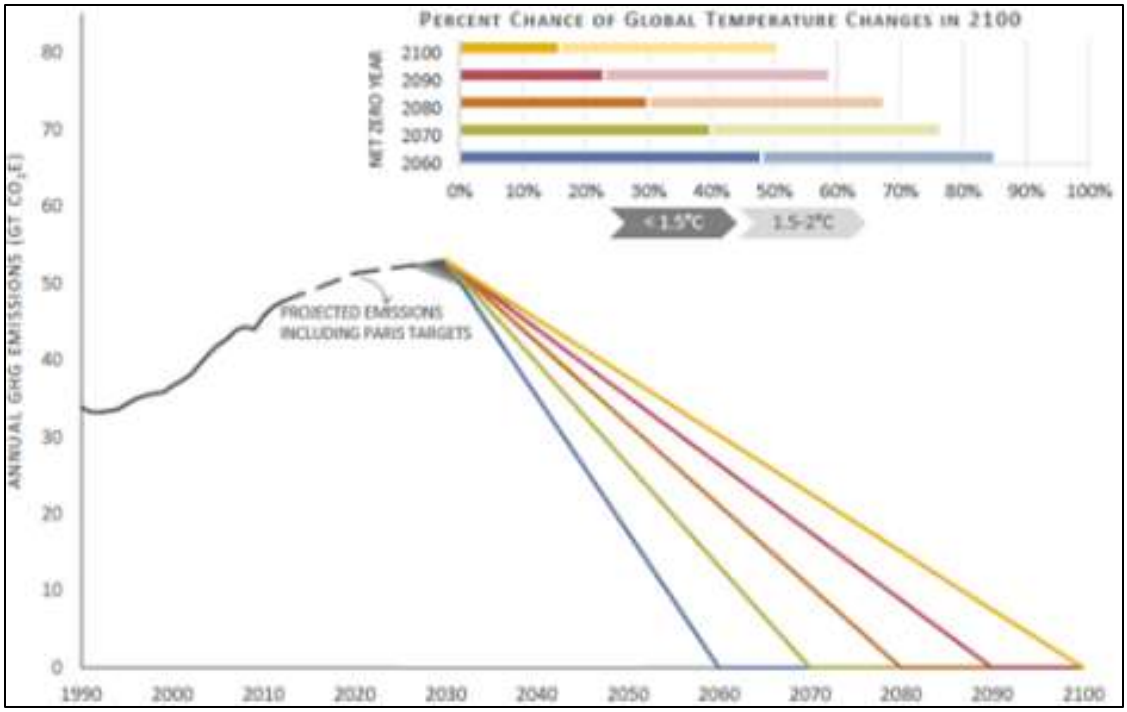
[72] The Maryland Department of Environment, 2015 Greenhouse Gas Emissions Reduction Act Plan Update (October 2015), http://news.maryland.gov/mde/wp-content/uploads/sites/6/2015/10/GGRA_Report_FINAL_10-29-15.pdf.

III. Pathways to Decarbonization and Implications for New Jersey

III.A. Deep Decarbonization[73] Targets

In December 2015 in Paris, nearly all countries of the world reached an agreement to avoid the most severe risks of climate change by limiting the increase in the global average temperature to well below 2 degrees Celsius above pre-industrial levels, and pursuing efforts to limit the temperature increase to 1.5 degrees Celsius ("Paris Agreement").[74] Achieving the goals of the Paris Agreement will require a rapid decline in global greenhouse gas (GHG) emissions to "net zero global emissions" (i.e., the balancing of global emissions sources and sinks). Recent modeling suggests that a pathway in which global emissions peak in 2030 and decline at a consistent pace thereafter until achieving net zero emissions by 2080 will result in a roughly two-thirds probability of limiting warming to two degrees C (as shown in Figure III.A-1).[75]

Figure III.A-1. Global Greenhouse Gas Emissions Pathways and Temperatures.



Source: Figure adapted from the United States Mid-Century Strategy for Deep Decarbonization.

[73] Throughout this report, the term "decarbonization" refers to economy-wide reductions in all greenhouse gas emissions (not limited to carbon dioxide).

[74] Conference of the Parties, Adoption of the Paris Agreement, U.N. Doc. FCCC/CP/2015/L.9/Rev.1 (Dec. 12, 2015), http://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf.

[75] White House, United States Mid-Century Strategy for Deep Decarbonization (2016), http://unfccc.int/files/focus/long-term_strategies/application/pdf/mid_century_strategy_report-final_red.pdf.

The current international climate framework, under the United Nations Framework Convention on Climate Change (UNFCCC),[76] is a "bottom-up" approach whereby countries develop their own emissions targets. Under the terms of the Paris Agreement, each country develops successive nationally determined contributions (NDCs) signaling the emissions reductions it intends to achieve in the upcoming decade or two (most of the 165 NDCs submitted to the UNFCCC provide emissions targets for 2025 or 2030).[77] The Paris Agreement also addresses longer-run global emissions objectives, calling for net zero global emissions before the end of the century and inviting countries to develop mid-century greenhouse gas emissions strategies.[78] The international community has long recognized that all countries cannot be expected to decarbonize at the same pace, and the Paris Agreement states that countries have "common but differentiated responsibilities and respective capabilities, in light of different national circumstances."[79] Simply put, this means if the world is going to successfully decarbonize, wealthy countries like the United States will need to lead the way.

The United States has submitted to the UNFCCC both a 2025 target and a long-term strategy for U.S. emissions reductions, as requested under the Paris Agreement. The NDC set a target for the United States to reduce emissions by 26 to 28 percent below 2005 levels by 2025.[80] The United States Mid-Century Strategy for Deep Decarbonization describes a vision for emissions reductions of 80 percent or more below 2005 levels by 2050, putting the country on a pathway to achieve net zero GHG emissions before 2060.[81] Other developed countries have outlined similarly ambitious long-term emissions objectives, some developed in the context of mid-century strategies submitted to UNFCCC (e.g., Germany, France, Mexico, Canada), others developed in other contexts (*see* Figure III.A-2).

The election of President Trump has put the U.S. climate change commitments on hold. In March 2017, President Trump issued an Executive Order to "suspend, revise, or rescind" the Clean Power Plan and other Obama Administration regulations intended to reduce greenhouse gas emissions.[82] Then, on June 1, 2017, President Trump announced the intention to withdraw the United States from the Paris Agreement, initiating a process that would lead to an official exit in November 2020. While the U.S. federal

[76] Kyoto Protocol to the United Nations Framework Convention on Climate Change, Dec. 10, 1997, U.N. Doc FCCC/CP/1997/7/Add.1, 37 I.L.M. 22 (1998). Dec 8, 2015; The UNFCCC is an international treaty adopted on May 9, 1992 and entered into force on March 21, 1994. The UNFCCC objective is to "stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system" (The United Nations Framework Convention on Climate Change).

[77] *See INDCs as communicated by Parties*, The United Nations Framework Convention on Climate Change, http://www4.unfccc.int/submissions/indc/Submission%20Pages/submissions.aspx (last retrieved June 1 2017).

[78] Conference of the Parties, Adoption of the Paris Agreement, U.N. Doc. FCCC/CP/2015/L.9/Rev.1 (Dec. 12, 2015), http://unfccc.int/files/essential_background/convention/application/pdf/english_paris_agreement.pdf.

[79] This language from the 2015 Paris Agreement dates back to the 1992 United Nations Framework Convention on Climate Change; Kyoto Protocol to the United Nations Framework Convention on Climate Change, Dec. 10, 1997, U.N. Doc FCCC/CP/1997/7/Add.1, 37 I.L.M. 22 (1998). Dec 8, 2015.

[80] United States of America, *Intended Nationally Determined Contribution*, Submitted to the UNFCCC (2015), http://www4.unfccc.int/ndcregistry/PublishedDocuments/United%20States%20of%20America%20First/U.S.A.%20First%20NDC%20Submission.pdf.

[81] White House, United States Mid-Century Strategy for Deep Decarbonization (2016), http://unfccc.int/files/focus/long-term_strategies/application/pdf/mid_century_strategy_report-final_red.pdf.

[82] Exec. Order No. 13,783, 82 Fed. Reg. 16093, 16095 (Mar. 28, 2017).

government may in the future renew its commitment to action on climate change,[83] for now, action at the sub-national level becomes increasingly important. Indeed, in light of the Trump Administration's pullback on climate action, many U.S. states, cities and business leaders have declared their continued commitment to action on climate change and the goals of the Paris Agreement.[84]

Figure III.A-2. Countries and States with 2050 Greenhouse Gas Emissions Goals.

Country	2050 Goal
Albania	2 tonnes of GHG emissions per capita
Armenia	100% ("ecosystem neutral GHG emissions")
Canada	80% below 2005 levels
Central African Republic	25% below business as usual levels
Equatorial Guinea	50% below 2010 levels
European Union	80% to 95% below 1990 levels
France	75% below 1990 levels
Germany	80% to 95% below 1990 levels
Kyrgyzstan	1.23 to 1.58 tonnes of GHG emissions per capita
Mexico	50% below 2000 levels
Monaco	80% below 1990 levels
New Zealand	50% below 1990 levels
Norway	100% ("carbon neutral")
Sierra Leone	25% to 35% improvement in intensity vs 1990
Solomon Islands	50% or more by 2050
Switzerland	70% to 85% below 1990 levels
United Kingdom	80% or more below 1990 levels
United States	80% or more below 2005 levels

U.S. State	2050 Goal
California	80% below 1990 levels
Colorado	80% below 1990 levels
Connecticut	80% below 2001 levels
Florida	80% below 1990 levels
Massachusetts	80% below 1990 levels
Maine	75% to 80% below 2003 levels
Michigan	80% below 2005 levels
New Hampshire	80% below 1990 levels
New Jersey	80% below 2006 levels
New York	80% below 1990 levels
Rhode Island	80% below 1990 levels
New Mexico	75% below 2000 levels
Oregon	75% below 1990 levels
Vermont	75% below 1990 levels
Illinois	60% below 1990 levels
Minnesota	50% below 1990 levels
Washington	50% below 1990 levels

Notes: Table omits all caveats to emissions goals; Lists United States 2050 goal under President Obama, as outlined in the U.S. MCS.

No "rule of thumb" exists to apportion a U.S. state's responsibility to reduce GHG emissions, but if the country as a whole is to achieve deep decarbonization by mid-century, dramatic cuts in emissions in all states over the coming decades is needed—a trajectory of flat or incremental emissions reductions is insufficient. Fourteen U.S. states have adopted mid-century targets to reduce emissions by 75 percent or

[83] In his June 2017 speech announcing the intention to withdraw the United States from the Paris Agreement, President Trump noted that he would attempt to negotiate a modified agreement. Even if he does not, given that most Americans support U.S. participation in the Paris Agreement, a successor to President Trump could reengage in the international process and either adopt the Obama Administration emission targets or develop new commitments and associated policies; *See* Jennifer Marlon et al., *Majorities of Americans in Every State Support Participation in the Paris Agreement*, Yale Program on Climate Communication (May 8, 2017), http://climatecommunication.yale.edu/publications/paris_agreement_by_state/ (providing evidence that most Americans support U.S. participation in the Paris Agreement).

[84] In anticipation of President Trump's announcement, on May 3, 2017, twelve governors (California, Colorado, Connecticut, Delaware, Hawaii, Minnesota, New York, Oregon, Pennsylvania, Rhode Island, Virginia, and Washington) sent a letter to President Trump signaling their readiness to support the agreement and if possible to go further and on May 17, 2017 two governors (Massachusetts and Vermont) sent a joint letter to Secretary of Energy Rick Perry requesting the U.S. stay in the agreement noting their states will continue to do their share to reach the U.S. target. Several governors have formed the United States Climate Alliance, a coalition that will convene U.S. states committed to upholding the Paris Agreement while a coalition of states, cities, colleges and universities, and business leaders has also formed to commit to the principles and targets of the agreement; *See Governors Letter to President of the United States*, Georgetown Climate Center (May 3, 2017), http://www.georgetownclimate.org/files/report/Governors-letter-to-POTUS-Paris_Agreement_1.pdf; *Letter from Governors to U.S. Department of Energy*, State of Massachusetts (May 17, 2017), http://www.mass.gov/governor/docs/news/paris-agreement-letter-5-17-17.pdf; *States React to Trump's Decision to Abandon Paris Climate Agreement*, Georgetown Climate Center (June 1, 2017), http://www.georgetownclimate.org/articles/states-react-to-trump-s-decision-to-abandon-paris-climate-agreement.html; *Leaders in the U.S. Economy Say "We Are Still In" on Paris Climate Agreement*, We are Still In (June 5, 2017), http://wearestillin.com/.

more (see Figure III.A-2). However, few have developed comprehensive plans nor implemented specific policies designed to drive the emissions reductions needed to achieve those mid-century targets.

The New Jersey Global Warming Response Act of 2007 (GWRA) requires New Jersey to reduce economy-wide GHG emissions to 1990 levels by 2020 and to 80 percent below 2006 levels by 2050.[85] New Jersey's 2050 limit is similar to the low end of the U.S. long-term vision to reduce GHG emissions to 80 percent or more below 2005 levels by 2050, which the U.S. MCS describes as consistent with the global ambition of the Paris Agreement. New Jersey's 2020 target was achieved in 2008.[86] While New Jersey has described a broad vision for the pathway to 2050 (described below), policies have not yet been put in place that would put the state on that pathway. To help guide a long-term transition, many states have adopted interim emissions targets for years between 2025 and 2040. New Jersey does not have an emissions target over this time period.

III.B. Benefits of Developing Pathways for Achieving Deep Decarbonization Targets

An ambitious long-term emissions target is an important component of a long-term decarbonization strategy, but it is not sufficient in itself. Developing detailed and comprehensive long-term decarbonization pathways is beneficial to a country or sub-national region for various reasons. First, absent a policy that places an economy-wide cap on emissions, detailed planning is required to understand the set of policies, technologies, and economic conditions that will combine to achieve a given long-term emissions target. It can also help to elucidate what near-term emissions objectives are consistent with a pathway to achieving a long-term target.

Second, a comprehensive long-term strategy can highlight opportunities and challenges associated with various decarbonization pathways. For example, pathways may call for the emergence of clean energy technologies that have not yet been proven at the necessary scale, such as carbon capture and storage or the electrification of heavy industry. Overcoming the barriers to the deployment of these technologies may be challenging and time consuming, but it may also provide substantial economic opportunities in a decarbonizing global economy.

Third, a comprehensive, economy-wide analysis is needed to understand important interactions across sectors of the economy. For example, a large expansion of the use of biomass as a source of low-carbon energy is a component of many long-term decarbonization strategies, including as a source of "negative emissions" when biomass is combined with carbon capture and storage.[87] However, the increased use of land for bioenergy production could lead to unintended and detrimental consequences, including

[85] The New Jersey Global Warming Response Act of 2007 (GWRA), **N.J.S.A 26:2C-37.**

[86] Michael Aucott et al., *2012 Update to New Jersey's Statewide Greenhouse Gas Emission Inventory*, Rutgers University (2015), http://climatechange.rutgers.edu/docman-list/special-reports/354-2012-update-to-new-jersey-s-statewide-greenhouse-gas-emission-inventory/file.

[87] Biomass combined with carbon capture and storage can achieve negative emissions if the biomass absorbs CO_2 from the atmophere as it grows and then the CO_2 is captured and permanently sequestered underground when the biomass is burned at power plants.

reducing the land carbon sink or increasing food prices. Careful planning is needed to minimize unwanted effects and ensure that only carbon-beneficial forms of biomass are developed.

Finally, a detailed long-term strategy can point to fundamentally different near-term actions compared to those that would be undertaken to achieve a near-term target. For example, in many places, emissions targets for 2020 and 2030 can be achieved with a significant expansion in the use of natural gas for energy production if the natural gas is replacing more carbon-intensive energy sources like coal or petroleum products. However, to achieve a 2050 target, natural gas may need to be largely replaced with carbon-free energy sources. Since new and long-lived natural gas infrastructure (e.g., power plants) will still be capable of functioning in 2050, building such infrastructure in the near-term could make the 2050 target more difficult and costly to achieve. Moreover, achieving a long-term target cost-effectively may require the support and emergence of technologies like electric vehicles that will not realize their full potential for emissions reductions before the electric grid has been decarbonized.

For these and other reasons, many national and sub-national governments are developing long-term decarbonization strategies. The United States did so under President Obama, whose strategy submitted to the UNFCCC is briefly described below.

III.C. The United States Mid-Century Strategy for Deep Decarbonization

The United States Mid-Century Strategy for Deep Decarbonization (U.S. MCS), submitted by the U.S. Government to the United Nations in November 2016, demonstrates various ways the country can achieve an ambitious long-term GHG emissions pathway while meeting the growing demands on its energy system and lands, maintaining a thriving economy, and ensuring a just transition for Americans whose livelihoods are connected to fossil fuel production and use. While President Trump has announced his intention to withdraw from the Paris Agreement, the United States strategy remains a useful roadmap for cost-effective pathways to deep decarbonization in the coming decades.

The U.S. MCS is grounded in a set of decarbonization scenarios developed using sectoral and economy-wide analyses, including detailed energy and land sector modeling and an integrated economy-wide analysis using the Global Change Assessment Model (GCAM).[88] The U.S. MCS explores six pathways to net GHG emissions of 80 percent below 2005 levels by 2050 that differ based on the availability and penetration of key technologies (e.g., electric vehicles, bioenergy, CCS) and changing societal dynamics (e.g., urban development, land use) over the next few decades, thus demonstrating that deep decarbonization can be achieved in many ways and under many circumstances. The U.S. MCS also explores a seventh "Beyond 80 Percent" scenario, in which the combination of stronger global action to reduce emissions and more rapid advances in low-carbon technologies enables deeper reductions in U.S. emissions by 2050.

[88] GCAM is maintained and run by the Pacific Northwest National Laboratory. Data for the U.S. MCS was developed by experts at the U.S. Department of Energy, the U.S. Environmental Protection Agency, the U.S. Department of Agriculture, and the White House.

Figure III.C-1. United States Mid-Century Strategy for Deep Decarbonization, Pathways and Policies.

Overview of Category of Action:	*Components of Decarbonization Pathways:*	*Policy Prescriptions:*
Transitioning to a Low-Carbon Energy System. *Meeting the growing demands on the U.S. energy system is essential to economic growth and prosperity. Energy is responsible for 80 percent of U.S. GHG emissions, and fossil fuels supply 80 percent of U.S. energy consumption. The U.S. MCS envisions energy CO_2 emissions falling 74 to 86 percent between 2005 and 2050.*	▪ Cut energy waste: primary energy use declines by over 20 percent between 2005 and 2050. ▪ Decarbonize the electricity system: over 90 percent carbon-free generation by 2050 from renewables, nuclear, and fossil fuels with CCUS[89]. ▪ Replace direct fossil fuel use in the transportation, buildings, and industrial sectors: emphasis on electrification and expanded use of bioenergy.	▪ Double clean energy innovation investment. ▪ Encourage deployment of clean energy and energy efficiency. ▪ Reform electricity grid to encourage flexibility, reliability and cost-effectiveness. ▪ Shift to an economy-wide price on carbon over time. ▪ Support for American workers and communities whose livelihoods are tied to a high-carbon economy.
Sequester carbon through forests, soils and CO_2 removal technologies. *U.S. lands sequester over 10 percent of GHG emissions, but aging forests will degrade the land sink over time. Even with action to enhance the land carbon sink, sequestered CO_2 could moderately increase or decrease between 2005 and 2050.*	▪ Bolster carbon stored and sequestered in U.S. lands, including 40-50 million acres of forest expansion by 2035. ▪ Begin to deploy "negative emissions" technologies: bio-energy combined with carbon capture and storage provides 0-5 percent of electricity generation by 2050 (depending on scenario).	▪ Increase incentives for forest carbon enhancing activities and soil carbon sequestration. ▪ Scale up forest restoration and expansion on federal lands. ▪ Promote research and policies that increase working land productivity and promote smart urban development. ▪ Support development and deployment of CO2 removal technologies.
Reduce non-CO_2 greenhouse emissions. *Non-CO_2 GHG emissions result mainly from fossil fuel production, agriculture, waste, and refrigerants, and account for one-fifth of U.S. GHG emissions. The U.S. MCS envisions reductions of non-CO_2 emissions of 10-30 percent between 2005 and 2050.*	▪ Decrease fossil fuel production, achieving co-benefits in methane reduction. ▪ Reduce methane leaks from oil and gas systems and coal mines. ▪ Reduce methane and nitrous oxide emissions from agriculture and waste streams. ▪ Reduce hydrofluorocarbons (HFCs) from refrigeration and air conditioning.	▪ Better measure and monitor diffuse methane sources. ▪ Enhance regulations to reduce methane leaks. ▪ Increase RD&D90 and incentives to reduce nitrogen fertilizer application in agriculture. ▪ Scale up RD&D and incentives to reduce livestock-related methane. ▪ Implement policies that promote alternatives and proper disposal for HFCs.

[89] CCUS refers to carbon capture, utilization and storage.

[90] RD&D refers to research, development & deployment

The U.S. MCS emphasizes three broad categories of action: (1) transitioning to a low-carbon energy system;[91] (2) sequestering carbon through forests, soils and CO_2 removal technologies, which are sources of "negative emissions;" and (3) reducing non-CO_2 greenhouse gas emissions. For each category, the pathways and high-level policy prescriptions consistent with the long-term vision are summarized in Figure III.C.-1.

The energy system pathway consists of an initial focus on improving energy efficiency and decarbonizing the electricity sector, where many low-cost and low-carbon opportunities exist today and more will become cost effective as low carbon generation sources and enabling technologies (e.g., energy storage, grid flexiblity) continue to progress. Over time, the remaininder of the energy system is decarbonized by switching to low-carbon fuels such as clean electricity or low-carbon forms of biomass. The energy transition is propelled by policies that promote innovation, encourage more efficient energy production and use, and put a price on carbon emissions. The strategy for sequestering carbon focuses on policies and incentives that create larger and more productive forests, but also stresses the importance of improving crop yields and soil carbon sequestration, as well as smarter urban development. Strategies for reducing non-CO_2 GHG emissions vary due to the diversity of emissions sources, but a common theme is the need for technological innovation to identify low-carbon and low-cost alternatives to major sources of methane, nitrous oxide and hydroflourocarbon (HFC) emissions.

While U.S. MCS shows that deep decarbonization is achievable by mid-century, current policies do not put the country on a successful pathway. Total U.S. net GHG emissions were 5,528 $MMTCO_2e$ in 2015, 11 percent below 2005 levels.[92] Future U.S. emissions depend on a range of uncertain factors, including the evolution of the economy, the energy system and the land sector. A recent analysis by the Rhodium Group that explores each of these uncertainties finds that under current policies, emissions could be as high as 13 percent and as low as 23 percent below 2005 levels in 2025, with all scenarios missing the 2025 target of 26-28 percent reductions.[93]

III.D. Other Deep Decarbonization Pathways and General Takeaways from the Literature

Aside from the U.S. MCS, various other studies have developed detailed pathways to deep decarbonization, particularly for the energy sector. In addition to the United States, four other countries have submitted 2050 national strategies to the UNFCCC: Germany, France, Canada and Mexico. Various U.S. states are also moving forward with developing detailed long-term planning, including New York, which has developed a Climate Action Plan to 2050.[94] California passed climate change legislation in 2006 requiring the state to adopt regulations to achieve the maximum technologically feasible and cost-

[91] The U.S. energy system includes demands for energy services within the United States for transportation, industrial uses, and in both residential and commercial buildings; it includes energy supplied directly from fossil fuels or renewable sources, as well as electricity produced from these sources.

[92] *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2015*, U.S. Environmental Protection Agency (March 2015), https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2015.

[93] *Taking Stock 2017: Adjusting Expectations for US GHG Emissions*, Rhodium Group (May 2017), http://rhg.com/wp-content/uploads/2017/05/RHG_ENR_Taking_Stock_24May2017.pdf. The Rhodium study does not account for the potential for additional policy action, either at the national or sub-national level.

[94] *See generally Climate Action Plan Interim Report, New York Department of Environmental Conservation*, http://www.dec.ny.gov/energy/80930.html (last retrieved June 1, 2017).

effective GHG emissions reductions. California has since implemented sweeping legislation to drive down GHG emissions within the state, including setting a declining annual cap on most emissions sources within the state and establishing a 2050 target of 80 percent below 1990 levels.[95]

Non-government organizations have also produced important contributions to the literature on deep decarbonization pathways at the global, national, and subnational levels. The Deep Decarbonization Pathways Project (DDPP) is a global collaboration of research teams that has developed technically feasible deep decarbonization pathways for 16 countries, as well as a synthesis report published in 2014.[96] In 2016, The Risky Business Project published deep decarbonization pathways for the U.S. energy system using a similar modeling approach to the DDPP but with a greater focus on the economic opportunities for businesses and investors of the transition to a low-carbon energy system.[97] Stanford's Energy Modeling Forum, which brings together leading experts from around the world to examine important energy and environmental issues, has devoted projects to both U.S. and global decarbonization scenarios.[98]

Certain general themes have emerged from this literature on deep decarbonization pathways that are applicable regardless of jurisdiction:[99]

- There are many pathways to deep decarbonization, including pathways that do not require major technological breakthroughs.[100]
- Innovation in low-carbon technologies lowers the cost of decarbonization and can enable a more rapid pace of decarbonization.[101]
- Certain low-carbon technologies and strategies are emphasized in nearly all decarbonization pathways, including energy efficiency improvements, increased usage of solar, wind and bio-energy, and increased electrification of energy end-uses.
- Technological innovation alone will not lead to deep decarbonization. Strong policies, such as a price on greenhouse gas emissions and/or regulations of major emitters, are needed to drive deep reductions in greenhouse gas emissions.

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[95] *See generally, Assembly Bill 32 Overview*, California Air Resources Board, https://www.arb.ca.gov/cc/ab32/ab32.htm (last retrieved June 1, 2017).

[96] *See generally Deep Decarbonization Pathways Project*, Deep Decarbonization Pathways Project, http://deepdecarbonization.org/ (last retrieved June 1, 2017).

[97] *See generally Reports*, Risky Business, https://riskybusiness.org/reports/ (last retrieved June 1, 2017).

[98] *See* John Weyant et al., *EMF 24: U.S. Technology and Climate Policy Strategies*, Stanford University (August 1, 2014), https://emf.stanford.edu/projects/emf-24-us-technology-and-climate-policy-strategies; John Weyant et al., *EMF 27: Global Model Comparison Exercise*, Stanford University, https://emf.stanford.edu/projects/emf-27-global-model-comparison-exercise (last retrieved June 1, 2017).

[99] Examples drawn from the U.S. MCS

[100] Most decarbonization studies rely only on technologies that are either currently or near-currently available commercially. The U.S. MCS and many other studies show pathways that exclude existing technologies that have not been deployed widely, such as carbon capture and storage. Brand new technologies that may or may not emerge are typically excluded entirely (e.g. a cost-effective way to store electricity over many months).

[101] The Stanford's Energy Modeling Forum (EMF) 24 asked teams of modelers to compare scenarios with "optimistic" and "pessimistic" assumptions about technology costs. Results show the costs of achieving 50 percent emission reductions are about twice as high with pessimistic technology cost assumptions than with optimistic assumptions.

- The economic costs of decarbonization are highly dependent on policy structures, with strategies that include flexible and comprehensive policies such as economy-wide carbon prices producing the most beneficial economic outcomes.[102]
- The sooner climate policy action is implemented, the cheaper it is to achieve a given emissions target.[103]

III.E. Comparison of Deep Decarbonization Pathways for New Jersey and the United States

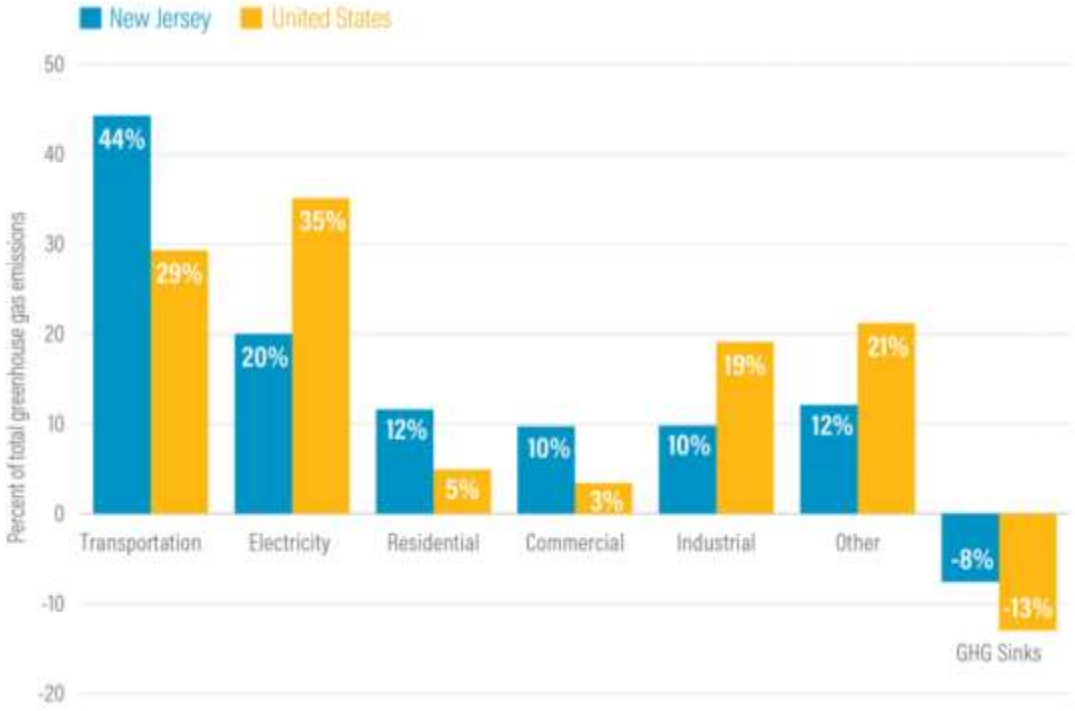
The U.S. MCS and the broader literature on deep decarbonization pathways provide important context for considering decarbonization pathways and strategies for the state of New Jersey. Indeed, each of the general themes that have emerged from the literature (listed above in Section III.D.) apply to New Jersey. By implementing strong, comprehensive and flexible policies that encourage reductions in GHG emissions, and by supporting the emergence of a broad range of low-carbon technologies, New Jersey can take important and cost-effective steps to reduce its GHG emissions.

At the same time, the pathways to deep decarbonization in New Jersey will depend on the specific circumstances of the state, because emissions sources and opportunities for emissions reductions differ from other states and countries.

Figure III.E-1 shows GHG emissions for New Jersey compared to the United States in 2012, the last year an emissions inventory for the state was completed.[104] In New Jersey, GHG emissions per capita were 13 tonnes of CO_2-equivalent emissions, compared to 17 for the United States as a whole.[105] Emissions from electricity generation were responsible for just 20 percent of total emissions in New Jersey, compared to 35 percent for the United States, largely due to the state's reliance on nuclear power for electricity. In contrast, New Jersey emissions are largely from mobile sources and from direct fossil fuel use in homes and businesses. New Jersey's pathway to deep decarbonization may therefore require a larger emphasis on driving down emissions from these sources.

[102] EMF 24 explored a pathway that involved only increasingly stringent electricity and transportation regulations, and found costs that were two to five times higher than an economy-wide carbon price that achieved the same emissions reductions.
[103] *The Cost of Delaying Action to Stem Climate Change*, White House Council of Economic Advisers (July 2015), https://obamawhitehouse.archives.gov/blog/2014/07/29/new-report-cost-delaying-action-stem-climate-change.
[104] *See* Michael Aucott et al., *2012 Update to New Jersey's Statewide Greenhouse Gas Emission Inventory*, Rutgers University (2015), http://climatechange.rutgers.edu/docman-list/special-reports/354-2012-update-to-new-jersey-s-statewide-greenhouse-gas-emission-inventory/file.
[105] *CAIT Climate Data Explorer*, World Resources Institute, http://www.wri.org/our-work/project/cait-climate-data-explorer (last retrieved June 1, 2017).

Figure III.E-1. Percent of Greenhouse Gas Emissions by Sector, New Jersey and United States 2012.



Source: Rutgers 2012 Update to New Jersey's Statewide Greenhouse Gas Emission Inventory; EPA Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2015.

In achieving deep decarbonization, New Jersey has potential advantages compared to other U.S. states:

- Compared to other states, New Jersey generates far more of its electric power from carbon-free sources, due to nearly half of its electricity generation coming from nuclear energy. Indeed, New Jersey has the fifth-lowest carbon dioxide emissions rate for electricity production of all U.S. states.[106] Given that most deep decarbonization pathways show the near-complete decarbonization of the electricity system, New Jersey has a significant head start.
- The New Jersey coastline gives it a large opportunity to generate electricity with off-shore wind. While off-shore wind is not a contributor to the state's electricity system today, the New Jersey Department of Environmental Protection (NJ DEP) projects the state could deploy up to 7 to 8 GW of electricity capacity by 2035.[107] This represents nearly 40 percent of the state's current total electricity capacity.[108] With significant advances in tidal energy, this technology could represent an additional opportunity for electricity production from the New Jersey coastline.

[106] State of New Jersey, 2015 New Jersey Energy Master Plan Update (December 2015), http://nj.gov/emp/docs/pdf/New_Jersey_Energy_Master_Plan_Update.pdf. Calculated in terms in tons per MWh generated.
[107] *2050 GHG Emissions Scenarios Report On-Line*, State of New Jersey Department of Environmental Protection, http://www.nj.gov/dep/ages/sggi.html (last retrieved June 1, 2017).
[108] *See New Jersey Electricity Profile 2015*, U.S. Energy Information Administration (2015), https://www.eia.gov/electricity/state/newjersey/.

- New Jersey's location in the Northeast and Mid-Atlantic and the integration of its economy with neighboring states affords the opportunity to participate in multi-state decarbonization initiatives.
- As a densely populated state, New Jersey may see relatively large benefits from pursuing "smart growth" strategies such as improved urban development, well-developed mass transit, and shared mobility, which can reduce demands on both the energy system and lands, and yield important co-benefits including advancing livable communities and promoting environmental justice. Indeed, New Jersey has already made considerable progress, with development patterns that focus on infill and relatively high level of transit use.
- New Jersey has relatively low emissions from the industrial sector (10 percent of New Jersey's emissions compared to nearly 20 percent for the United States), in which deep emissions cuts are generally more expensive to achieve.[109]
- New Jersey has a history of establishing authorities to regulate a broad range of greenhouse gas emission sources, including landfills, industrial sources and natural gas pipelines.

However, New Jersey's "head start" in the decarbonization of its electricity system could be undercut by the retirement of nuclear power plants, which currently produce well over 90 percent of the state's carbon free electricity. The 636 megawatt Oyster Creek nuclear power plant is scheduled to shut down in 2019, and others may follow.[110] The other nuclear power plants in New Jersey include the Salem Nuclear Generating Station (licensed through 2036 for Unit 1 and 2040 for Unit 2) and Hope Creek (licensed through 2046).[111] The retirement of the current nuclear fleet could increase the costs and feasibility of decarbonization, particularly if other large sources of continuous carbon free electricity generation (e.g. fossil fuels with carbon capture and storage) do not emerge.

New Jersey also faces certain disadvantages as a relatively small and dense northeastern U.S. state. For example, New Jersey may not have the land or climate needed to expand the use of land-based wind energy or utility-scale solar energy to the same degree as other U.S. states. Still, even utility-scale solar and land-based wind energy can see significant growth compared to their small contributions today, particularly with a more flexible grid that enables an increase in the penetration of intermittent electricity generation.[112]

[109] Analyses of cost-effective emissions reduction pathways in the United States show that in the early years, emissions reductions come disproportionately from electricity, with relatively fewer from industry; *See Delivering on the U.S. Climate Commitment: A 10-Point Plan Toward a Low-Carbon Future*, World Resources Institute (May 27, 2015), http://www.wri.org/events/2015/05/delivering-us-dimate-commitment-10-point-plan-toward-low.

[110] The CEO of PSEG has warned that without policy support, its nuclear plants may not be economically feasble to continue operating. Tom Johnson, *PSEG Warns that Without Subsidies Nuclear Plants Could Go Dark*, NJ Spotlight (March 7, 2017), http://www.njspotlight.com/stories/17/03/06/pseg-warns-that-without-subsidies-nuclear-plants-could-go-dark/.

[111] https://www.pseg.com/family/power/nuclear/salem.jsp and https://www.pseg.com/family/power/nuclear/hope_creek.jsp.

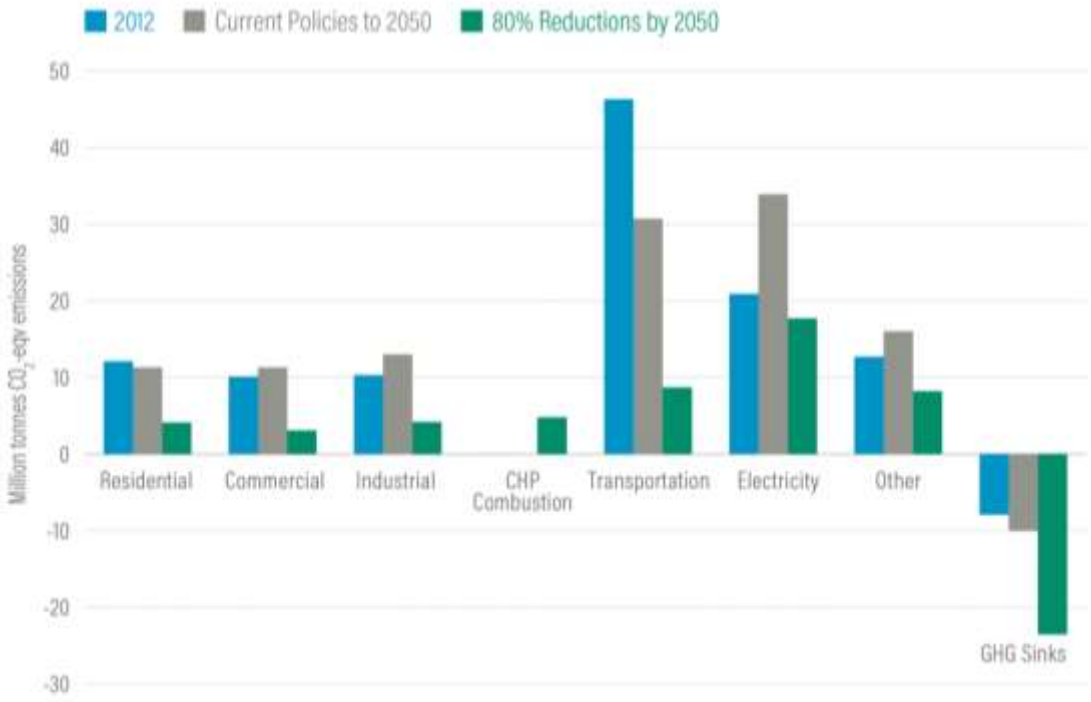
[112] *2050 GHG Emissions Scenarios Report On-Line*, State of New Jersey Department of Environmental Protection, http://www.nj.gov/dep/aqes/sggi.html (last retrieved June 1, 2017).

III.F. Deep Decarbonization Pathways for New Jersey

In 2015, The New Jersey Department of Environmental Protection published a high-level description of a pathway to achieving 80 percent emissions reductions from 2006 levels by 2050,[113] summarized in Figures III.F-1 and III.F-2 ("the NJ DEP Pathway"). The NJ DEP Pathway identifies the following four broad priorities for achieving the 2050 target:

1. Energy efficiency measures for buildings, industry, and transportation;
2. Electrification to avoid combustion wherever it is possible;
3. Non-combustion electricity generating technology (e.g., renewables and nuclear); and
4. Measures to increase and enhance natural sinks.

Figure III.F-1. New Jersey DEP Scenarios Report: Greenhouse Gas Emissions by Sector.



Notes: 2012 emissions are from Aucott et al. (2015) 2012 Update to New Jersey's Statewide Greenhouse Gas Emission Inventory; "Current Policies to 2050" is DEP's "Base Case" scenario, described as its "business-as-usual" pathway; "80 percent Reductions by 2050" is DEP's "Green" scenario, representing the successful achievement of the New Jersey target of reducing GHG emissions by 80 percent below 2006 levels by 2050.

[113] *2050 GHG Emissions Scenarios Report On-Line*, State of New Jersey Department of Environmental Protection, http://www.nj.gov/dep/aqes/sggi.html (last retrieved June 1, 2017). Neither the methodology nor the full results are available that would enable a detailed understanding of the decarbonization pathway or a comparison with other studies.

In the electricity sector, the NJ DEP pathway involves an aggressive expansion of wind and solar energy as well as the addition of new nuclear power plants. This large buildout of the electricity system is needed because NJ DEP describes the "electrification" of significant portions of the residential, commercial, industrial and transport sectors. The NJ DEP Pathway also involves large increases in energy efficiency across all sectors, reducing the demands on the energy system.[114]

The NJ DEP describes a broadly similar pathway as the U.S. MCS and other studies in the deep decarbonization literature, but some key differences are worthy of note. Despite New Jersey's head start on decarbonizing the electricity system, the NJ DEP Pathway shows larger emissions from the electricity sector in 2050 compared to other studies due to a continued heavy reliance on natural gas. 2050 electricity sector emissions in the NJDEP Pathway are only modestly lower than 2012 emissions levels, whereas the US MCS shows the near-complete decarbonization of the sector by 2050, with only a small amount of uncontrolled natural gas remaining. Conversely, the NJ DEP Pathway shows much deeper emissions reductions in the transportation sector than other studies. Electric vehicles comprise 90 percent of the light-duty fleet by 2050 in the NJDEP Pathway, compared to roughly 60 percent in the U.S. MCS "Benchmark" scenario.

Another key difference is the NJDEP Pathway's three-fold increase in "negative emissions" provided by the land carbon sink by 2050. In contrast, the U.S. MCS Benchmark scenario shows that even with a large reforestation effort, the nationwide land carbon sink would be moderately smaller than today's levels in 2050. According to NJ DEP, the increased land carbon sink will be achieved by expanding, accelerating and aggressively implementing state programs related to forests, wetlands and agriculture, as well as "new and radical initiatives" to protect and restore forested wetlands, bio-char production from fast growing tree plantations, bio-char soil augmentation, and urban green space vegetative cover retention.[115]

In addition, in some scenarios of the US MCS, sequestration by land carbon sinks is supplemented by the emergence of a technology that combines biomass energy production with carbon capture and storage (often referred to as "BECCS"). As noted in the U.S. MCS, while BECCS is not widely used today, there are no known technical barriers preventing its use in the electricity, transportation, and industrial sectors. With appropriate carbon accounting frameworks in place to ensure that bioenergy production is carbon beneficial, BECCS can be a source of negative emissions. The BECCS technology is not mentioned as a contributor to the NJDEP Pathway.

NJDEP does not provide detailed descriptions of decarbonization pathways in all sectors of the economy. For example, achieving 80 percent reductions in GHG emissions from mobile sources, as described in the NJDEP Pathway, will require a shift away from the use of petroleum fuel for trucks and other heavy-duty vehicles. But a strategy for decarbonizing the heavy-duty vehicle fleet is not mentioned by the NJ DEP.[116]

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[114] *Id.* The natural gas "technical" energy efficiency (EE) potential identified by NJ Board of Public Utilities (BPU) commissioned study is applied, i.e., all EE measures recommended by the study are assumed to be adopted without cost constraints. . See NJDEP website: http://www.nj.gov/dep/aqes/sggi.html (accessed June 1, 2017).

[115] *2050 GHG Emissions Scenarios Report On-Line*, State of New Jersey Department of Environmental Protection, http://www.nj.gov/dep/aqes/sggi.html (last retrieved June 1, 2017).

[116] Other studies have emphasized the increased use of electricity, hydrogen or biomass fuels for heavy-duty vehicles, as well as increasing the use of rail for freight.

Figure III.F-2. New Jersey DEP Scenarios Report: Summary of Pathway to 2050 Target.

Sector	*Pathway highlights*
Electricity	▪ Eliminate use of coal ▪ Two new nuclear plants are added; Oyster creek nuclear power plant retires ▪ Large expansion of solar (16.4 percent of load in 2050) ▪ Large expansion of wind energy (over 7 GW of capacity) ▪ Load projections from 2011 Energy Master Plan to 2020, constant thereafter
Transportation	▪ Light-duty vehicle fleet is 25 percent electric by 2035 and 90 percent electric by 2050 ▪ Fuel efficiency gains consistent with Obama Administration CAFE standards
Residential, Commercial, Industrial	▪ Energy consumption from EIA's 2012 Annual Energy Outlook Reference Case ▪ 35 percent of energy demand is electrified ▪ All identified natural gas energy efficiency "technical potential" achieved[117]
Non-CO_2	▪ 50 percent reductions in HFC and 75 percent reductions in natural gas transmission and distribution GHG emissions compared to baseline scenario
Land	▪ Land sink expands three-fold with new programs that address forest stewardship and expansion, sustainable agriculture, wetlands, bio-char, and urban green space vegetative cover retention

Other organizations have called for pathways to 100 percent renewable energy in New Jersey, including Environment New Jersey[118] and The Solutions Project.[119] Supporters of 100 percent renewable pathways exclude the use of other low- or zero- carbon energy sources such as nuclear energy and fossil fuels combined with CCS, and sometimes also rule out the use of biomass energy. While pursuing a renewables-only pathway to deep decarbonization is likely to be more challenging and more expensive than pursuing a more diverse portfolio of clean energy technologies,[120] 100 percent renewable energy pathways have garnered considerable support from the environmental community and from prominent activists and politicians.[121]

III.G. Future Work on New Jersey Deep Decarbonization Pathways

Of course, both in planning and implementing long-term decarbonization in New Jersey, important work remains. First, developing detailed and comprehensive pathways to deep decarbonization will enable a better understanding of the set of policies, technologies, and economic conditions that will combine to achieve New Jersey's emissions target, and elucidate what near-term actions are consistent with a cost-effective pathway to deep decarbonization. By revisiting its long-term strategy on a regular basis, New

[117] ENERNOC, Utility Solutions consulting, New Jersey Energy Efficiency Market Potential Assessment Report Number 1401 (October 2012).

[118] *See generally About Environment New Jersey*, Environment New Jersey, http://www.environmentnewjersey.org/page/nje/about-environment-new-jersey (last retrieved July 11, 2017)

[119] Mark Z. Jacobsen et al., *100 percent clean and renewable wind, water, and sunlight (WWS) all-sector energy roadmaps for the 50 United States*, 8 Energy & Environmental Science 2093 (2015).

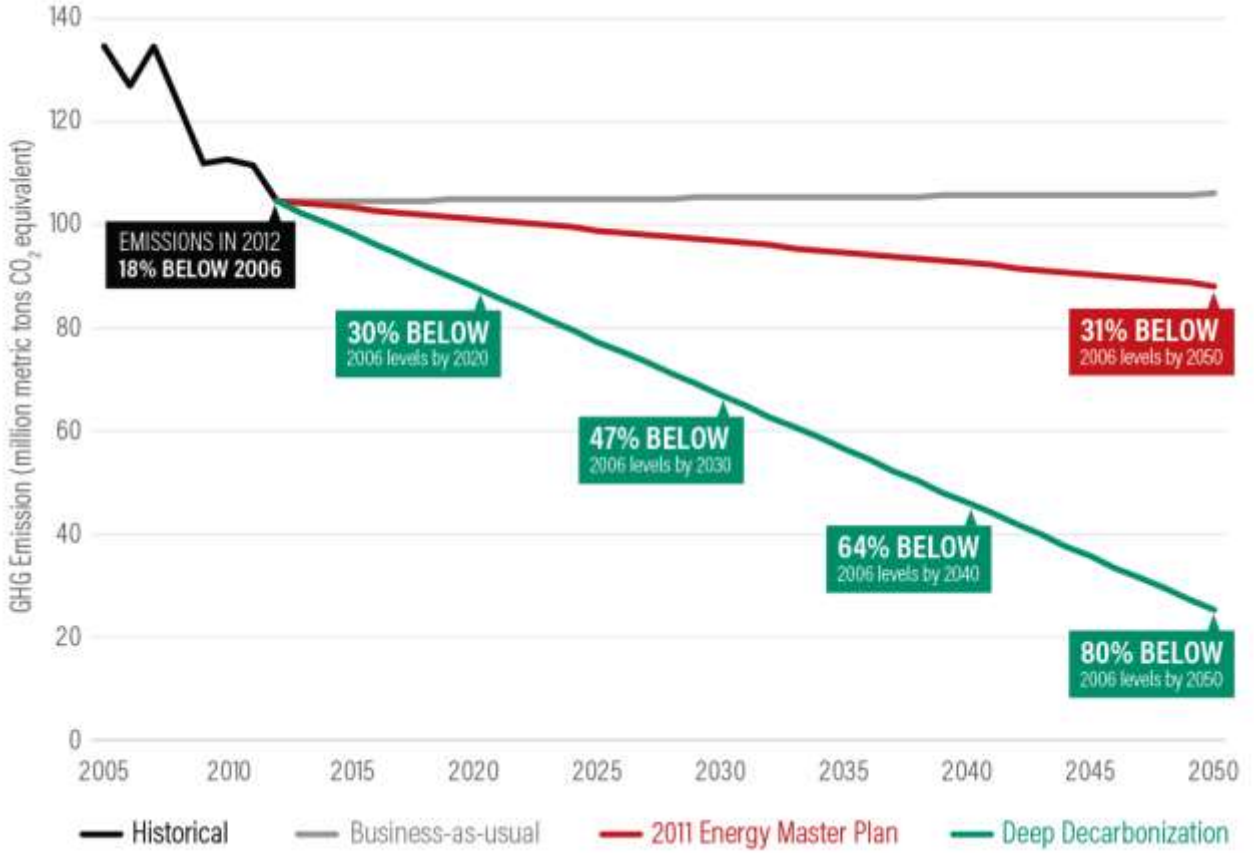
[120] *E.g.*, John Weyant et al., *EMF 27: Global Model Comparison Exercise*, Stanford University, https://emf.stanford.edu/projects/emf-27-global-model-comparison-exercise (last retrieved June 1, 2017).

[121] For example, U.S. Senators Bernie Sanders (I-Vt.), Jeff Merkley (D-Ore.), and Edward J. Markey (D-Mass.) introduced federal legislation in April 2017 for a 100 percent renewable energy economy by 2050; *See* 100 by '50 Act, S.987 (115th), https://www.merkley.senate.gov/imo/media/doc/100%20by%2050%20Act%20text.pdf (last retrieved June 1, 2017).

Jersey can periodically update its decarbonization pathways to account for important changes in technologies, consumer behavior, and market conditions.

Perhaps the largest unanswered question—not only for New Jersey but also for the country and the world—is how to implement policies that match the ambition of long-term GHG emissions targets. Indeed, while New Jersey has made important progress in recent years—statewide emissions declined over 20 percent between 2005 and 2012[122]—the state is far from a pathway that will lead to achieving the 2050 target of 80 percent reductions by 2050.

Figure III.G-1. New Jersey Greenhouse Gas Emissions Pathways to 2050.



Notes: Historic data from the 2012 Update to New Jersey's Statewide Greenhouse Gas Emission Inventory.Each of the three projections scenarios are straight-line pathways from 2012 emissions to the 2050 results from the NJ Department of Environmental Protection's 2050 GHG Emissions Scenario Report. "Business-as-usual" is the grey scenario; "2011 Energy Master Plan" (EMP) pathway is the red scenario; Deep Decarbonization Pathway is the green scenario.

The NJDEP Pathway to 2050 does not identify the policies that will achieve deep decarbonization. The State of New Jersey's Energy Master Plan, developed in 2011 and updated in 2015, provides policy recommendations across various categories, including promoting renewables, promoting conservation

[122] Michael Aucott et al., *2012 Update to New Jersey's Statewide Greenhouse Gas Emission Inventory*, Rutgers University (2015), http://climatechange.rutgers.edu/docman-list/special-reports/354-2012-update-to-new-jersey-s-statewide-greenhouse-gas-emission-inventory/file; *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2015*, U.S. Environmental Protection Agency (March 2015), https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2015.

and energy efficiency, supporting innovative energy technologies, and improving energy infrastructure.[123] But many of the recommendations are not specific (e.g., "support off-shore wind"), and, as a whole, they do not constitute a policy roadmap of the scale or scope of the energy transition required to achieve deep decarbonization by 2050. Figure III.G-1 shows the NJDEP's estimates of business-as-usual and NJ Energy Master Plan scenarios, neither of which achieve the necessary emissions reductions in the coming decades.[124] It also shows a pathway to achieving the 2050 target of 80 percent reductions, which points to medium-term objectives of roughly 47 percent below 2006 levels by 2030 and 64 percent below 2006 levels by 2040.

Figure III.C-1 above shows the policy recommendations from the U.S. MCS for transitioning to a low-carbon energy system, reducing non-CO_2 emissions and sequestering carbon in U.S. lands. The detailed energy sector modeling published in the U.S. MCS showed that in combination with strong support for clean energy innovation, a price on carbon dioxide emissions that starts at $20 per ton in 2017 and increases by 5 percent per year has the potential to achieve emissions reductions in line with the national long-term emissions target through at least 2040.[125]

Fortunately, revolutionary advancements in clean energy technologies in recent years have begun to break down previously intractable political barriers by reducing the costs of switching away from fossil fuels. Figure III.G-2 shows reductions in costs of various clean energy technologies since 2008, including for land-based wind, utility scale solar, and electric vehicle batteries of 41 percent, 64 percent and 73 percent, respectively.[126] In addition, the average capital cost of an off-shore wind energy plant fell 10 percent in 2016 alone.[127]

Advances in clean energy technologies have led to large increases in the deployment of these technologies, which in turn have led to even greater cost reductions through learning and economies-of-scale.[128] Clean energy innovation has also made decarbonization policies more economically attractive, thus increasing policy ambition, which causes increased deployment and further cost reductions costs. Going forward, these mutually reinforcing cycles of innovation, deployment, and policy are likely to continue to make decarbonization increasingly cost-effective and politically feasible.

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[123] State of New Jersey, 2015 New Jersey Energy Master Plan Update (December 2015), http://nj.gov/emp/docs/pdf/New_Jersey_Energy_Master_Plan_Update.pdf.

[124] The 2015 update to the NJ Energy Master Plan provides certain additional recommendations compared to the 2011 plan. While no modeling is available of the 2015 version, the updates to the 2011 version all appear to be relatively minor from the perspective of statewide emissions.

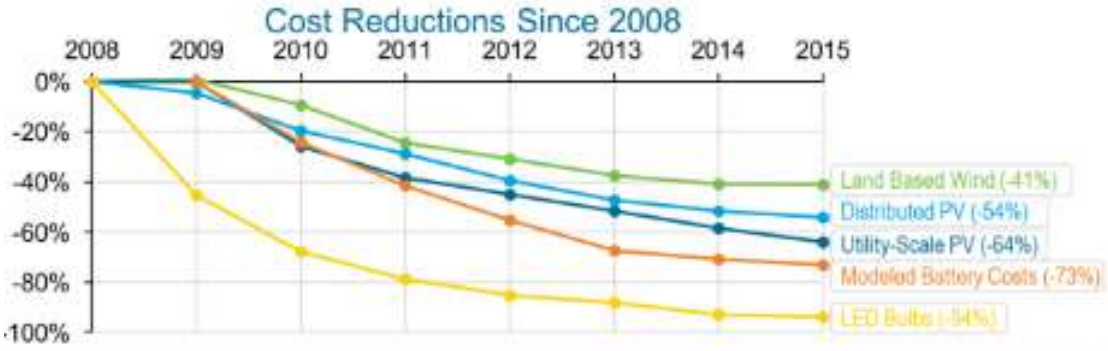
[125] White House, United States Mid-Century Strategy for Deep Decarbonization (2016), http://unfccc.int/files/focus/long-term_strategies/application/pdf/mid_century_strategy_report-final_red.pdf.

[126] U.S. Department of Energy, The Future Arrives for Five Clean Energy Technologies - 2016 Update (2016), https://energy.gov/sites/prod/files/2016/09/f33/Revolutiona%CC%82%E2%82%ACNow%202016%20Report_2.pdf.

[127] *Global Trends in Renewable Enregy Investment 2017*, Frankfurt School FS-UNEP Collaborating Centre for Climate & Sustainable Energy Finance (2017), http://fs-unep-centre.org/sites/default/files/publications/globaltrendsinrenewableenergyinvestment2017.pdf.

[128] Richard D. Duke & Daniel M. Kammen, *PV Market Transformation: The virtuous circle between experience and demand and the strategic advantage of targeting thin-film photovoltaics*, 20 Energy Journal 15-64 (1999). Workshop proceedings of the IEA Workshop. "Experience Curves for Policy Making: The Case of Energy Technologies, Stuttgart, 10-11 May, 1999 (IEA Volume), 77 – 100; and Juliana S. Lacerda & Jeroen C.J.M. van den Bergh, *International diffusion of renewable energy innovations: Lessons from the lead markets for wind power in China, Germany and USA*, 7 Energies 8237 (2014), www.mdpi.com/1996-1073/7/12/8236/pdf.

Figure III.G-2. Clean Energy Cost Reductions Since 2008.



Notes: Land based wind costs derived from levelized cost of energy from representative wind sites from references [1] and [2]. Distributed PV is average residential installed cost from reference [3]. Utility-Scale PV is median installed cost for utility-scale PV systems from reference [4]. Modeled battery costs are at high-volume production of battery systems, derived from DOE/UIS Advanced Battery Consortium PHEV Battery development projects. LED bulbs are for A-type bulbs from reference [5].

IV. State Policy Models for Reducing GHG Emissions

States are increasingly working to reduce greenhouse gas emissions from various sectors and sources. In the United States, states have historically been leaders in developing and implementing climate and clean energy policies. States have implemented policies to cap GHG emissions, promote renewable energy and energy efficiency, encourage the use of cleaner vehicles and fuels, support more compact land use, and reduce methane and other highly warming gas emissions, among others.

This document provides a preliminary overview of several mitigation strategies that states are using to reduce or sequester emissions. The strategies for emissions reductions center on those sectors that are the largest contributors to GHG emissions in New Jersey.[129] This includes overviews of strategies in the following categories:

- Setting interim targets
- Emission budgets and carbon pricing policies (that can cover multiple sectors)
- Power
- Transportation
- Commercial and residential buildings
- Methane emissions from the natural gas supply chain
- Other high global warming potential GHGs
- Forestry practices
- Strategies for addressing equity considerations.

Descriptions include recent or notable examples of state action and examples on effectiveness and impacts where available. Each section notes whether New Jersey already has policies of this type, and notes if the legal analysis in Section V discusses legal authority for such policies.

IV.A. Setting Interim Reduction Targets and GHG Planning Processes

As discussed in the previous chapter, setting GHG reduction goals and planning to meet goals are foundational strategies for achieving the required level of GHG emission reductions. Many states have established near-term and long-term GHG emission reduction goals, including limits set by New Jersey

[129] Sectors not addressed herein include: agriculture which is less than one percent of New Jersey's GHG emissions; industrial non-fuel emissions (other than halogenated gases which are addressed in this report) which are less than 1% of New Jersey's GHG emissions; and waste management which is less than five percent of New Jersey's GHG emissions and for which for which New Jersey had a 12.4 percent reduction in emissions from 1990-2012 from landfills due to closures and less out of state waste; *See* Michael Aucott et al., *2012 Update to New Jersey's Statewide Greenhouse Gas Emission Inventory*, Rutgers University (2015), http://dimatechange.rutgers.edu/docman-list/special-reports/354-2012-update-to-new-jersey-s-statewide-greenhouse-gas-emission-inventory/file.

for 2020 and 2050.[130] Mirroring the architecture of the Paris Agreement,[131] several states are now setting interim goals for years in the range of 2025 to 2035 that set them on the path to achieve the 2050 goal.[132] These states are also establishing complementary processes to develop plans to meet the goals, track emissions, and report regularly on progress.

The Paris Agreement requires countries to set goals and describe plans for meeting goals, report on progress, collectively take stock, and then set new goals with the aim of sufficiently increasing ambition to meet the agreement's temperature target. Setting interim goals can serve an analogous function at the state level, creating a measurable pathway to achieving long-term goals. As described above, fourteen states—California, Connecticut, Colorado, Delaware, Hawaii, Massachusetts, Minnesota, New York, Oregon, Puerto Rico, Rhode Island, Vermont, Virginia, and Washington—have committed to upholding the Paris Agreement in light of President Trump's announced intention to withdraw the United States from the agreement as part of the United States Climate Alliance.[133]

This chapter reviews the mid-term GHG emission reduction targets that some states have adopted and discusses the complementary processes that several states are using to develop plans to achieve the interim targets, report on emissions, and track progress.

State Policy Model	*Notable Implementations*	*Related New Jersey Actions?*	*Notes*
Interim GHG goal	CA, CO, DC, DE, MD, MN, NH, NY, RI, VT, WA have set interim targets, as has the New England region	No	
Comprehensive GHG planning, reporting, and progress tracking	CA, MA, MD	GWRA requires GHG emissions monitoring and biennial reporting and progress tracking	NJ did not adopt the GHG emissions monitoring and reporting regulations required by the GWRA

[130] N.J. Stat. Ann. § 26:2C-39 to 40 (2017); *see, e.g.*, Ct. Public Act No. 08-98 (2008) (setting 2050 goal); Md. Sen. Bill 278 (2009) (setting 2050 goal); Mass. Global Warming Solutions Act (2008) (setting 2050 goal); Minn. Stat. § 216H.02, subd. 1. (2017) (setting 2050 goal); Wash. Rev. Code § 70.235.020(1)(a) (2017) (setting 2050 goal); Governor Arnold Schwarzenegger, Ex. Order S-3-05 (2005) (setting 2050 goal); and N.H. Dept't of Entvl. Servs., The New Hampshire Climate Action Plan: A Plan for New Hampshire's Energy, Environmental and Economic Development Future 1 (2009), http://des.nh.gov/organization/divisions/air/tsb/tps/climate/action_plan/nh_climate_action_plan.htm (setting 2050 goal) [hereinafter New Hampshire Climate Action Plan].

[131] The Paris Agreement committed the world's nations to the long-term goal of holding the increase in global average temperatures to well below two degrees Celsius above pre-industrial levels through "rapid reductions" in GHG emissions. Paris Agreement, art. 2, 4, Dec. 12, 2015, UNFCCC CP 2015 L.9 Rev. 1 [hereinafter Paris Agreement].

[132] *See, e.g.*, Cal. Sen. Bill 32 (2016) (setting 2030 goal); Md. Envir. Code Ann. § 2-1204.1 (2017) (setting 2030 goal); Minn. Stat. § 216H.02, subd. 1. (setting 2025 goal); Wash. Rev. Code § 70.235.020(1)(a) (setting 2035 goal); New Hampshire Climate Action Plan at 1 (setting 2025 goal).

[133] In response to President Trump's announcement that he intends to withdraw the U.S. from the Paris Agreement, the governors of California, New York, and Washington announced a new U.S. Climate Alliance that will be committed to upholding the Paris Climate Agreement and will take aggressive action on climate change. *See* Press Release of Governor Andrew M. Cuomo, *New York Governor Cuomo, California Governor Brown, And Washington Governor Inslee Announce Formation of United States Climate Alliance* (June 1, 2017), http://governor.wa.gov/news-media/inslee-new-york-governor-cuomo-and-california-governor-brown-announce-formation-united. By July 11, 2017, 11 other governors announced that they were joining the alliance, https://www.usdimatealliance.org/

IV.A.1 State Interim Targets

Ten states and the District of Columbia have adopted interim GHG emission reduction targets for years between 2025 and 2035 through legislation or executive action (as shown in Figure IV.A.-1). These ten states and the District of Columbia have different emission reduction targets and different baseline years from which they measure the required level of emission reductions:

State	*Interim Targets*	*Mechanism to Establish Targets*
California[134]	40 percent target by 2030 below 1990 levels	Legislation
Colorado[135]	25 percent by 2025 below 2005 levels	Executive Action
Delaware[136]	30 percent target by 2030 below 2008 levels	Executive Action
District of Columbia[137]	50 percent target by 2032 below 2012 levels	Executive Action
Maryland[138]	40 percent target by 2030 below 2006 levels	Legislation
Minnesota[139]	30 percent by 2025 below 2005 levels	Legislation
New Hampshire[140]	20 percent by 2025 below 1990 levels	Executive Action
New York[141]	40 percent target by 2030 below 1990 levels	Executive Action
Rhode Island[142]	45 percent target by 2035 below 1990 levels	Legislation
Vermont[143]	50 percent by 2028 below 1990 levels	Legislation
Washington[144]	25 percent target by 2035 below 1990 levels	Legislation

In addition, the New England Governors and Eastern Canadian Premiers have set a regional target of achieving 35 to 45 percent reductions by 2030 from 1990 levels.[145]

Connecticut Governor Dannel Malloy created a Governor's Council on Climate Change and directed the body to identify interim targets that, if met, will "ensure" meeting the state's 2050 GHG limit.[146] Massachusetts' comprehensive climate change legislation also requires the state to set a 2030 and 2040 target at some point in the future.[147]

New Jersey has set limits for the years 2020 and 2050, but not for interim years.[148]

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134 Cal. Sen. Bill 32 (2016).

135 Gov. John Hickenlooper Exec. Order D 2017-015 (July 11, 2017), https://www.colorado.gov/governor/sites/default/files/executive_orders/climate_eo.pdf.

136 Del. Dep't of Nat. Res. & Envtl., Climate Framework for Delaware 12 (2014), http://www.dnrec.delaware.gov/energy/Documents/The%20Climate%20Framework%20for%20Delaware.pdf .

137 D.C., A Vision for A Sustainable DC 4 (2012), http://www.sustainabledc.org/wp-content/uploads/2012/10/sustainable-DC-Vision-Plan-2.2.pdf.

138 Md. Code Ann., Envir. § 2-1204.1 (2017).

139 Minn. Stat. § 216H.02, subd. 1.

140 New Hampshire Climate Action Plan at 1.

141 N.Y. State Energy Planning Bd., The Energy to Lead: 2015 New York State Energy Plan 112 (2015).

142 R.I. Gen. Laws § 42-6.2-2(a)(2)(ii) (2017).

143 Vt. Stat. Ann. 10 § 578(a) (2017).

144 Wash. Rev. Code § 70.235.020(1)(a).

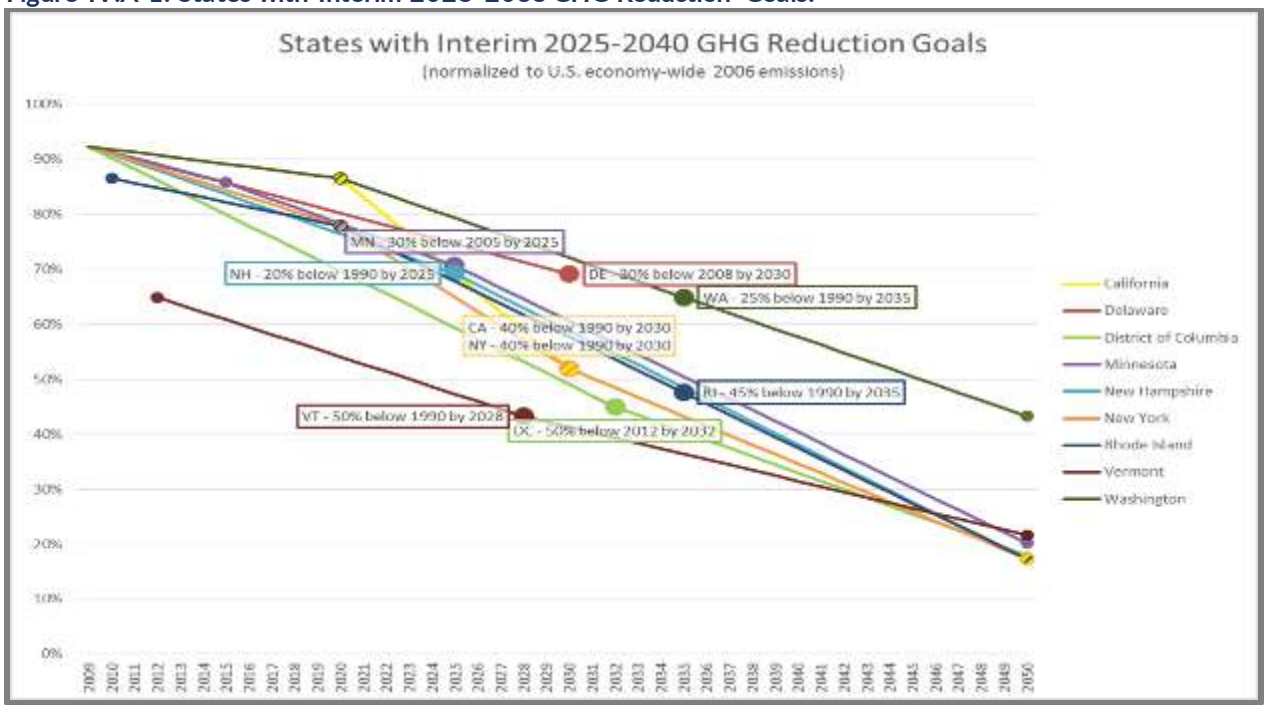
145 New England Governors and Eastern Canadian Premiers Regional Climate Initiative, Resolution 39-1 (Aug. 31, 2015), http://www.coneg.org/regional-climate-initiative.

146 Governor Dannel Malloy, Exec. Order No. 46 (April 22, 2015), http://www.ct.gov/deep/cwp/view.asp?a=4423&Q=568878&deepNav_GID=2121.

147 Massachusetts Global Warming Solutions Act, Acts Chapter 298, Section 3A (2008).

148 N.J. Stat. Ann. § 26:2C-39 to 40 (no inclusion of a GHG reduction goal in the years 2025-2040).

Figure IV.A-1. States with Interim 2025-2035 GHG Reduction Goals.



To better compare state goals articulated as reductions from different baseline years ranging from 1990 to 2008, this graph normalizes state goals against U.S. economy-wide GHG emissions (U.S. EPA GHG Inventory). Goal pathways are linearly interpolated between state goal points. 2009 emissions are used as a starting point, with the exception of Rhode Island and Delaware, which had early goals articulated for years 2009-2012.

IV.A.2. State Planning Processes Related to Targets

Several of the states that have adopted interim GHG reduction targets also employ processes to develop plans to meet the targets, report on emissions, and track progress.[149] Three of the most notable state goal setting, planning, and reporting frameworks are from California, Maryland, and Massachusetts.

California's comprehensive statewide climate change legislation, AB 32, requires that the California Air Resources Board (CARB) prepare and approve a scoping plan that identifies and recommends policies that will achieve "maximum feasible and cost-effective reductions" of GHGs and will ensure meeting the state's 2020 and 2030 targets.[150] AB 32 also directs CARB to implement policies to achieve the required reductions through rules and regulations.[151] The first scoping plan was adopted in 2008 to help the state reach its 2020 target of 1990 levels of GHG emissions. An updated scoping plan proposed in 2017 would achieve the state's 2030 target of 40 percent below 2030 levels by continuing the state's major emission reduction programs, including its cap-and-trade rule, RPS, and Low Carbon Fuel Standard.[152] The scoping

[149] *See, e.g.*, Cal. Air Res. Bd., The 2017 Climate Change Scoping Plan Update: The Proposed Strategy for Achieving California's 2030 Greenhouse Gas Target (2017), https://www.arb.ca.gov/cc/scopingplan/2030sp_pp_final.pdf [hereinafter 2017 Scoping Plan]; Md. Comm'n on Climate Change, 2016 Annual Report (2016), http://mde.maryland.gov/programs/Marylander/Documents/MCCC/Publications/2016Report/MCCC_2016_final.pdf[hereinafter 2016 Annual Report]; R.I. Ex. Climate Change Coordinating Council, Rhode Island Greenhouse Gas Emissions Reduction Plan (2016), http://www.planning.ri.gov/documents/climate/EC4%20GHG%20Emissions%20Reduction%20Plan%20Final%20Draft%202016%2012%2029%20clean.pdf.

[150] Cal. Health & Safety Code §§ 38561, 38566§ 38571 (2017).

[151] Cal. Health & Safety Code § 38562 (2017).

[152] 2017 Scoping Plan at ES-1.

plans are developed in coordination with other state agencies, the legislature, stakeholders and the Environmental Justice Advisory Committee,[153] and reflects input from the public solicited through more than 15 public meetings.[154] AB 32 also required CARB to establish mandatory statewide annual reporting of GHG emissions,[155] and directs that the scoping plan be updated at least every five years.[156] (See more background and details on AB 32 in the box below).

California's Economy-Wide Framework to Address GHG Emissions

California has established a unique statutory framework in the United States for addressing greenhouse gas emissions economy-wide through two key pieces of legislation. Its Global Warming Solutions Act of 2006 (also referred to as AB 32) sets an enforceable statewide cap on all greenhouse gases from all sectors of the economy. AB 32 establishes mid and long-term statewide emissions limits and requires the California Air Resources Board (CARB) to issue a scoping plan which lays out the state's strategy for meeting the state limits. The scoping plan outlines a specific mix of policies, planning, direct regulations, market approaches, incentives and voluntary efforts that are designed to meet the state limits through emissions reductions from cars and trucks, electricity production, fuels and other sources. Using the authority provided under AB 32, California has established a mandatory emissions reporting program, a Low Carbon Fuel Standard, Advanced Clean Car standards, and an economy-wide Cap-and-Trade program as well as recently issued performance standards for non-CO_2 Highly Warming Gases. The state's initial scoping plan as well as a 2014 update and the 2017 proposed plan focused on:

- Expanding energy efficiency programs, including building and appliance standards;
- Increasing electricity generation from renewable resources to at least 33 percent of the statewide electricity mix by 2020;
- Establishing programs to meet a target for passenger vehicle-related GHG emissions for regions throughout California;
- Adopting measures to implement the state's clean car standards and a Low Carbon Fuel Standard; and
- Developing a binding cap-and-trade program that incorporates all GHG emissions and all sectors of the economy.

AB 32 is complemented by The Sustainable Communities and Climate Protection Act of 2008 (SB 375), the goal of which is to achieve GHG emissions reductions by reducing vehicle miles traveled and encouraging smart growth. The law requires CARB to set regional targets for GHG emissions reductions for which regional transportation planning agencies are required to create plans to address those targets. If the regional targets cannot be met, an alternative planning strategy may be developed which identifies how the regional targets would be met through alternative development patterns, infrastructure investment, and additional transportation policies.

In July 2017, California approved two additional laws related to its statewide cap-and-trade program. AB 398 authorizes California's cap-and-trade program beyond 2020 and AB 617 institutes a program to address emissions and air quality in local communities.

Maryland amended its 2009 Greenhouse Gas Reductions Act in 2016 to set a GHG reduction target of 40 percent reduction below 2006 levels by 2030.[157] The original 2009 Act led to the creation of Maryland's Greenhouse Gas Reduction Plan which included more than 150 programs and initiatives designed to

[153] *Id.* at 7.

[154] *Id.* at 7-8.

[155] Cal. Health & Safety Code § 38530 (2017).

[156] Cal. Health & Safety Code § 38561(h) (2017).

[157] Md. House Bill 610 (2016).

reduce the state's annual emissions by the equivalent of 55 million metric tons of carbon dioxide.[158] The Act's revision requires that the Maryland Department of the Environment (MDE) create a new action plan reflecting the amended reduction target by December 31, 2018, and that it finalize this plan within the following year.[159] The Act requires that the plan incorporate all measures for which the State agencies have existing statutory agencies but also directs the Department to provide a summary of any legislative authority needed to fully implement the plan, as well as a timeline specifying the time such authority would be necessary.[160] Additionally, the 2016 Act renews language in the 2009 Act that requires the MDE to prepare and publish an updated inventory of statewide GHG emissions with continuous updates every three years.[161] A separate statute requires that the Maryland Commission on Climate Change report annually on the "status of the State's efforts to mitigate the causes of, prepare for, and adapt to the consequences of climate change."[162]

Massachusetts' Global Warming Solutions Act requires the Secretary of Energy and Environmental Affairs to set GHG targets for 2025, 2030, and 2045, and requires that these goals "maximize the ability" of the state to meet a 2050 limit of at least 80 percent reductions below 1990 levels.[163] The Act requires the Secretary to develop and update plans for meeting these goals every five years,[164] and also requires the Department of the Environment to "promulgate regulations establishing a desired level of declining annual aggregate emission limits for sources or categories of sources that emit greenhouse gas emissions."[165] Finally, the Act establishes a GHG reporting program and requires that the Secretary report on progress toward meeting these goals every five years.[166]

New Jersey does not have an interim limit between its 2020 and 2050 GHG targets. New Jersey does however, have requirements under the 2007 GWRA to establish rules for a greenhouse gas emissions monitoring and reporting program by 2009 and to prepare a report biennially on the status of such a GHG emissions monitoring and reporting program.[167] The GWRA also directs the state to report on progress made toward compliance with its 2020 and 2050 limits, including updated and comparative inventories.[168] NJDEP proposed, but never promulgated, the GHG emissions monitoring and reporting program rules.[169] The agency also did not submit a report for achieving the 2050 limit to the Governor,

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[158] Md. Dep't Env't, The 2015 Greenhouse Gas Emissions Reduction Act Plan Update (2015), http://news.maryland.gov/mde/wp-content/uploads/sites/6/2015/10/GGRA_Report_FINAL_10-29-15.pdf.

[159] Md. Environment Code Ann. §2–1204.

[160] Md. Environment Code Ann. §2–1205. *Id. Id.*

[161] Md. Environment Code Ann. §§2–1201, 2–1211.

[162] Md. Environment Code Ann. § 2-1304

[163] Massachusetts Global Warming Solutions Act, Acts Chapter 298, Section 3A (2008).

[164] *Id.* at Section 4.

[165] *Id.* In May 2016, the Massachusetts Supreme Judicial Court in *Kain et al. v. Massachusetts Department of Environmental Protection (DEP)* found that this provision of the Global Warming Solutions Act requires the state to establish decreasing volumetric limits on GHG emissions and held that the state's existing policies and regulations do not meet this statutory requirement. The court ruled that the GWSA requires MassDEP to promulgate regulations addressing multiple sources of emissions and set annual declining, mass-based limits for those sources. *Kain v. Dep't of Envtl. Prot., 474 Mass. 278 (2016).*

[166] Massachusetts Global Warming Solutions Act, Acts Chapter 298, Section 3A (2008). The most recent report was published in 2013. Commonwealth of Massachusetts, Global Warming Solutions Act 5-Year Progress Report (2013), http://www.mass.gov/eea/docs/eea/gwsa/ma-gwsa-5yr-progress-report-1-6-14.pdf.

[167] N.J. Stat. § 26:2C-41 (2017).

[168] *Id.*

[169] New Jersey Greenhouse Gas Monitoring and Reporting Program, DEP Docket Number: 21-08-12/665, (proposed Jan. 20, 2009), http://www.nj.gov/dep/rules/proposals/012009a.pdf.

legislature or appropriate committee members by June 30, 2010. NJDEP has not issued inventories accounting for emissions after 2012; researchers from Rutgers University (including co-authors of this report) independently developed an inventory for years 2010-2012 using the same methodology as NJDEP previously used concurrent with NJDEP's development of a similar inventory.[170]

IV.B. Emission Budget and Carbon Pricing Policies

Policies that limit emissions of greenhouse gases by establishing an emission budget or setting a price on emissions introduce a market-based approach rather than specifying how the reductions are achieved. They can also be used to address multiple sectors through the same mechanism.

These policies drive private-sector changes to reduce emissions to meet the budget or respond to the carbon price. Most of these programs either directly require emitters to pay a price for each ton of GHG pollution they emit, or indirectly create such a price.

One important difference between the two approaches is that emission budget programs require a specified level of emissions reduction, and the carbon price created is a function of how the market responds to the total level of emission reduction required. In contrast, programs that establish a carbon price through regulation, for example through a carbon tax or fee, typically do not require a specific level of emission reduction. Instead, the level of reduction achieved is a result of how the market responds to the established price.[171]

There are two prominent examples of state emission budget programs. In the northeast, states participating in RGGI established a CO_2 emission budget that applies to the power sector, while California has established a GHG emission budget program that applies to most of its economy. As described above, New Jersey was a founding member of RGGI, but withdrew from the program in 2012.

[170] *See* New Jersey Department of Environmental Protection, New Jersey Greenhouse Gas Inventory and Reference Case Projections, 1990-2020 (2008), http://njedl.rutgers.edu/search_results?query=GHG+inventory; New Jersey Department of Environmental Protection, New Jersey Statewide Greenhouse Gas Emissions Inventory Update: 2005, 2006, and 2007 Estimates, http://www.nj.gov/dep/sage/docs/inventory-05-06-07.pdf; New Jersey Department of Environmental Protection, Statewide Greenhouse Gas Emission Inventory for 2008 (May 2011), http://www.nj.gov/dep/sage/docs/ghg-inventory2008.pdf; New Jersey Department of Environmental Protection, Statewide Greenhouse Gas Emissions Inventory for 2009 (November 2012), http://www.nj.gov/dep/sage/docs/ghg-inventory2009.pdf; Michael Aucott et al., *2012 Update to New Jersey's Statewide Greenhouse Gas Emission Inventory*, Rutgers University (2015), http://dimatechange.rutgers.edu/docman-list/special-reports/354-2012-update-to-new-jersey-s-statewide-greenhouse-gas-emission-inventory/file; New Jersey Department of Environmental Protection, 2012 Statewide Greenhouse Gas Emissions Inventory (September 2014), http://www.nj.gov/dep/aqes/docs/GHGinventoryFinal.pdf.

[171] There are variations in program design in both program types that can make each program type operate more like the other. For example, emission budget programs can include design components such as offsets or cost containment measures that reduce the certainty of achieving a specific level of emission reduction but seek to limt or contain the resulting carbon price. Carbon tax or fee programs can include indexing mechanisms that change the carbon price to meet a certain level of emission reductions.

A carbon tax approach has not been adopted by any U.S. states at this time, but has been implemented in many places around the world including British Columbia, and carbon tax legislation has been introduced in several states.

The federal government has also pursued approaches to directly limit carbon emissions from the power sector, adopting the Clean Power Plan (CPP) in 2015. The CPP requires states to adopt an emissions budget – to reduce the absolute level of power-sector GHG emissions – or an emissions rate-based program – to reduce the carbon emissions intensity of electric power generation – including programs that could be linked with other states.[172] In early 2017, however, President Trump issued an energy independence executive order that instructed EPA to review the CPP and—if appropriate—take steps to roll back or rescind the Clean Power Plan.[173] The D.C. Circuit is also considering whether to pause litigation challenging the CPP or send the rule back to EPA in light of the executive order. [174]

This chapter surveys state policies to reduce GHG emissions through emission budget programs and carbon pricing policies. First, it discusses emission budget programs that set a limit (usually declining over time) on GHG emissions, including RGGI, California's economy-wide cap-and-trade program, and Washington State's clean air rule. Then it explores programs in British Columbia and Boulder, Colorado, to reduce carbon emissions by placing a per-ton price on carbon emissions. Next, it discusses emerging legislative carbon tax proposals in the northwest and New England and examines emerging policy ideas in the Transportation and Climate Initiative (TCI) and a regional proposal to place a price on carbon emissions that is reflected in wholesale electricity market prices. The chapter concludes with a discussion on incorporation of the social cost of carbon into regulatory and planning processes. Summary Table of State Emission Budget and Carbon Pricing Policy Models

[172] *See generally* Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, 80 Fed. Reg. 64,662 (Oct. 23, 2015).

[173] *Presidential Executive Order on Promoting Energy Independence and Economic Growth* § 4 (2017).

[174] *West Virginia et al. v. Envtl. Prot. Agency,* No. 15-1363, Order (Apr. 28, 2017); Ellen M. Gilmer, *Both Sides Claw for Advantage In Fight Over Case's Future*, Enery Wire (May 16, 2017), https://www.eenews.net/energywire/2017/05/16/stories/1060054593.

State Policy Model	Notable Implementations	Related New Jersey Actions?	Notes
Emissions budget programs	RGGI; CA's economy-wide cap-and-trade program; WA's clean air rule	NJ joined RGGI in 2009, but withdrew in 2012	Under existing authority, New Jersey could rejoin RGGI or another emission budget program VA is developing a power sector emission budget program that is able to trade with other states
Taxing carbon emissions	British Columbia, Canada and Canadian federal government; Boulder, CO Legislative proposals in CT, MA, RI, and NY	No	
Emerging policy ideas	TCI work on market-based policies PJM's electricity grid carbon pricing proposal	No	New Jersey does participate in the Transportation and Climate Initiative but did not join announcement saying it would participate in work on market-based policies New Jersey is part of the PJM electricity grid, which is considering this proposal
Social cost of carbon in regulatory and planning processes	IL, CA, CO, MA, NY, MN	No	New Jersey does not consider social cost of carbon currently but could explore establishment in regulatory planning processes (e.g., Executive Order 215; BPU regulatory programs, Economic Impact Analysis under NJ Administrative Procedures Act)

IV.B.1. Emission Budget Programs

Emission budget programs set a limit or "cap" on emissions to reduce the amount of GHGs released into the atmosphere. In most cases, the emission budget declines over time. The pollution limits can be set for a specific sector, multiple sectors, or the economy as a whole, and can cover just one state or multiple jurisdictions. Two of the programs listed below—RGGI and California's program—are cap-and-trade programs. These programs operate by creating and distributing emission allowances (i.e., tradable permits that give the holder the right to emit a quantity of carbon content, or to supply fuels that have a quantity of carbon content that will be emitted upon combustion).[175] Allowances equal to the emissions budget can initially be auctioned or distributed freely, and can generally be bought and sold, enabling a market for the allowances to emerge. Regulated entities can comply by reducing emissions (or carbon content) from a regulated activity or products, or by purchasing allowances on the market. Unlike a carbon fee, the price of allowances is not fixed—rather the quantity of allowable emissions is set by the program, and the market determines the price. In programs in which allowances are distributed through an auction, the auction generates proceeds that can be invested by governments, and many programs use these proceeds to support emission reduction strategies (these programs are sometimes referred to as

[175] Washington's proposed Clean Air Rule establishes a cap for each regulated entity, but allows entities to generate credits if they are under the cap-and-trade independently, and allows use of allowances from other state or regional programs.

cap-and-invest programs). In contrast, Washington State's program (the third program below), which took effect this year, requires individual sources to annually reduce their emissions to a pre-determined level.

Regional Greenhouse Gas Initiative

The Regional Greenhouse Gas Initiative (RGGI) is the first mandatory cap-and-trade program in the United States to limit CO_2 emissions. It is a collaboration among the Northeastern and Mid-Atlantic states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont. New Jersey was an original member of RGGI, but withdrew from the Initiative in January 2012.[176] The program caps CO_2 emissions from fossil fuel-fired power plants with a nameplate capacity equal to or greater than 25 megawatts. Participating states jointly developed a memorandum of understanding and model rule, and then each state promulgated its own implementing regulation (with most states first passing legislation). Most of the allowances in the RGGI program are distributed through quarterly auctions.[177] Each state chooses what to do with the proceeds of its allowances from these auctions, although the states agreed in the MOU that at least 25 percent of allowances would be used "for consumer benefit or strategic energy purpose."[178] RGGI conducted its first CO_2 emissions allowance auction in 2008 and compliance obligations began in 2009. In the third phase of the program, the cumulative RGGI cap was set at 91 million short tons for 2014 and declines 2.5 percent annually between 2015 and 2020.[179] RGGI auctions have raised more than $2.6 billion through 35 quarterly auctions.[180] In practice, the states have invested the vast majority of proceeds from allowances into strategies that achieve further emission reductions and provide public benefit. For example, 62 percent of RGGI investments through 2013 funded energy efficiency measures, which both reduce electricity bills and emissions.[181]

The RGGI states evaluate elements of the program through a periodic "program review," and recommend potential changes.[182] Following the first program review in 2012, the RGGI states significantly lowered the program's carbon cap to its current level, recognizing that the region's emissions were significantly below the prior cap level.[183] The states are currently in the process of another program review, which includes consideration of post-2020 cap levels and adjustments to compliance flexibilities[184]; as part of this review

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[176] *New Jersey Participation*, Reg'l Greenhouse Gas Initiative, http://rggi.org/design/history/njparticipation (last retrieved Feb. 14, 2017).

[177] *Board of Directors*, RGGI, Inc., http://www.rggi.org/rggi/board (describing RGGI's direction by a board of environment and energy leaders from each participating state).

[178] *Memorandum of Understanding*, Regional Greenhouse Gas Initiative § G(1) (Dec. 20, 2005). http://rggi.org/docs/mou_final_12_20_05.pdf.

[179] *Welcome*, Reg'l Greenhouse Gas Initiative, https://www.rggi.org/.

[180] *Auction Results*, Regional Greenhouse Gas Initiative, https://www.rggi.org/market/co2_auctions/results (last retrieved June 5, 2017).

[181] *Investment of RGGI Proceeds through 2013*, Regional Greenhouse Gas Initiative 8 (2015) http://www.rggi.org/docs/ProceedsReport/Investment-RGGI-Proceeds-Through-2013.pdf.

[182] *RGGI 2012 Program Review: Summary of Recommendations to Accompany Model Rule Amendments*, Reg'l Greenhouse Gas Initiative 1 (2012), http://rggi.org/docs/ProgramReview/_FinalProgramReviewMaterials/Recommendations_Summary.pdf.

[183] *Id.* at 2; The states also established a cost containment reserve, which is a reserved quantity of allowances, in addition to the cap, that would be available, if pre-determined prices triggers are exceeded, as a way to control the cost of the carbon cap; *Id.*

[184] *Reg'l Greenhouse Gas Initiative*, Reg'l Greenhouse Gas Initiative, http://rggi.org/design/2016-program-review (last retrieved May 15, 2017).

in August 2017, the RGGI states announced a proposal for an additional 30% cap reduction by the year 2030, relative to 2020 levels.[185]

RGGI states have reduced carbon emissions from the power sector over 45 percent since 2005 while over the same time period, the region's GDP has grown approximately 8 percent.[186] A 2015 Analysis Group study of the program reported that in 2012-2014 RGGI led to $1.3 billion in economic value to the nine-state region and energy consumers enjoyed a net gain of $460 million in lower energy bills.[187]

During the time that New Jersey participated in RGGI, the state received 12.9 percent of RGGI's allowances, resulting in $113 million in auction proceeds over three years.[188] As of the end of 2010, New Jersey had devoted 44 percent of auction proceeds to state budget deficit reduction, 18 percent to energy efficiency projects, 18 percent to renewable energy projects, 14.2 percent to direct electricity bill assistance, and 5.3 percent to program administration.[189] New Jersey's Global Warming Solutions Fund Act provides that 60 percent of the Fund's money is to be allocated to the New Jersey Economic Development Authority to provide grants for end-use energy efficiency projects and 20 percent be allocated to reduce electricity demand or costs to electricity customers in low-income and moderate income sectors.[190] The remaining 20 percent is to be allocated evenly between promoting local government efforts to plan, develop, and implement measures to reduce GHG emissions and supporting programs that enhance the stewardship and restoration of the state's forest and tidal marshes that "provide important opportunities to sequester" or reduce GHGs.[191]

Competitiveness Concerns and Carbon Leakage

A common concern with implementing carbon pricing is that it could reduce the competitiveness of covered facilities or sectors and result in carbon leakage. This occurs when carbon pricing in one jurisdiction results in emissions increase in another jurisdiction. This can result from displaced production of manufactured goods or because of electric power generation shifting to markets not covered by carbon pricing. Climate policies typically include provisions to avoid carbon leakage, due to concerns that environmental goals would not be achieved or economic dislocation could result.

For the power sector, if states that operate in the same electricity markets take different approaches to pricing carbon – or if one state prices carbon while another does not – this introduces the potential for carbon leakage. For example, EPA recognized that the structure of the final Clean Power Plan created the potential for leakage and so states with mass-based programs that only covered existing sources were required to demonstrate that the policy did not lead to emissions leakage with respect to uncovered sources.[192] California also has policy provisions to address emission

[185] *RGGI States Announce Proposed Program Changes: Additional 30% Emissions Cap Decline by 2030.* (August 23, 2017). http://rggi.org/docs/ProgramReview/2017/08-23-17/Announcement_Proposed_Program_Changes.pdf

[186] *The Investment of RGGI Proceeds Through 2014*, Reg'l Greenhouse Gas Initiative 3 (2016), https://www.rggi.org/docs/ProceedsReport/RGGI_Proceeds_Report_2014.pdf.

[187] Paul J. Hibbard et al., *The Economic Impacts of the Regional Greenhouse Initiative on Nine Northeast and Mid-Atlantic States*, C2ES 5-7 (2015), https://www.c2es.org/docUploads/rggi-mou.pdf.

[188] *Investment of Proceeds from RGGI CO_2 Allowances*, Reg'l Greenhouse Gas Initiative 4 (2011), http://www.rggi.org/docs/Press_Release_%20RGGI_Proceeds_Report.pdf [hereinafter 2011 *Investment Proceeds*]; *NJ Proceeds by Auction*, Reg'l Greenhouse Gas Initiative (2012), http://rggi.org/docs/NJ_Proceeds_by_Auction.pdf.

[189] 2011 *Investment Proceeds* at 12.

[190] N.J. Stat. Ann. § 26:2C-51(b) (2016).

[191] *Id.*

[192] In December, 2016, EPA released draft technical support documents suggesting specific approaches that states could take to minimize leakage using mass-based emissions budget trading programs; U.S. Environmental Protection Agency, Draft Technical Support Document Leakage Requirement for State Plans Using Mass-based Emission Budget Trading Programs (2016), https://blog.epa.gov/blog/wp-content/uploads/2016/12/CPP-Leakage-Doc-draft-12-18-16-clean-508.pdf.

leakage from the power sector, necessitated by the fact that neighboring states from which they purchase power do not have comparable carbon pricing policies.[193]

The economic sectors that are most at risk of competitiveness concerns and emissions leakage are emissions-intensive and trade-exposed (EITE) industries. For many of these sectors, any significant and persistent changes in production costs – due to carbon pricing or other factors[194] – may cause shifts in manufacturing activity that favor jurisdictions with no – or less stringent – carbon pricing. These shifts could occur through an increase in imports to meet domestic demand for emission-intensive goods or through a reduction in exports to other markets.[195]

While there is limited available evidence to suggest that carbon leakage has resulted from past policies[196] – particularly when carbon prices remain low – several polices have been proposed or implemented to address concerns, including: border price adjustments, export rebates or output-based allowance allocation.[197] For example, the European Union's Emission Trading System targets free allocation of allowances to EITE sectors, which are considered most prone to leakage.[198]

California's Cap-and-Trade Program

Like RGGI, California's cap-and-trade program sets a declining annual cap on emissions and requires covered entities to procure allowances, including through an auction. Two key differences are that California's program covers all GHG emissions, not just CO_2, and that it covers most sectors of the state's economy, not just power sector emissions.

In 2013, the California cap-and-trade program began with a first phase that covered GHG emissions from power plants and industrial facilities emitting over 25,000 metric tons of CO_2e annually.[199] In 2015, the program scope was expanded in its second phase to include entities supplying transportation fuels with a cumulative carbon content above 25,000 CO_2e.[200] The program establishes an emission budget that declines three percent annually in 2015-2020, and issues allowances annually equal to the budget.[201] Electric power, industrial, and transportation fuel entities all participate in the same market for emissions allowances, which opens up the possibility for cross-sector trading of allowances.

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[193] California Air Resources Board, Public Hearing to Consider Proposed Amendments to the California Cap on Greenhouse Gas Emissions and market-based compliance mechanisms (2016), https://www.arb.ca.gov/regact/2016/capandtrade16/isor.pdf.

[194] Production and investment decisions for manufacturing firms are also influenced by fuel costs, proximity to markets, transportation costs, exchange rates, labor costs, and other uncertain or variable business risks; *What is the Impact of Carbon Pricing on Competitiveness?*, Carbon Pricing Leadership Coalition (June 2016), http://pubdocs.worldbank.org/en/759561467228928508/CPLC-Competitiveness-print2.pdf.

[195] *See* U.S. Environmental Protection Agency, The Effects of H.R. 2454 on International Competitiveness and Emission Leakage in Energy-Intensive Trade-Exposed Industries (December 2, 2009), https://19january2017snapshot.epa.gov/sites/production/files/2016-07/documents/interagencyreport_competitiveness-emissionleakage.pdf.

[196] *What is the Impact of Carbon Pricing on Competitiveness?*, Carbon Pricing Leadership Coalition (June 2016), http://pubdocs.worldbank.org/en/759561467228928508/CPLC-Competitiveness-print2.pdf; *Carbon Leakage Evidence Project*, European Commission & DG Climate Action (September 23, 2013), https://ec.europa.eu/clima/sites/clima/files/ets/allowances/leakage/docs/cl_evidence_factsheets_en.pdf.

[197] Meredith L. Fowlie, Mar Reguant, and Stephen P. Ryan, *Measuring Leakage Risk*, U.C. Berkeley (2016), https://www.arb.ca.gov/cc/capandtrade/meetings/20160518/ucb-intl-leakage.pdf.

[198] *The EU Emissions Trading System (EU ETS)*, European Commission Climate Action, https://ec.europa.eu/clima/policies/ets_en (last retrieved July 12, 2017).

[199] The California program covers a basket of seven GHG gases and measures emissions in metric tons; RGGI covers only CO_2 and measures emissions in short tons.

[200] 17 CCR §§ 95811, 95840, 95851-52 (2015).

[201] The overall budget increased in 2015 as the transportation sector was included in the program scope.

As in New Jersey, transportation-sector emissions account for the largest source of emissions in California.[202] For transportation fuels, the program requires petroleum fuel importers, refiners, and distributors to hold allowances equal to the CO_2e content of the fuel.[203] Biofuels do not have a compliance obligation under the program, reflecting that GHGs directly emitted by biofuel combustion are offset to a large degree by the CO_2 absorbed by the plants, or "feedstocks," prior to being converted to fuel.[204] California has a complementary Low Carbon Fuel Standard (LCFS) designed to promote the use of less-carbon-intensive transportation fuels in the state on a life-cycle basis (see discussion in Section IV.D.3).[205]

California is required by legislation to spend auction proceeds on programs that support the goals of its comprehensive climate program.[206] Recent legislation also requires that 25 percent of funds be spent in disadvantaged communities.[207] As of April 2017, the state has held 18 auctions generating $4.4 billion in proceeds.[208] Auction proceeds have been appropriated by the state legislature to state agencies implementing GHG reduction programs, funding nearly 30,000 energy efficiency projects in homes, over 100,000 rebates for zero emission and plug-in hybrid vehicles, and with 50 percent of appropriated funds benefiting disadvantaged communities.[209]

In 2014, California linked its program with Quebec's similar program through the Western Climate Initiative (WCI). Ontario is also planning to link its cap-and-trade program with California and Quebec in 2018.[210] Linking typically involves emissions budget programs sharing administrative systems for emissions monitoring and reporting, emission and allowance tracking, and auctioning of allowances; and the acceptance of allowances and/or offsets from one region for compliance in another.[211] Linked programs provide significant benefits, including a larger aggregate program that provides regulated entities greater compliance flexibility, lowering the overall cost of compliance, and reduced administrative costs through shared administrative systems.[212]

The California legislature recently passed legislation authorizing the cap-and-trade program to run through 2030 in order to meet the state's goal of reducing GHG emissions to 40 percent below 1990 levels in that year.[213] The legislation also moots legal challenges to the California program. Opponents had

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[202] *California's Cap-and-Trade Program: Fuel Facts*, Air Resources Board (2015), http://www.arb.ca.gov/cc/capandtrade/guidance/facts_fuels_under_the_cap.pdf.

[203] Covered fuels include reformulated gasoline blendstock for oxygen blending (RBOB), distillate fuel oils number 1 and 2, liquefied petroleum gas, natural gas, liquefied natural gas, and blends of these fuel; 17 CCR § 95852.1.

[204] 17 CCR § 95852.2.

[205] *Id.* § 95480 *et seq*.

[206] The proceeds are treated as a fee that must be used for purposes related to the authorizing legislation; Cal. Health & Safety Code §39710. Cal Sen. Bill 535 (2016).

[207] Cal. Assem. Bill 1550 (2016).

[208] *California Cap-and-Trade Program Summary of Proceeds to California and Consigning Entities*, California Air Resources Board (April 2017), https://www.arb.ca.gov/cc/capandtrade/auction/proceeds_summary.pdf.

[209] *2017 California Climate Investments: Cap and Trade Dollars at Work*, California Air Resources Board (2017), https://arb.ca.gov/cc/capandtrade/auctionproceeds/cci_annual_report_2017.pdf.

[210] *Canada- Ontario Cap-and-Trade Program*, Int'l Carbon Action P'ship (May 3, 2017), https://icapcarbonaction.com/en/?option=com_etsmap&task=export&format=pdf&layout=list&systems[]=71.

[211] Kathryn A. Zyla, *Linking Regional Cap-and-Trade Programs: Issues and Recommendations*, Georgetown Climate Center 2 (2010), http://www.georgetownclimate.org/files/report/GCC%20Linking%20Regional%20Cap%20and%20Trade.pdf.

[212] *Id.*

[213] A.B. 398, 2017-2018 Sess. (Cal. 2017).

challenged the cap-and-trade program in court, arguing that the program's allowance auction was a tax that could only be authorized by legislation receiving approval of two-thirds of the legislature under California law.[214] Although a California appellate court recently sided with the state and found that the allowance auction was not a tax,[215] the new legislation passed with a two-thirds vote,[216] rendering the issue moot. In addition, A.B. 398 granted CARB the authority to set a ceiling price on allowances and reduced the amount of offsets, requring that half of all offsets originate from in-state programs.[217] A.B. 617, the legislative package's nonvehicular air pollution portion, requires that the state board select high priority locations in the state for deployment of community air monitoring systems.[218]

Washington Clean Air Rule

Washington State's Clean Air Rule was adopted in September 2016 by the Washington Department of Ecology.[219] The rule was adopted under the agency's general air pollution control authority; no additional legislation was passed.[220] Beginning in 2017, the rule requires that large stationary sources, petroleum producers and importers, and natural gas distributors reduce GHG emissions 1.7 percent annually. Sources also have the option of procuring credits from other facilities that have achieved reductions beyond the minimum requirement, offsetting their emissions through specific eligible actions (e.g., commuter trip reduction programs), or purchasing allowances from other state GHG emission reduction programs (such as California's program).[221] The threshold for applicability—initially set at annual emissions of the equivalent of 100,000 metric tons of carbon dioxide—will be lowered by 5,000 tons every three years until 2035. The program is expected to eventually cover two-thirds of the state's GHG emissions.[222] The Washington State program—unlike the RGGI or California programs—does not involve the auctioning of allowances or the investment of auction proceeds.

Virginia Executive Order

On May 16, 2017, Virgina Gov. Terry McAuliffe issued an executive order directing the Department of Environmental Quality to develop regulation to cut CO_2 emissions from power plants. The regulations are to be "trading ready," meaning that they would allow for the use of market-mechanisms and the trading of emissions allowances through a multi-state trading program.[223]

IV.B.2. Taxing Carbon Emissions

A carbon fee or tax is a charge levied on greenhouse gas emissions, typically expressed as a dollar per ton of CO_2e. Unlike an emission budget program, a carbon fee or tax does not set an absolute limit on the emissions of the covered sector. The level of emissions reduced would depend on how the market

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[214] *Cal. Chamber of Commerce v. State Air Res. Bd.* (Cal. May 15 2017) (No. S241948).

[215] *Id.*

[216] Adam Nagourney, *California Extends Climate Bill, Handing Gov. Jerry Brown a Victory*, N.Y. Times (July 17, 2016), https://www.nytimes.com/2017/07/17/dimate/california-cap-and-trade-approved-jerry-brown.html.

[217] *Id.*

[218] Cal. Assem. Bill 617 (2017).

[219] *Washington Adopts First-of-its-Kind Rule to Combat Climate Change*, Wash. Dep't of Ecology (Sept. 15, 2016), http://www.ecy.wa.gov/news/2016/118.html.

[220] *Rule-Making Order*, Wash. Dep't of Ecology (Sept. 15, 2016), http://www.ecy.wa.gov/laws-rules/WAC173442/X1510.pdf.

[221] Wash. Admin. Code §§ 173-442-030; 173-442-060; 173-442-100; and 173-442-130 - 173-442-150.

[222] *Clean Air Rule*, Wash. Dep't of Ecology, http://www.ecy.wa.gov/climatechange/CARcompliance.html (last visited Feb. 17, 2017).

[223] Gov. Terry McAuliffe Exec. Directive 11 (May 16, 2017), https://governor.virginia.gov/newsroom/newsarticle?artideId=20285.

responds to the carbon price. A carbon price may be set in a variety of ways: it could be a fixed price, a price that increases over time, a price tied to another indicator, or a price updated automatically based on specific factors. A carbon fee or tax also generates proceeds that can be used by a state in many ways, including spending on strategies to promote further emission reduction, returning funds to households as a dividend or rebate to offset the cost of transitioning to a decarbonized economy, and placing the tax revenue in the state general fund.

British Columbia and Canada

In July 2008, British Columbia introduced a carbon tax on the purchase and use of fossil fuels within the province. The tax was initially set at $10 Canadian per metric ton of CO_2e in 2008 and ramped up by $5 each year to reach $30 Canadian per metric ton by July 2012.

British Columbia assesses its carbon tax on gasoline, diesel, natural gas, heating oil, propane, and coal[224] at the point of purchase.[225] As different fuels generate different amounts of GHG emissions, the carbon tax rate of $30 per ton must be translated based on the type of fuel used, so the tax rate is 5.7 Canadian cents (approximately 4.2 cents U.S.) per cubic meter of natural gas, 6.7 cents per liter of gasoline (approximately 19 cents U.S. per gallon), and 7.7 cents per liter of diesel (approximately 22 cents U.S. per gallon).[226] A 2015 study of the British Columbia carbon tax estimated that the tax drove emission reductions of somewhere between 5 to 15 percent.[227]

In December 2016, Canada's federal government and eight of the country's ten provinces established the Pan-Canadian Framework on Clean Growth and Climate Change, under which each participating jurisdiction will set a carbon price of $10 Canadian per tonne by 2018, rising to $50 per tonne by 2022.[228] The price could be achieved either through a carbon tax or a cap-and-trade system.[229] To implement this agreement, the federal government would have to pass legislation establishing a national carbon price plan that would require provinces to adopt their own carbon pricing system or have the federal government impose a levy and return the revenue to the provincial government.[230]

Boulder, Colorado

Boulder, Colorado passed a voter-approved tax on carbon emissions in 2006.[231] The tax is levied on city residents and businesses on the basis of the amount of electricity they consume and generates

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[224] *Self-assessing Motor Fuel And Carbon Tax*, British Columbia Ministry of Finance 2 (2011), http://www2.gov.bc.ca/assets/gov/taxes/sales-taxes/publications/mft-ct-006-self-assessing-motor-fuel-carbon-tax.pdf.

[225] Brian C. Murray & Nicholas Rivers, *British Columiba's Revenue-Neutral Carbon Tax: A Review of the Latest "Grand Experiment" in Environmental Policy*, Duke Nicholas Inst. 4 (May 2015), https://nicholasinstitute.duke.edu/sites/default/files/publications/ni_wp_15-04_full.pdf.

[226] *British Columiba's Revenue-Netural Carbon Tax*, British Columbia, http://www2.gov.bc.ca/gov/content/environment/dimate-change/planning-and-action/carbon-tax (last retrieved May 19, 2017).

[227] Murray and Rivers at 9.

[228] *Pan-Canandian Framework on Clean Growth and Climzte Change*, Annex I, Gov't of Canada (Dec. 14, 2016), https://www.canada.ca/en/services/environment/weather/dimatechange/pan-canadian-framework/annex-federal-investments-measures.html.

[229] *Id.*

[230] Shawn McCarthy, *Carbon Prices Must Rise to Meet Canada's 2030 Greenhouse-Gas Targets: Officials*, The Globe and Mail (Mar. 31, 2017), https://www.theglobeandmail.com/report-on-business/industry-news/energy-and-resources/carbon-prices-must-rise-to-meet-2030-ghg-targets-officials/article34510739/

[231] Boulder, Colorado, Ordinance No. 7657 (2009); Boulders Climate Action Plan, City of Boulder 1 (2016), https://www-static.bouldercolorado.gov/docs/CAP_document_FINAL-1-201603211302.pdf?_ga=2.56516971.1926980587.1495485894-1626195789.1495485182.

approximately $1.8 million in revenue each year.[232] The funds are invested in energy efficiency and renewable energy generation programs to further reduce GHG emissions.[233]

Legislative Carbon Tax Proposals in U.S. States

Several U.S. state legislatures are considering bills to tax carbon emissions.[234] For example, the Washington State legislature is considering carbon tax legislation after voters rejected a carbon tax ballot initiative in 2016.[235] In New England, carbon tax legislation in Massachusetts would introduce a price starting at $10 per ton of carbon dioxide equivalent and would increase by $5 every year until the rate is $40 per ton.[236] The bill has attracted 80 cosponsors. Connecticut legislators are considering a bill that would establish a carbon tax at $15 per ton that would increase $5 annually until a Carbon Pollution Council determines otherwise.[237] The Connecticut legislation stipulates that the carbon tax would only be implemented if Massachusetts and Rhode Island also enacted a carbon tax,[238] so as not to put the state at a competitive disadvantage to other states.[239] (see box above on Competitiveness Concerns and Carbon Leakage) Similar legislation has been introduced in Rhode Island that would not be implemented until Massachusetts has also enacted a carbon tax.[240]

IV.B.3. Emerging Policy Ideas

Transportation and Climate Initiative work on Market-Based Policies

The Transportation and Climate Initiative (TCI) is a collaborative effort of 11 Northeastern and Mid-Atlantic States and the District of Columbia that seeks to reduce GHG emissions from the transportation sector. The collaboration was founded in 2010 by the heads of transportation, energy, and environment agencies in all 12 jurisdictions, including New Jersey.[241] TCI began by focusing on discrete projects like promoting electric vehicles and sustainable communities. In November 2015, several states, not including New Jersey, announced publicly that they would work together through the TCI to develop potential market-based strategies that could achieve significant reductions in transportation emissions.[242] At the same time, The Georgetown Climate Center, which facilitates the TCI, released an analysis of potential emission reductions and economic benefits that could be achieved in the region, including through such

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[232] *Id.*

[233] *Id.*

[234] *See* Chelsea Harvey, *Defying Trump, These State Leaders are Trying to Impose Their Own Carbon Taxes*, Wash. Post (May 12, 2017), https://www.washingtonpost.com/news/energy-environment/wp/2017/05/12/defying-trump-these-state-leaders-are-trying-to-impose-their-own-carbon-taxes/?utm_term=.9087ba9fd082.

[235] Wash. House Bill 1646 (2017); Austin Jenkins, *Carbon Tax Keeps Popping Up In Divided Washington Legislature*, NW News Network (Mar. 17, 2017), http://nwnewsnetwork.org/post/carbon-tax-keeps-popping-divided-washington-legislature.

[236] Mass. Sen. Bill 1821 § 13(A)(b) (2017).

[237] Conn. House Bill 7247 § 1(b)(1) (2017).

[238] *Id.* § 1(f)(1).

[239] Chelsea Harvey, *Defying Trump, These State Leaders are Trying to Impose Their Own Carbon Taxes*, Wash. Post (May 12, 2017), https://www.washingtonpost.com/news/energy-environment/wp/2017/05/12/defying-trump-these-state-leaders-are-trying-to-impose-their-own-carbon-taxes/?utm_term=.9087ba9fd082.

[240] RI Sen. Bill 365 (2017).

[241] *Transportation and Climate Initiative Declaration of Intent*, The Transportation & Climate Initiative, http://www.transportationandclimate.org/sites/default/files/TCI-declaration.pdf.

[242] *Five Northeast States and DC Announce They Will Work Together to Develop Potential Market-Based Policies to Cut Greenhouse Gas Emissions for Transportation*, Georgetown Climate Center (November 24, 2015), http://www.georgetownclimate.org/articles/five-northeast-states-and-dc-announce-they-will-work-together-to-develop-potential-market-based-policies-to-cut-greenhouse-gas-emissions-from-transportation.html.

policies: *Reducing Greenhouse Gas Emissions from Transportation: Opportunities in the Northeast and Mid-Atlantic*.[243] The report shows that New Jersey and other states in the northeast and mid-Atlantic could cut greenhouse gas emissions between 29 to 40 percent by 2030. A comprehensive implementation that included a pricing policy could result in net cost savings of up to $72.5 billion over 15 years for businesses and consumers, along with tens of thousands of new jobs and improvements in public health.

Regional Carbon Pricing

PJM, the entity that operates the electricity grid that serves New Jersey, Pennsylvania, Maryland and other states (or parts of states) in the midwest and Mid-Atlantic,[244] recently released a proposal for pricing carbon emissions on the wholesale electricity market in response to state initiatives for compensating nuclear energy generators for their carbon-free electricity.[245] Under the proposal, a sub-group of states in the PJM region would agree to place a single price on carbon emissions across the sub-regional group, which would be reflected in the wholesale electricity market price for those states.[246] Price leakage[247] would need to be prevented in order to create an even playing field for resources competing in the "carbon price sub-region" of PJM (currently including Maryland and Delaware, the only PJM states in RGGI) and the "non-carbon price sub-region."[248] Each state in the carbon price sub-region would decide how revenue collected as a result of the carbon price would be used, including, as the PJM proposal states, possibly mitigating electricity price impacts of the carbon price.[249]

IV.B.4. Social Cost of Carbon in Regulatory and Planning Processes

Many states mandate the use of the Social Cost of Carbon value to capture the value of external environmental costs in electricity generation and distribution. For example, as part of its Reforming the Energy Vision (REV) process (see discussion in Section IV.C.3), the state of New York proposed a compensation rate for distributed energy that includes an environmental value based either on the higher Social Cost of Carbon or New York Renewable Energy Credit (REC) prices.[250] The March 2017 proposal is currently only available to projects that would otherwise qualify for the state's net metering program, though the second phase of the program would explore expansion to include additional resources.[251] The New York Public Service Commission Clean Energy Standards also use the metric in valuing zero-emissions credits (ZECs) for nuclear power plants.[252] The ZECs are priced according to the U.S.

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[243] Gabe Pacyniak et al., *Reducing Greenhouse Gas Emissions from Transportation*, Georgetown Climate Center (November 2015), http://www.georgetownclimate.org/files/report/GCC-Reducing_GHG_Emissions_from_Transportation-11.24.15.pdf.

[244] PJM serves all or parts of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia and the District of Columbia. *Territory Served*, PJM, http://www.pjm.com/about-pjm/who-we-are/territory-served.aspx (last retrieved Aug. 17, 2017).

[245] *Advacing Zero Emissions Objectives through PJM's Energy Markets*, PJM 1 (2017), http://www.pjm.com/~/media/library/reports-notices/special-reports/20170502-advancing-zero-emission-objectives-through-pjms-energy-markets.ashx.

[246] *Id.*

[247] Price leakage occurs when the increased cost to emitting resources in RGGI states is passed through to consumers in non-RGGI via electricity exports from RGGI states.

[248] *Id.*

[249] *Id.*

[250] New York Public Service Commission, Case15-E-0751, Order On Net Energy Metering Transition, Phase One Of Value Of Distributed Energy Resources, And Related Matters.

[251] *Id.*

[252] Case 14-M-0101, Reforming the Energy Vision, Order Establishing the Benefit Cost Analysis Framework (issued January 21, 2016), pp. 17-19.

Environmental Protection Agency's Social Cost of Carbon less market revenues already captured through the state's participation in RGGI.[253]

Additionally, a statute in Minnesota requires utilities to account for "environmental costs" when deciding how to generate electricity.[254] In a related legal challenge, an Administrative Law Judge recommended that the state's Public Utilities Commission adopt the federal Social Cost of Carbon as an appropriate measure of the greenhouse gas component of such costs.[255] More recently, the state's Public Utilities Commission voted to increase the estimated Social Cost of Carbon utilities must consider in planning for new infrastructure projects.[256] This is similar to developments in the state of Colorado where the state's Public Utilities Commission has the authority to consider the "cost-effective implementation of new clean energy and energy-efficient technologies in its consideration of general acquisitions for electric utilities."[257] This includes the authority to include externalities, such as a proxy for carbon externalities, in resource planning considerations.[258] Pursuant to this authority, the Commission required that a utility price potential resources planning portfolios to incorporate a social cost of carbon starting at $43 per ton in 2022 and increase to $69 per ton in 2050.[259] California has statutory provisions to consider the societal benefits of GHG emission limits and reduction measures as well as the social costs of the emissions of GHGs.[260]

By contrast, New Jersey does not consider Social Cost of Carbon currently but could explore establishment of a social cost of carbon metric and incorporation of the social cost of carbon in state regulatory and planning processes. The state could also use the metric to value investments including economic impact statements required pursuant to the New Jersey Administrative Procedures Act.[261]

Social Cost of Greenhouse Gas Emissions

The social cost of carbon (or other greenhouse gas) emissions is a metric that estimates, in dollars, the long-term climate-related costs of an incremental ton of carbon dioxide (or other greenhouse gas) emissions in a given year. The climate-related costs included in the metric include changes in net agricultural productivity, human health, property damages from increased risk of flooding, and changes in energy system costs including reduced costs

[253] Case 14-M-0101, Reforming the Energy Vision, Order Establishing the Benefit Cost Analysis Framework (issued January 21, 2016), p. 18.

[254] Minn. Stat. § 216B.2422 Subd. 3. "Each utility required to file a resource plan under subdivision 2 shall include in the filing a narrative identifying and describing the costs, opportunities, and technical barriers to the utility continuing to make progress on its system toward achieving the state greenhouse gas emission reduction goals established in section 216H.02, subdivision 1, and the technologies, alternatives, and steps the utility is considering to address those opportunities and barriers."

[255] Minnesota Office of Administrative Hearings, In the Matter of the Further Investigation into Environmental and Socioeconomic Costs Under Minn. Stat. § 216B.2422, Subd. 3, MPUC 14-643, April 15, 2016. https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showPoup&documentId={1BCD99A9-17A3-4115-BBFF-36D083A837E8}&documentTitle=20164-120135-01.

[256] Mike Hughlett, *'Social cost'" of carbon dioxide emissions from power plants increased*, Star Tribune (July 27, 2017), http://www.startribune.com/minnesota-regulators-increase-social-cost-of-co2-emissions-but-not-as-much-as-asked/437066353/.

[257] Colorado Revised Statutes § 40-2-123(1)(a).

[258] Colorado Revised Statutes §40-2-123(1)(b).

[259] Colorado Public Utilities Commission Decision No. C17-0316 (March 23, 2017).

[260] California A.B. 197 (requiring the California Air Resources Board to conduct a detailed economic and environmental analyses and document the social cost of carbon, and the range of greenhouse gas, criteria pollutant and toxic pollutant emission reductions from each proposed measure of A.B. 32, the state's cap-and-trade program).

[261] *See* N.J.S.A. 52:14B-B4(a)(2) and N.J.A.C. 1:30-5.1(c)3, reviews under Executive Order 215, and programs within the purview of the Board of Public Utilities.

from heating and increased costs from air conditioning.[262] The effort to incorporate the social cost of carbon (SCC) into regulatory impact analyses began during the Bush Administration, where each Federal agency developed its own estimate of the metric using a variety of methodologies.[263] In 2009, the Obama Administration established an interagency working group to develop a single set of estimates to be used by all agencies in their emissions reducing regulations.264 Under Presidential directive, the agencies used the metric to evaluate agency actions based upon economic and social-benefit analyses.[265] At the request of the working group, the National Academy of Sciences conducted a study examining potential approaches to conducting a comprehensive update to the SCC estimates.[266]

On March 28, 2017, President Trump issued an executive order (EO 13783)[267] that eliminated the working group and withdrew a series of technical documents that detailed the scientific basis that the Obama Administration used for estimating the social cost of carbon, methane and nitrous oxide. Going forward, EO 13783 instructs federal agencies to conduct cost-benefit analysis in rulemakings by following general guidance found in Circular A-4, published in 2003 by Office of Management and Budget. However, this Circular does not contain specific guidance on how to monetize costs associated with greenhouse gas emissions.

IV.C. Power Sector Strategies for Reducing Emissions

The electric power industry, referred to here as the power sector, generates the energy that provides power to homes and businesses.[268] The power sector in the United States is largely powered by carbon emitting fossil fuels, such as coal and natural gas, and the sector is the second largest source of carbon emissions in the U.S. economy.[269] Transitioning to a low-carbon energy system is one of the primary strategies for achieving deep decarbonization described in Section III, and decarbonizing the electricity system is a critical pathway within that strategy. Policy options for decarbonizing the power sector include encouraging deployment of clean energy and energy efficiency and reforming the electricity grid.

[262] *The Social Cost of Carbon*, United States Environmental Protection Agency, https://19january2017snapshot.epa.gov/climatechange/social-cost-carbon_.html (last retrieved July 11, 2017).

[263] Howard Shelanski & Maurice Obstfeld, *Estimating the Benefits from Carbon Dioxide Emissions Reductions*, The White House (July 2, 2015), https://obamawhitehouse.archives.gov/blog/2015/07/02/estimating-benefits-carbon-dioxide-emissions-reductions.

[264] *Technical Support Document: - Social Cost of Carbon for Regulatory Impact Analysis- Under Executive Order 12866*, Office of Management and Budget (February 2010), https://obamawhitehouse.archives.gov/sites/default/files/omb/inforeg/for-agencies/Social-Cost-of-Carbon-for-RIA.pdf.

[265] Exec. Order 13514, 74 Fed. Reg. at 52122.

[266] National Academy of Sciences, 2017. Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide. http://www.nap.edu/24651

[267] Executive Order 13783: Promoting Energy Independence and Economic Growth (2017), https://www.whitehouse.gov/the-press-office/2017/03/28/presidential-executive-order-promoting-energy-independence-and-economi-1.

[268] United States Dep't of Energy, United States ElectricitY Industry Primer 4, 15 (2015), https://www.energy.gov/sites/prod/files/2015/12/f28/united-states-electricity-industry-primer.pdf.

[269] *How Much of US Carbon Dioxide Emissions Are Associated with Electricity Generation*, United States Energy Info. Amin, https://www.eia.gov/tools/faqs/faq.php?id=77&t=11 (last updated May 10, 2017); *Power Sector Carbon Dioxide Emissions Fall Below Transportation Sector Emissions*, United States Energy Info. Amin, https://www.eia.gov/todayinenergy/detail.php?id=29612# (Jan. 19, 2017).

The 2012 inventory of greenhouse gas emissions in New Jersey reported that the state had already reduced its GHG emissions below 1990 levels, with some of that reduction attributable to emission reductions in the power sector.[270] In 2012, the power sector accounted for 20 percent of the state's GHG emissions.[271]

A relatively high percentage of New Jersey's electricity supply comes from carbon-emission-free sources. In 2015, 43.6 percent of the state's electricity came from nuclear generation and another 2.7 percent came from renewable sources.[272] However, one of the state's nuclear power plants—the 625 MW capacity Oyster Creek Generating Station, which provides approximately six percent of the state's electricity—is scheduled to retire in 2019.[273] In addition, PSEG, the utility that operates three nuclear facilities at Hope Creek and Salem, has stated that these facilities are "under unprecedented economic pressure, and their future is at risk."[274] Retiring a substantial portion of New Jersey's nuclear generation could make it difficult for the state to continue to maintain a large percentage of its electricity from emission-free sources. As described below, two states have implemented policies to address economic challenges faced by nuclear power plants in competitive wholesale markets. Other policies that implement a carbon price could also address the competitiveness challenges of nuclear facilities if the price is high enough (see discussion of policies establishing a carbon price in Section IV.B.).

More broadly, states have implemented power sector policies that reduce GHG emissions by mandating or promoting clean energy and energy efficiency, as well as by improving the operation of the electricity grid.

This chapter discusses the following state policy models:

- **Clean energy policies:** renewable portfolio standards, zero emission standards, power purchase agreements, net metering, and community solar policies;
- **Energy efficiency policies:** policies requiring utilities to treat energy efficiency as a resource, energy efficiency performance standards, and decoupled utility rate structures; and
- **Policies related to changes in electricity grid operation:** grid-of-the-future proceedings and promotion of energy storage deployment.

[270] Michael Aucott et al., Rutgers University, *2012 Update to New Jersey's Statewide Greenhouse Gas Emission Inventory* (2015), http://climatechange.rutgers.edu/docman-list/special-reports/354-2012-update-to-new-jersey-s-statewide-greenhouse-gas-emission-inventory/file..

[271] *Id.* at 4.

[272] See discussion *supra* in Section II.B.

[273] *Exelon Announces Outcome of 2020-2021 PJM Capacity Auction*, Exelon (May 24, 2017), http://www.exeloncorp.com/newsroom/pjm-auction-results-release-2017; *Exelon to Retire Oyster Creek Generating Station in 2019*, Exelon (Dec. 8, 2010), http://www.exeloncorp.com/newsroom/Pages/pr_20101208_Nuclear_OysterCreekRetirement.aspx (estimating the power plant provides six percent of the state's power).

[274] *Preserving Nuclear Energy, A New Jersey Resource: A PSEG Position Paper*, PSEG (2017), https://www.pseg.com/family/power/nuclear/pdf/nj_nuclear_brochure.pdf.

Summary Table of Key State Power Sector Policy Models

State Policy Model	Notable Implementations	Related New Jersey Actions?	Notes
RPS	CA, NY, VT, and HI have established RPSs of 50 percent+	20.38 percent RPS + 4.1 percent solar carve out and a carve out for offshore wind	Pending legislation to increase solar carve out goal. NJBPU has a pending rulemaking to implement the offshore wind carve out.
CES/ZES	NY adopted CES; IL passed ZES; MA considering adopting CES	No	The NJ utility PSEG has said it may need a CES/ZES to keep its nuclear plants operating
Distributed generation	41 states have net metering policies MN expects to have 400 MW of community solar power by the end of 2017	New Jersey has a net metering regulation; BPU has discretion to cap at 2.9 percent of sales NJ has not implemented state level polices for community solar	As distributed generation deployment increases, PUCs are considering how to revise net metering policies—including the rate of revenue provided to distributed renewable owners and the size of the programs—to continue promoting distributed renewable deployment but also create a sustainable financial model
Energy efficiency as a resource	CA, DE, and MA make efficiency highest priority resource	EDECA requires NJBPU to determine amount of energy efficiency to fund each year through social benefit fund proceeds	
EEPS	CA and IL recently strengthened EEPSs	NJBPU has statutory authority to adopt an EEPS through 2020, but has not adopted an EEPS	NJBPU declined in 2014 to adopt EEPS
Decoupling utility rate structure	19 states have electricity decoupling policies.	NJ has adopted decoupling for natural gas but not electricity	NJ may have authority to adopt decoupling for electricity. See discussion in Section V.
Grid of the future proceeding	NY, MD, MN, RI, CA have begun proceedings	No	NJ has authority through its Energy Master Plan statute and GWRA to address decarbonization of the electricity sector.
Energy storage	CA energy storage target for state's three largest utilities	New Jersey has implemented Renewable Electric Storage Program under EDECA authority	NJ program has led to installation 6,625 kWh of capacity; funded for $3 million in FY 2017.

IV.C.1. Clean Energy Programs

Renewable Portfolio Standards

Renewable portfolio standards (RPS) require a specified portion of a state's electricity from eligible renewable resources.[275] An RPS generally reduces power sector carbon emissions by reducing the proportion of electricity supplied to the grid by fossil fuel-fired generation plants.[276] Electric utilities that

[275] United States Envtl. Prot. Agency, EPA-HQ-OAR-2013-0602, Survey of Existing State Policies and Programs that Reduce Power Sector CO_2 Emissions, Appendix for State Plan Considerations, Technical Support Document 36 (2014) [hereinafter Survey].
[276] Survey at 36.

sell power to retail customers are usually the entities with an obligation to comply with an RPS.[277] In order to do so, the retailer must submit renewable energy certificates (RECs) that are awarded to qualifying producers of renewable energy and sold to retailers.[278] Most states allow some or all of the RPS target to be met through RECs generated in other states, meaning that the renewable energy resource may not actually be located in the state or even on the same electricity grid.

Many RPSs include a "carve-out" that requires a subset of the renewable energy target to be met by electricity from a specific type of renewable resource, such as distributed or onsite solar generation.[279] A small number of states have also adopted alternative energy portfolio standards (AEPS), which operate in a similar fashion to RPSs but include a broader range of qualifying energy sources, such as biofuels, methane converted from landfills, or converted coal waste.[280] In addition, some states have set renewable energy goals, which are voluntary, aspirational goals for the amount of consumed electricity that should be generated from renewable sources.[281]

Twenty-nine states and the District of Columbia currently have mandatory RPSs, ranging from 12.5 percent of electricity load by 2021 in North Carolina to 100 percent by 2045 in Hawaii.[282] Eight additional states have voluntary renewable goals.[283] Seventeen states and the District of Columbia have solar or distributed generation carve outs in their RPSs.[284]

Several states have recently established new RPS targets:

- California raised its RPS of 33 percent by 2020 to 50 percent by 2030 in 2015.[285]
- Hawaii hiked its RPS of 40 percent by 2030 to 100 percent by 2045 in 2015.[286]
- Oregon increased its RPS from 20 percent by 2020 to 50 percent by 2040 in 2016.[287]
- Vermont, which had a voluntary RPS prior to 2015, set its mandatory RPS target at 75 percent by 2032 in 2015.[288]
- District of Columbia raised its RPS of 20 percent by 2020 to 50 percent by 2032 in 2016.[289]

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[277] *See id.* at 38. In some cases, an RPS places the compliance obligation on electricity generators rather than retailers in the state.

[278] These programs are typically administered by Public Utility Commissions. Many programs, including New Jersey's, use a third-party electronic platform for compliance. The New Jersey RPS is administered by NJBPU and uses the PJM-GATS renewable energy credit tracking system; *New Jersey*, PJM-GATS, https://www.pjm-eis.com/program-information/new-jersey.aspx.

[279] N.C. Clean Energy Tech. Ctr., States with In-State Resource RPS Requirements 1 (2014), http://ncsolarcen-prod.s3.amazonaws.com/wp-content/uploads/2015/01/2014-Daniel-In-State-RPS-Requirements.pdf; U.S. Envtl. Prot. Agency, Energy and Env't Guide to Action: State Policies and Best Practices for Advancing Energy Efficiency, Renewable Energy, and Combined Heat and Power (2015), 5-1, https://www.epa.gov/sites/production/files/2015-08/documents/guide_action_full.pdf [hereinafter Energy and Env't Guide].

[280] 73 Pa. Cons. Stat. § 1648.2 (2016).

[281] *Id.*

[282] *State Renewable Portfolio Standards and Goals*, Nat'l Conference of State Legislatures (Apr. 26, 2017), http://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx.

[283] *Id.*

[284] Energy and Env't Guide at 5-1.

[285] *Id.*

[286] *Hawaii and Vermont Set High Renewable Portfolio Standard Targets*, U.S. Energy Info. Admin (June 29, 2015), http://www.eia.gov/todayinenergy/detail.php?id=21852 [hereinafter *Hawaii and Vermont*].

[287] Or. Sen. Bill 1547 § 5 (2016).

[288] *Hawaii and Vermont*.

[289] D.C. Code § 34-1431(a-1). (2017).

A 2014 survey of state studies on the impact of RPSs indicated that RPS have provided significant climate and economic benefits.[290] For example, New York's RPS of 30 percent by 2015 has achieved a reduction of 4.1 million tons of carbon emissions and thousands of tons of traditional pollutants[291] and increased the gross state product by approximately $921 million.[292] Compliance with all state RPSs in 2013 was projected to have reduced fossil-fuel generation by 3.6 percent, reducing 59 $MMTCO_2e$ on a life cycle basis.[293]

New Jersey has a mandatory RPS requiring 20.38 percent[294] of energy sold in the state by 2021 to come from a wide range of renewable resources. Most of the RPS—17.88 percent—must be met through "Class I" resources that include solar energy, wind energy, wave or tidal action, geothermal energy, landfill gas, anaerobic digestion, and fuel cells using renewable fuels. Each year 2.5 percent of the RPS requirement may be met from "Class II" resources: hydropower facilities larger than 3 MW and less than 30 MW, and resource-recovery facilities (i.e., municipal solid waste).[295]

Only resources that are located within the PJM electricity grid, or that deliver electricity to the PJM grid, are eligible.[296] Most qualifying projects can be located outside of New Jersey, though some (for instance, hydropower larger than 3 MW) must be located in-state.

Additionally, the New Jersey RPS has two technology-specific carve-outs. The first is a 4.1 percent carve-out for distributed solar generation located in the state by 2028.[297] Load-serving entities must procure Solar Renewable Energy Credits (SRECs) to meet this requirement.[298] Eligible projects create SRECs for the first 15 years of operation and SRECs may be banked for 5 years.[299]

The SREC market has experienced significant volatility that policymakers attempted to lessen through changes to the program design in 2012. In 2010 and 2011, the state experienced a rapid boom in solar development, due to strong SREC demand and falling technology and installation prices. In 2011, SREC prices exceeded $600 in some periods. However, the system quickly became overbuilt, and prices crashed to $200 as SREC availability outstripped compliance needs.[300] In response to this volatility, the legislature made modifications to the program, increasing the SREC compliance requirement to the current level (*i.e.*, 4.1 percent), lowering the alternative payment that compliance entities could make in lieu of purchasing SRECs, and increasing the shelf life of SRECs from three to five years.[301] However, some price

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[290] *See generally* J. Heeter et al., A Survey of State-Level Cost and Benefit Estimates of Renewable Portfolio Standards (2014), http://www.nrel.gov/docs/fy14osti/61042.pdf.

[291] *Id.* at 55.

[292] *Id.* at 60.

[293] *See* Ryan Wiser et al., *A Retrospective Analysis of the Benefits and Impacts of U.S. Renewable Portfolio Standards*, Lawrence Berkeley Nat'l Lab. (Jan. 2016), https://emp.lbl.gov/sites/all/files/lbnl-1003961.pdf.

[294] N.J. Admin. Code § 14:8-2.3 (2016).

[295] N.J. Stat. Ann. § 48:3-51 (2016).

[296] N.J. Admin. Code § 14:8-2.7 (2017).

[297] N.J. Stat. Ann. § 48:3-87(d)(3) (2016); N.J. Admin. Code § 14:8-2.7 (2017) (specifying only in-state facilities may qualify).

[298] SRECs can be created by a range of distributed solar projects: (1) net metered facilities, (2) facilities that meet the definition of "on-site generation"; (3) facilities eligible for aggregated net metering; (4) facilities owned or operated by a public utility approved by the BPU; (5) facilities connected to the distribution system at 69 kilovolts (kV) or less and approved by the BPU; and (6) facilities certified by the BPU and DEP as being located on a brownfield, an area of historic fill, or a closed landfill. No project connected to the grid above the distribution level (i.e., 69 kV) can create SRECs unless it is a net metering facility. N.J. Stat. Ann. § 48:3-51 (2016).

[299] N.J. Stat. Ann. § 48:3-87(p) (2016).

[300] *See, e.g.*, *Solar Market Development Volatility in New Jersey*, Rutgers University Center for Energy, Economic and Environmental Policy (CEEEP) (May 2014), http://www.njcleanenergy.com/files/file/Solar%20Act/Solar%20Act%20letter%20and%20SDV%20report.pdf.

[301] N.J. Senate Bill No. 1925, 215th Legisture (Adotped May 17, 2012).

volatility has continued as the market experiences ongoing mismatches between SREC demand and supply.[302]

The second carve-out requires the development of at least 1,100 megawatts of offshore wind generation.[303] However, a specific timeline to achieve this target has not been established, and proposed projects to date have failed to acquire the necessary contracts for purchasers of this energy.

Clean Energy Standards or Zero Emission Standards

Nuclear generation provides zero-emission baseload power[304] in many areas of the United States, including in New Jersey. In some competitive wholesale electricity markets, however, nuclear power has struggled to remain economically viable.[305] This is due in part to lower operating costs for natural gas and renewables, and also because the pricing of electricity does not take into account the zero-emissions attribute of nuclear energy (excepting those states that participate in a CO_2 cap-and-trade program, which sets a price on carbon and therefore rewards zero-emission generation). In order to address this situation, two states—New York and Illinois—are implementing clean energy standards (CESs) or zero emission standards (ZESs) that require electric utilities to purchase zero emission credits (ZECs) from qualifying zero-emission nuclear facilities.[306] The revenue that CESs and ZESs provide to nuclear facilities supports their continued operation and avoids the possibility of replacing emissions-free nuclear generation capacity with greenhouse gas-emitting energy sources, such as natural gas.[307] In evaluating support for nuclear power, states will likely consider many factors related to nuclear generation resources, including challenges with nuclear waste disposal, safety issues, and the potential to replace nuclear in the future with a combination of renewable energy and energy storage.

New York and Illinois became the first states to adopt CESs and ZESs in 2016.[308] The Massachusetts Executive Office of Energy and Environmental Affairs also proposed a CES in 2016.[309] New York's CES raised the state's renewable target from 30 percent by 2015 to 50 percent by 2030[310] and required utilities to procure ZECs in proportion to their share of the state's electricity load.[311] The ZEC program is approved for 12 years and is designed to have nuclear generation serve as a bridge fuel, providing

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[302] *See, e.g., SREC Pricing*, State of New Jersey Board of Public Utilities, http://www.njcleanenergy.com/renewable-energy/project-activity-reports/srec-pricing/srec-pricing (last retrieved Aug. 1, 2016).

[303] *Id.* 48:3-87(d)(4).

[304] In contrast to the combustion of coal or natural gas, nuclear fission does not emit GHGs. There are GHG emissions associated with nuclear generation—as well as with wind and solar energy—when assessed on a lifecyclelife-cycle basis that includes GHG emissions from the construction and operation of these facilities. *See Nuclear Energy*, Intergovernment Panel on Climate Change (2007), http://www.ipcc.ch/publications_and_data/ar4/wg3/en/ch4s4-3-2.html.

[305] *See Three Mile Island is the latest nuclear power plant to announce retirement plans*, U.S. Energy Information Administration (June 13, 2017), https://www.eia.gov/todayinenergy/detail.php?id=31612.

[306] Ill. Sen. Bill 2814, § 1-75(d-5) (2016); Order Adopting a Clean Energy Standard, N.Y. Pub. Serv. Comm., Case 15-E-0302, 156 (Aug. 1, 2016) [hereinafter CES Order].

[307] Press Release, Gov. Andrew Cuomo, *Governor Cuomo Announces Establishment of Clean Energy Standard that Mandates 50 Percent Renewables by 2030*, New York State (Aug. 1, 2016), https://www.governor.ny.gov/news/governor-cuomo-announces-establishment-clean-energy-standard-mandates-50-percent-renewables.

[308] Ill. Sen. Bill 2814, § 1-75(d-5); CES Order at 156.

[309] Clean Energy Standard (proposed Dec. 16, 2016) (to be codified at 310 Mass. Code Regs. 7.75) [hereinafter CES proposal]; *Reducing GHG Emissions Under Section 3(d) of the Global Warming Solutions Act*, Mass. Exec. Office of Energy and Envtl. Affairs, http://www.mass.gov/eea/agencies/massdep/air/climate/section3d-comments.html (last visited Feb. 14, 2017)

[310] CES Order at 81.

[311] *Id.* at 45, 156.

emissions-free generation until there is greater renewable energy generation in 2030.[312] ZECs cannot be used to demonstrate compliance with the RPS; the ZEC requirement is in addition to the RPS.[313] The ZEC price is administratively determined by the New York Public Service Commission (NYPSC), based upon the US Interagency Working Group's (USIWG) projected social cost of carbon and NYPSC-determination of the necessity of the zero-emission power.[314]

Illinois' ZES required utilities to procure ZECs equivalent to 16 percent of the utility's energy load[315] in addition to the state's RPS. The price for each ZEC will be based on the social cost of carbon as defined by the USIWG, expressed on a per megawatt hour basis.[316] Massachusetts' proposed CES would require that 80 percent of the commonwealth's electricity load be met through clean energy, including nuclear power, by 2050.[317] The Massachusetts proposal does not establish a price; the price would be set by the market.

Both the New York and Illinois programs were subject Energy to litigation that challenged the constitutionality of the programs. The plaintiffs claimed that the programs unconstitutionally intrude upon the exclusive authority of the Federal Energy Regulatory Commission (FERC) to oversee the sale of electric energy at wholesale energy prices in interstate commerce and as violating the dormant Commerce Clause because the programs benefit certain wholesale producers of nuclear energy in-state to the detriment of out-of-state producers.[318] In July, a federal district court dismissed challenges against the New York program.[319]

As described above, other policies that set a carbon price—including cap-and-trade programs or a carbon tax—could also potentially address competitiveness issues for nuclear generation if the carbon price was high enough.[320]

Contracting for Clean Energy

Power purchase agreements (PPAs) are agreements by utilities to purchase a specified amount of electricity from an electric generating facility, including from renewable energy facilities.[321] PPAs can indirectly decrease the use of fossil fuel-fired electricity on the grid by contracting for clean energy.[322] In some cases—for example in Connecticut—states have used PPAs to contract for renewable energy that is within the state's electricity grid and therefore is more likely to reduce fossil fuel use and related conventional pollution that affects the state's air.[323] In contrast, an RPS that allows out-of-state RECs

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312 *See id.* at 45, 143.

313 *Id.* at 45

314 *Id.* at 45, 49-50.

315 Ill. Sen. Bill 2814, § 1-75(d-5).

316 The price is adjusted downward if market prices exceed a market price baseline. *Id.* § 1-75(d-5)(1)(B).

317 CES proposal.

318 Complaint, *Vill. of Old Mill Creek et al. v. Star*, N.D. Ill. Feb. 14, 2017 (Civ. Doc. No. 1:17-cv-01163); Complaint, *Electric Power Supply Ass'n et al. v. Star et al.*, N.D. Ill. Feb. 14, 2017 (Civ. Docket No. 1:17-cv-01164); Complaint, *Coaltion for Competitive Electricity et al. v. Zibelman et. al.*, S.D.N.Y. Oct. 10, 2016 (Civ. Docket No. 1:16-cv-08164-VEC).

319 Memorandum Opinion and Order, *Coaltion for Competitive Electricity et al. v Zibelman et. al.*, S.D.N.Y. Oct. 10, 2016 (Civ. Docket No. 1:16-cv-08164-VEC).

320 Note that New York participates in RGGI, which establishes a carbon price, but still chose to implement the ZEC program.

321 *See* Survey at 20; *State Policies for Power Purchase Agreements*, Nat'l Conference of State Legislatures (July 10, 2015), http://www.ncsl.org/research/energy/state-policies-for-purchase-agreements.aspx [hereinafter Power Purchase Agreements].

322 *See* Energy and Env't Guide at 3-14; 3-15.

323 *See* CT. Pub. Act No. 13-202, *An Act Concerning Connecticut's Clean Energy Goals* (June 2015), https://www.cga.ct.gov/2013/act/pa/pdf/2013PA-00303-R00SB-01138-PA.pdf.

would not necessarily lead to reductions of conventional pollutants in a state's airshed. PPA's are also used by states that do not have RPSs.

More than 15 states have adopted legislation to authorize and regulate PPAs.[324] Minnesota's statute, for example, authorizes the state utility commission to approve or disapprove of power purchase contracts entered into by utilities to satisfy the state's RPS.[325] PPAs can also be used to procure clean energy and reduce emissions, even if not directly in satisfaction of a RPS. In 2013, Connecticut authorized its Department of Energy and Environmental Protection (CT DEEP)—in coordination with other states in the region or on its own initiative—to direct utilities to enter into PPAs for up to four percent of the state's electricity load for up to 20 years if CT DEEP determines it is consistent with the state's GHG emission reduction targets.[326] Similarly, Massachusetts, in 2016, required utilities in the state to solicit proposals to procure at least 9.45 million megawatt hours of clean energy by 2022 and 1,600 megawatts of offshore wind power by 2027.[327] These bids may be coordinated with other New England states.[328] However, a joint solicitation for renewable energy projects by Connecticut, Massachusetts, and Rhode Island is currently the subject of litigation in the Second Circuit alleging that the procurement program encroaches on FERC's authority and violates the dormant Commerce Clause.[329]

Policies to Promote Distributed Renewable Energy: Net Metering and Community Solar

States are also seeking to strengthen renewable production by promoting distributed generation through net metering and community solar policies. In addition to displacing fossil fuels, distributed generation provides other benefits—lower electricity bills for ratepayers, resiliency, and more efficient use of transmission.[330]

Net metering policies expand the use of renewable energy by allowing utility customers that generate on-site renewable energy—referred to as distributed generation[331]—to sell excess electricity to a utility and receive credit on their utility bill.[332] The credit offsets the customer's consumption during other times of the day, lowering the electricity bill—and in some cases providing net revenue to the customer.[333] Distributed generation sources are often located at a house, school, or business and include solar panels or small wind power generators.[334]

Forty-one states and Washington, DC have net metering programs, including New Jersey.[335] However, a few states are moving away from conventional net-metering amid concerns that the compensation provided to net-metering customers allows the customers to avoid compensating utilities for the cost of

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[324] *See* Power Purchase Agreements; Minn. Stat. § 216B.1645 (2016).

[325] Minn. Stat. § 216B.1645.

[326] 295 Ct. Gen. Stat. Ann. § 16a-13f (2016).

[327] Act of Aug. 8, 2016, Chap. 188, § 83C, 83D, 2016 Mass. Acts.

[328] *Id.*

[329] *Allco Finance Ltd. v. Klee*, Case No. 16-2946 (2d Cir. 2016); Stan Parker, *2nd Circ. Lifts Injunction in Conn. Clean Energy Fight*, Law360 (Dec. 13, 2016), https://www.law360.com/articles/872115/2nd-circ-lifts-injunction-in-conn-clean-energy-fight.

[330] *Distributed Generation of Electricity and its Environmental Impacts*, United States Envtl. Prot. Agency, https://www.epa.gov/energy/distributed-generation-electricity-and-its-environmental-impacts (last visited May 24, 2017).

[331] In contrast to large centralized generation resources owned by utilities or merchant power companies.

[332] *State Net Metering Policies*, Nat'l Conference of State Legislatures (Nov. 3, 2016), http://www.ncsl.org/research/energy/net-metering-policy-overview-and-state-legislative-updates.aspx.

[333] *See id.*

[334] *Id.*

[335] *Id.*

maintaining the electric grid infrastructure that the customers use to sell the generated electricity back to the grid.[336] The most prominent example of this is Nevada, which in 2015 changed the compensation rate for distribution generation providers from the "retail" rate to the "avoided cost" rate; but opposition to this change led the Nevada Public Utilities Commission to restore net metering for more than 30,000 residential customers who applied to the program before 2016.[337] Moreover, in June 2017 the Nevada legislature passed A.B. 405, which requires net metering compensation to be offered at a rate close to the retail rate.[338]

New Jersey's net metering program requires the state's utilities and energy suppliers to offer net metering for residential, commercial and industrial customers.[339] Renewable energy can include solar, wind, geothermal, wave, tidal, landfill gas or sustainable biomass resources, including fuel cells.[340] Customers are able to fully net qualifying generation up to the level of their annual consumption, effectively receiving full retail rate compensation for this generation.[341]

In August 2015, the legislature enacted S.B. 2420, which authorizes the NJBPU to increase the limit for net metering from 2.5 percent of peak load to 2.9 percent of total electricity sales in the state by each electric power supplier during the prior one year period.[342] The requirement, however, is discretionary in that the BPU may continue to allow net metering even if this threshold is reached,[343] and historically, the BPU has not imposed a cap on net metering.[344] For example, some estimates show that New Jersey net metered generation in 2015 was more than 180 percent of "capped" levels.[345]

Community solar involves multiple members of a community investing in a local solar energy project in return for sharing in the generated solar energy and any associated financial benefits, such as bill credits for supplying electricity back to the grid.[346] The projects are often situated on public or jointly-owned property.[347] Community solar allows renters and others that cannot or prefer not to install solar panels on their property to benefit from a local solar energy project.[348] Participation models include the utility-sponsored model, in which a utility owns or operates a project that is open to voluntary ratepayer

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[336] *See id.*

[337] Order Granting Application of Nevada Power Company for Approval of a Cost-of-Service Study and Net Metering Tariffs, Nev. Pub. Utils. Comm'n, Docket No. 15-07041 (Dec. 22, 2016) (changing compensation rate for distributed generation);Order Accepting Stipulation in Application of Nevada Power Company Filed Under Advice Letter No. 466 to Revise Tariff No. 1-B to Nodify Net Metering Rider-A Schedule NMR-A to Establish Separate Rates For Grandfathered Private Generation Customers, Nev. Pub. Utils. Comm'n, Docket No. 16-07028, (Sept. 16, 2016) (restoring netmetering for grandfathered customers).

[338] The legislation requires utilities to purchase electricity provided to the grid from qualifying distributed energy systems at a rate equal to 95 percent of the retail rate, declining to 75 percent as the total quantity of installed distributed energy increases. A. B. 405, 79th Sess. (Nev. 2017).

[339] N.J.A.C. 14:8-4.1 et seq.

[340] All "Class I" technologies under the state RPS. N.J.A.C. 14:8-4.1.

[341] N.J.A.C. 14:8-7.3 (2017).

[342] N.J. Stat. Ann. § 48:3-87 (2017).

[343] *Id.*

[344] *See, e.g., New Jersey Solar Policy* Survey, Pace Energy and Climate Center & Northeast Solar Energy Market Coalition (October 2016), http://nesemc.com/resources/policies/by_state/NESEMC%20Solar%20Policy%20Survey%20-%20New%20Jersey.pdf.

[345] *See e.g., New Jersey expands limit on net metered solar while Nevada keeps cap*, PV Magazine, https://www.pv-magazine.com/2015/08/13/new-jersey-expands-limit-on-net-metered-solar-while-nevada-keeps-cap_100020602/.

[346] United States Envtl. Prot. Agency, Community Solar: An Opportunity to Enhance Sustainable Development on Landfills and Other Contaminated Sites 1-2 (2016), https://www.epa.gov/sites/production/files/2016-12/documents/epa_repowering_community_solar_discussion_paper_final_120716_508.pdf.

[347] *Id.* at 1-2.

[348] United States Dep't of Enerty, A Guide to Community Solar: Unitility, Private, and Non-profit Project Development 3 (2010).

participation; a model in which individual investors join in a business enterprise to develop a community solar project; and a non-profit model, in which donors contribute to a community installation owned by a non-profit organization.[349]

Fifteen states and the District of Columbia have enacted legislation or regulations to encourage the development of community solar projects.[350] These policy initiatives have been successful in expanding solar-generated electricity. For example, Xcel Energy expects that 400 megawatts of community solar power will enter service by the end of 2017 as a result Minnesota's Solar Energy Jobs Act, which required Xcel to develop a plan for a community solar program for its customers.[351] While New Jersey does have community solar projects,[352] it does not have any state policy supporting the development of community solar projects.[353]

Other states have started pursuing value-of-solar or value-of-distributed-energy programs that provide a payment for distributed generation that attempts to capture the unique value of these distributed resources. For example, New York, as part of REV, proposed in March 2017 a compensation rate for some distributed energy that includes a location-based energy value, capacity value, environmental value (based on the higher of the Social Cost of Carbon or New York REC prices), a demand reduction value, and a locational system relief value. The rate is currently only available to projects that would otherwise qualify for New York's net metering program, although a second phase of the proceeding will explore expanding or revising the rate to include additional distributed resources.[354]

IV.C.2. Energy Efficiency Programs

Energy Efficiency as a Resource

Efficiency can be deployed as a resource to reduce energy demand by displacing electricity generated from traditional supply-side energy sources, such as coal or natural gas, and can be factored into utility decision-making about investment in new resources.[355] Investing in energy efficiency reduces both GHG emissions and operating costs.[356]

Nearly 40 states have some sort of policy or regulation to treat energy efficiency as a resource for meeting the state's electrical load needs.[357] Often this includes using a utility's integrated resource planning

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[349] *Id.* at 6.

[350] *State Policies for Shared Renewable Energy*, Nat'l Conference of State Legislatures (Arp. 19, 2017), http://www.ncsl.org/research/energy/state-policies-for-shared-renewable-energy.aspx [select "Legislative" tab] [hereinafter *Shared Renewable Energy*].

[351] Order Approving Value-of-Solar Rate For Xcel's Solar Garden Program, Minn. Pub. Utils. Comm., Docket No. E-002/M-13-867, 6 (Sept. 6, 2016).

[352] *See New Jersey Solar*, Cmty. Energy Solar, https://communityenergysolar.com/project/new-jersey-solar (last retrieved May 3, 2017).

[353] *Shared Renewable Energy*.

[354] New York Public Service Commission, Case15-E-0751, Order On Net Energy Metering Transition, Phase One Of Value Of Distributed Energy Resources, And Related Matters.

[355] *See* generally Nicole Hopper et al., *Energy Efficiency as a Preferred Resource: Evidence from Utility Resource Plans in the Western Us and Canada*, 2 Energy Efficiency 1 (2009).

[356] Nat'l Ass'n of Clean Air Agenices, Implenting EPA's Clean power Plan: A Menu of Options 11-1 (2015).

[357] *Energy Efficiency as a Resource*, Am. Council for an Energy-Efficient Econ., http://database.aceee.org/state/energy-efficiency-resource (last updated July 2017).

process to plan to meet future energy demand through efficiency.[358] Some states, including California, Delaware, and Massachusetts, establish efficiency as a higher priority than acquiring new generation capacity for satisfying new load demand.[359] New Jersey has a statutory provision that requires the New Jersey Board of Public Utilities to undertake every four years a comprehensive resource analysis of energy programs to determine the appropriate level of energy efficiency funding that a utility can collect through a societal benefits charge.[360]

Energy Efficiency Resource Standard

An energy efficiency resource standard or energy efficiency portfolio standard (EEPS) operates in a similar manner to a RPS, in that it typically requires that a utility achieve a specific percentage reduction in retail electricity sale growth or a specific electricity savings amount over a long-term period.[361] Some states have set voluntary efficiency goals instead of a mandatory EEPS.[362] EEPSs indirectly reduce greenhouse gas emissions by reducing fossil fuel-fired energy consumption.[363] Most enacted EEPSs require electricity savings, while a smaller number apply to natural gas.[364]

Twenty-three states have some sort of mandatory energy efficiency standard for electricity savings with most standards requiring annual energy savings in the range of .25-2.5 percent.[365] Three states have set voluntary energy efficiency goals.[366]

Most EEPSs were initially established between 2005 and 2010. In recent years, several states have strengthened their EEPSs. In 2015, California passed legislation to require the California Energy Commission—in consultation with the state's Public Utilities Commission and the regulated utilities—to establish annual targets for statewide energy efficiency savings that will achieve at least a doubling of statewide energy savings by 2030.[367] At the end of 2016, Illinois adopted legislation that strengthened its EEPS by requiring Illinois utilities Commonwealth Edison and Ameren to reduce electricity usage in their service areas by 21.5 percent and 16 percent, respectively, by 2030.[368]

States have also seen significant benefits from adopting EERSs. For example, Maryland's EmPOWER program helped reduce nearly 19 million tons of carbon emissions and saved consumers more than $4 billion over the life of the improvements.[369]

As discussed in Section V, the GWSFA provided NJBPU with discretionary authority to establish an energy efficiency portfolio standard of up to 20 percent by 2020, but NJBPU has not established a

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[358] *See, e.g.*, *In the Matter of Resoruce Planning and Procurment in 2013 and 2014*, Ariz. Corp. Comm'n, Docket No. E-00000V-13-0070 (Apr. 15, 2015); *In Re: Georgia Power Company's Application for Approval of its 2010 Integrated Resource Plan, Ga. Pub. Serv. Comm.*, Docket No. 31081, 31082 (July 13, 2010).

[359] Cal. Ass. Bill 1890 (1996); Cal Ass. Bill 995 (2000); Del. Senate Bill 106 (2009); Mass. Sen. Bill 2768 (2008).

[360] N.J. Stat Ann. § 48.3-60 (2016).

[361] Survey.

[362] *Id.* at 26.

[363] *Id.* at 6.

[364] *See id.* at 24.

[365] *Id.* at 26.

[366] *Id.*

[367] Cal. Sen. Bill 350 § 25310(2)(c)(1) (2016).

[368] Ill. Sen. Bill 2814, § 8-103B (2016).

[369] *EmPOWER Maryland Will Save Customers $4 Billion on Electric Bills*, American Council for an Energy-Efficient Economy (Jan. 11, 2017), http://aceee.org/press/2017/01/empower-maryland-will-save-customers.

standard. NJBPU has considered petitions to implement an electric and gas portfolio standard, most recently in 2014. NJBPU declined to adopt a portfolio standard at that time, citing its objective to "to phase out reliance on ratepayer-funded subsidies and phase in a market-driven model" and explaining that implementing a standard without "due consideration of all related issues" would not reach that objective.[370]

Decoupling

Decoupling is a tool used by utility regulators to change how gas and electric utilities are compensated for providing energy.[371] At least 19 states have electricity decoupling policies in place.[372] Under a decoupled rate structure, utility customers pay for the amount of energy they consume and the utility's revenue is based on a formula approved by the regulator that includes compensation for promoting conservation of electricity.[373] Customers continue to have an incentive to reduce energy consumption in order to lower their utility bills, and the utility has no disincentive to promote increased consumption (as it would if its revenue were tied directly to only energy sales).[374] This helps to indirectly reduce GHG emissions through lower levels of energy use.[375] Other programs—such as incentives that allow a utility to recover costs of energy efficiency investments and/or collect surcharges from customers if certain efficiency goals are met—can additionally create a direct incentive for utilities to reduce electricity usage and provide ways to fund conservation programs. Such funding mechanisms and performance-based incentives often complement decoupling measures, and help to fill in for lost revenue from reduced sales (if only these measures are employed, however, a utility's main source of revenue remains tied directly to energy sales, and thus such structures are not fully "decoupled"). Nineteen states and the District of Columbia have implemented decoupling for electric utilities. Fourteen of those states have also implemented decoupling for natural gas utilities. Four states—including New Jersey—have implemented a decoupling policy for natural gas utilities but not for electric utilities.[376] California has had a decoupled rate structure since the late 1970s and has been able to keep its per capita energy use relatively flat over the past 30 years, while national per capita energy use has increased by 50 percent over the same time frame.[377]

NJBPU has not approved decoupling mechanisms for electricity, but has approved such a mechanism for natural gas. The board approved a decoupling mechanism called the Conservation Incentive Program (CIP) for the New Jersey Natural Gas Company and the South Jersey Gas Company in 2006, and has since extended the program.[378] This program allows utilities to collect from shareholders the costs of certain conservation programs that reduce the amount of gas the company needs to serve its customers. If the

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[370] 46 N.J. Reg. 1656(d) (July 7, 2014).

[371] Pamela Morgan, A Decade of Decoupling for US Energy Utilities: Rate Impacts, Designs and Observations 2 (2013).

[372] *Decoupling Policies*, Center for Climate and Energy Solutions (November 2016), https://www.c2es.org/us-states-regions/policy-maps/decoupling.

[373] *Id.*

[374] *Id.* at 6.

[375] *Residential End-Use Efficiency*, Ctr. for Climate and Energy Solutions, https://www.c2es.org/technology/factsheet/ResidentialBuildingEnd-Use (last visited May 25, 2017).

[376] *Decoupling Policies*, Center for Climate and Energy Solutions (November 2016), https://www.c2es.org/us-states-regions/policy-maps/decoupling.

[377] Cal. Pub. Utils Comm'n, California's Decoupling Policy 1, http://www.fishnick.com/pge/Decoupling_Explained.pdf.

[378] N.J. BPU Order Docket Nos. GR05121019 and GRO5121020 (Dec. 12, 2006) (original order approving CIP), N.J. BPU Order Docket Nos. GR05121019 and GRO5121020 (Jan. 20, 2010) (authorizing extension of CIP), N.J. BPU Order, Docket No. GR13030185 (May 21, 2014) (authorizing extension of CIP). See also Morgan at 61.

company can demonstrate that it has achieved savings in its gas supply costs, it may also impose a surcharge on customers to recover lost revenues.

New Jersey statute allows gas and electric utilities to invest in energy efficiency programs and, with BPU approval, recover costs of such programs through the societal benefits charge (see below) or other rate mechanisms.[379] With regard to electricity, however, New Jersey does not decouple revenue from electricity sales, as do other states like California. New Jersey's existing statute may allow the board to decouple electric utility rate structures, as discussed in Section V. In 2016, legislators have again started a process to explore the potential for electricity decoupling legislation.[380]

Energy Efficiency and the Societal Benefits Charge

New Jersey's 1999 electric utility restructuring legislation (EDECA) authorized the Board of Public Utilities to allow utilities to continue collecting funds for public purpose programs—including energy efficiency programs— in a restructured utility market through a "societal benefits charge" (SBC).[381] These programs include New Jersey's Clean Energy Program, which in 2010 accounted for over a third of SBC revenue spent; 2010 spending on all SBC programs was $698.2 million, with $229.6 spent on clean energy. Of this portion, a majority was allocated to energy efficiency programs (both gas and electric). In 2011, over 80 percent of SBC funds collected for the Clean Energy Program were spent on efficiency.[382]

Property Assessed Clean Energy

Property Assessed Clean Energy (PACE) is a financing tool that allows property owners to finance up to 100 percent of the initial investments in clean energy projects—especially energy efficiency—that are then paid back through property tax assessments.[383] The payments are typically offset by the energy bill savings from the investments in energy efficiency. Because the loan is a voluntary assessment on a property tax bill, it is tied to the property itself and not the individual owner. PACE can be an effective policy for mitigating one of the chief barriers to improving energy efficiency in buildings—high up-front investments costs. There are two types of PACE programs: Residential Pace (R-PACE) for single homes and one- to four-family properties and Commercial PACE (C-PACE) for multifamily homes, small commercial properties, large commercial properties, industrial buildings, agriculture projects, and nonprofits. As a property tax program, PACE is typically administrated by city or county governments, but often require state authorization.[384] Since 2010, the Federal Housing Finance Agency (FHFA) has implemented mortgage policies intended to address additional lending risks associated with PACE loans,[385] and in practice these policies have reduced implementation of PACE programs.[386] Some states' residential programs have continued with appropriate disclosures or modifications to address the

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379 NJ Rev Stat § 48:3-98.1 (2013).

380 David Giambusso, *New Jersey energy experts set to take on 'decoupling'*, Politico (Aug. 12, 2016), http://www.politico.com/states/new-jersey/story/2016/08/decoupling-brain-trust-begins-friday-104684.

381 NJ Rev Stat § 48:3-60 (2013).

382 *Societal Benefits Charge*, New Jersey's Clean Energy Program, http://www.njcleanenergy.com/societal-benefits-charge (last retrieved August 12, 2016).

383 *See, e.g., Best Practice Guidelines for Residential Property Assessed Clean Energy Financing*, U.S. Department of Energy, https://energy.gov/eere/slsc/property-assessed-clean-energy-programs (last retrieved Aug. 12, 2016).

384 Pace Financing, National Conference of State Legislatures, http://www.ncsl.org/research/energy/pace-financing.aspx.

385 *See, e.g.,* https://www.fhfa.gov/Media/PublicAffairs/Pages/FHFA-Statement-on-Certain-Energy-Retrofit-Loan-Programs.aspx (July 6, 2010).

386 *Pace Financing*, National Conference of State Legislatures, http://www.ncsl.org/research/energy/pace-financing.aspx.

concerns raised by the FHFA, including programs in California, Oklahoma, and Vermont.[387] Other states, like Connecticut, have focused on C-PACE programs not subject to the FHWA mortgage policies.[388] In 2012 New Jersey enacted a statute to allow municipalities to establish PACE funding programs, although this program requires municipalities to get permission from the state to implement PACE programs.[389] Legislation proposed but not passed in recent years would have removed this requirement, and would also have allowed municipalities to seek private financing without issuing bonds.[390]

IV.C.3. Energy Planning and Grid Modernization

"Grid of the Future" Public Utility Commission Proceedings

Grid of the future refers to proceedings by state utility commissions to adjust the operation and structure of the electrical grid so that it can more efficiently respond to changes in how electricity is produced and consumed, and—in many cases—to facilitate a shift to a less carbon-intensive electricity system.[391] The U.S. electrical grid is undergoing dramatic change due to increases in distributed renewable energy, greater energy efficiency efforts, increased use of demand side management,[392] the emergence of grid-scale energy storage, future widespread electrification of the transportation sector and potentially residential heating, and the expanded use of microgrids and other smart grid technologies that can provide additional resilience and reliability in the face of increasing extreme weather events.[393] These changes present new policy questions that may not be adequately addressed by the current regulatory framework for electric utilities (e.g., how to value distributed renewable electricity, or how to encourage the development of energy storage). They also present challenges to the traditional utility business model, as clean energy policy goals place an increased emphasis on *reducing* electricity use and customers are increasingly able to generate or procure electricity without relying on the utility. Smoothly incorporating and accelerating the adoption of these changes could reduce GHG emissions by more effectively integrating renewable energy into the grid (e.g., by storing energy when the sun is shining and wind is blowing), encouraging investments in energy efficiency to reduce the cost of achieving emissions

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387 *Id.*

388 *Id.*

389 N.J.S.A. 40:56-1.4.

390 *See* S. 2150, 216th Leg. (N.J. 2015); Jon Hurdle, *NJ bill would allow towns to raise private capital for clean-energy projects*, N.J. Spotlight (June 15, 2015), http://www.newsworks.org/index.php/local/new-jersey-spotlight/83049-nj-towns-could-begin-raising-private-capital-to-encourage-clean-energy-building-projects.

391 *See., e.g.,* Order Adopting Regulatory Policy Framework and Implementation Plan, N.Y. Pub. Serv. Comm., Case 14-M-0101 (Feb. 26, 2015) [hereinafter Regulatory Policy Framework]; In the Matter of Transforming Maryland's Electric Distribution Systems to Ensure that Electric Service is Customer-Centered, Affordable, Reliable and Environmentally Sustainable in Maryland, Md. Pub. Serv. Comm., PC44 (Sept. 26, 2016) [hereinafter PC44]; Minn. Pub. Utils. Comm., Staff Report on Grid Modernization (Mar. 2016), https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showPoup&documentId={E04F7495-01E6-49EA-965E-21E8F0DD2D2A}&documentTitle=20163-119406-01 [hereinafter Grid Modernization Staff Report].

392 Demand side management is the planning, implementing, and monitoring of activities by electric utilites to encourage consumers, which demand electricity, to modify their level and pattern of electricity usage so as to provide cost-effective energy and capacity resources to help defer the need for new sources of power, including generation facilities and power purchases. *Electric Utility Demand Side Management - Archieve*, United States. Energy Info. Admin., https://www.eia.gov/electricity/data/eia861/dsm/ (last retrieved June 1, 2017).

393 U.S. Dep't of Energy, Quadrennial Energy Review: Energy Transmission, Storage, and Distribution Infrastructure 3-3 (2015), https://energy.gov/sites/prod/files/2015/04/f22/QER-ALL%20FINAL_0.pdf.

caps, and promoting beneficial electrification in the transportation and building sectors that reduces GHG emissions.[394]

Public utility commissions in several states, including New York, Minnesota, Maryland, Ohio, Rhode Island, and Hawaii have in the last few years initiated proceedings that seek to broadly revise utility regulations to further modernization, and in some cases, to promote decarbonization of the grid.

The New York Public Service Commission (NYPSC) began its Reforming the Energy Vision (REV) process to reorient the power sector and the ratemaking process towards a customer-centered approach that empowers technology advances and market forces.[395] One of the objectives of the REV proceeding is to support New York State's goal of achieving a 40 percent reduction in GHG emissions from 1990 levels by 2030.[396] NYPSC has used its REV proceeding to pursue climate goals by adopting the state's CES (discussed above) and a Community Choice Aggregation program to allow local governments to meet their energy needs from distributed energy resources.[397] Under REV, NYPSC also adopted an order to reform the utility revenue model away from earnings based solely on the cost of providing energy services to also include earnings tied to achievement of outcomes that support New York's energy policy goals.[398] This model is intended to create a regulatory environment that provides utilities the opportunity to develop a more efficient and resilient distributed low-carbon electric system.[399]

In 2015, the Minnesota Public Utilities Commission (MPUC) initiated a grid modernization proceeding with a focus on planning for and investing in the electricity distribution system of the future and aligning the planning process with reliability, efficiency, and public policy goals.[400] MPUC began the first phase of the initiative with a series of workshops with stakeholders that culminated in a staff paper defining grid modernization for the purpose of the proceeding as a grid that "assures continued safe, reliable, and resilient utility network operations, and enables Minnesota to meet its energy policy goals, including the integration of variable renewable electricity sources."[401] MPUC, in December 2016, completed the second phase of its grid modernization process by releasing three white papers on performance-based compensation, integrated systems planning, and grid modernization.[402] A move towards a performance-based compensation model could help advance climate goals by promoting clean energy through fairly valuing distributed energy resources and improving grid efficiency, while grid modernization planning

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394 MJ Bradly/Georgetown Climate Center, Aligning Grid of the Future with State Climate & Draft Environmental Goals (2017) (draft) [hereinafter Aligning Grid of the Future].

395 Regulatory Policy Framework at 3.

396 *Proceeding on Motion of the Commission in Regard to Reforming the Energy Vision*, N.Y. Pub. Serv. Comm., Case 14-M-0101 (April 25, 2014).

397 *Key Documents*, N.Y. Pub. Serv. Comm., http://www3.dps.ny.gov/W/PSCWeb.nsf/All/C12C0A18F55877E785257E6F005D533E?OpenDocument (last updated Dec. 20, 2016).

398 *Order Adopting A Ratemaking and Utility Revenue Model Policy Framework*, N.Y. Pub. Serv. Comm., Case 14-M-0101, 2 (May 19, 2016).

399 *Id.* at 2, 10.

400 Minn. Pub. Utils Comm., Building a Minnesota Conversation on Grid Modernization with a Focus on Distribution Systems (2015), http://mn.gov/puc-stat/documents//pdf_files/grid_modernization_5-12-2015.pdf.

401 Grid Modernization Staff Report at 50.

402 *See generally* e21 Initiative, Phase II Report: On Implementing a Framework for a 21st Century Electric System in Minnesota (2016), http://www.betterenergy.org/sites/default/files/e21_PhaseII_Report_2016.pdf. Performance-based compensation is a compensation system where some portion of the utility earnings is linked to utilties' performance on ouctomes valued by customers and supportive of state energy policies, such as renewable energy generation. *Id.* at 11.

could be more responsive to customers' preference for clean energy and efficient use of energy.[403] Phase three will adopt a long-term vision for grid modernization in Minnesota.[404]

Maryland's Public Service Commission (MDPSC) embarked on a proceeding in September 2016 to ensure that the state's electric distribution systems are responsive to customers, affordable, reliable and environmentally sustainable.[405] MDPSC's has identified seven focus areas for this proceeding, many of which have a clear clean energy nexus.[406] These include performance-based compensation, benefits and costs of distributed energy resources, interconnection and distribution system planning.[407] The first workshop of the proceeding was held in December 2016.[408]

Recognizing that grid modernization plays a strategic role in helping Hawaii achieve its 2020 and 2030 clean energy objectives, Hawaii's Public Utility Commission has opened multiple proceedings related to reliability standards and distributed energy policies.[409] Additionally, the Ohio Public Utility Commission (OHPUC) initiated a stakeholder process this Spring that will continue in 2018 to consider grid modernization projects, technologies, and regulatory pathways for such projects.[410] Rhode Island's Gov. Gina Raimondo also directed the Public Utilities Commission, the Office of Energy Resources, and the Division of Public Utilities and Carriers to develop draft regulatory frameworks, proposals, or deployment strategies by November 2017 that explore how to enable Rhode Island and its utilities to advance clean, affordable and reliable energy.[411]

For over a decade, the California PUC has carried out a variety of regulatory proceedings on distributed resource planning, energy efficiency ratemaking and other strategies designed to enable the integration of distributed energy resources (DER), including roof-top solar, electric vehicles, and energy storage.[412] In May 2017, the California PUC released a DER Action Plan to further enable grid modernization in the context of several related ongoing proceedings and initiatives.[413] The Plan describes a long-term vision for DER and is intended to serve as a roadmap for decision-makers, staff, and stakeholders, guiding the development and implementation of DERs and related policy. The Plan addresses rates and tariffs;

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403 *See generally, id.*

404 Grid Modernization Staff Report at 50.

405 PC44 at 1.

406 *Id.* at 3.

407 *Id.*

408 *Id. at 1.*

409 *See, e.g., Grid Modernization*, Hawaii State Energy Office (2017), http://energy.hawaii.gov/renewable-energy/grid-modernization; PUC Docket, Instituting a Proceeding to Investigate Distributed Energy Resource Policies, Docket No. 2014-0192; PUC Docket, Instituting A Proceeding to Investigate the Implementation of Reliability Standards For Hawaiian Electric Company, Inc., Hawaii Electric Light Company, Inc., and Maui Electric Company, Limited, Docket No. 2011-0206.

410 *See, e.g., Power Forward*, Ohio Public Utilities Commission, https://www.puco.ohio.gov/industry-information/industry-topics/powerforward/ (last retrieved Aug. 2017).

411 *See, e.g.,* Gina M. Raimondo, *Letter to Rhode Island Public Utility Commissioners*, State of Rhode Island and Providence Plantations (March 2, 2017), http://www.ripuc.org/utilityinfo/electric/GridMod_ltr.pdf; *Power Sector Transformative Initiative*, State of Rhode Island Public Utilities Commission and Division of Public Utilities and Carriers, http://www.ripuc.org/utilityinfo/electric/PST_home.html (last retrieved Aug. 2017).

412 California Public Utilities Commission, "Integrated Distributed Energy Resources." Visited Aug. 31, 2017. http://www.cpuc.ca.gov/General.aspx?id=10710

413 California Public Utilities Commission. "California's Distributed Energy Resources Action Plan: Aligning Vision and Action." May 3, 2017. http://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/About_Us/Organization/Commissioners/Michael_J._Picker/DER%20Action%20Plan%20(5-3-17)%20CLEAN.pdf

distribution grid Infrastructure, planning and procurement; and wholesale DER market integration and interconnection.

Including GHG Emissions Considerations in Utility Planning

Some states have instituted policies requiring that utilities take into account GHG emissions and their impacts in long-term planning or operational decisions. These policies include requirements to incorporate a carbon cost into program- or project- cost-benefit analyses (such as those comparing different generation resource types or the cost-effectiveness of energy efficiency programs) and requirements to ensure that new and existing energy procurement is in line with state GHG goals.

A statute in Minnesota, for example, requires utilities to account for "environmental costs" when deciding how to generate electricity.[414] An April 2016 report from an Administrative Law Judge in a related legal challenge recommended that the Minnesota Public Utilities Commission adopt the federal Social Cost of Carbon as an appropriate value for the GHG components of these costs.[415] In addition, the statute requires that utilities include in their integrated resources plans "a narrative identifying and describing the costs, opportunities, and technical barriers to the utility continuing to make progress on its system toward achieving the state greenhouse gas emission reduction goals" established by the state.[416] On July 27, the Minnesota PUC voted to increase the social cost of carbon from $9.05 to $43.06 per short ton by 2020.[417]

California utilities similarly must file an integrated resource plan that will, among other things, "ensure that load-serving entities… Meet the greenhouse gas emissions reduction targets established by the State Air Resources Board."[418]

In Colorado, the Public Utilities Commission has authority to consider the "cost-effective implementation of new clean energy and energy-efficient technologies in its consideration of generation acquisitions for electric utilities, bearing in mind the beneficial contributions such technologies make to Colorado's energy security, economic prosperity, insulation from fuel price increases, *and environmental protection, including risk mitigation*" (emphasis added).[419] The Commission also has discretion to include externalities within resource planning considerations.[420] In March 2017, the Public Utilities Commission found that including a proxy for carbon externality costs in resource planning decisions is consistent with

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[414] Minn. Stat. § 216B.2422 Subd. 3. "Each utility required to file a resource plan under subdivision 2 shall include in the filing a narrative identifying and describing the costs, opportunities, and technical barriers to the utility continuing to make progress on its system toward achieving the state greenhouse gas emission reduction goals established in section 216H.02, subdivision 1, and the technologies, alternatives, and steps the utility is considering to address those opportunities and barriers."

[415] Minnesota Office of Administrative Hearings, In the Matter of the Further Investigation into Environmental and Socioeconomic Costs Under Minn. Stat. § 216B.2422, Subd. 3, MPUC 14-643 (April 15, 2016), https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showPoup&documentId={1BCD99A9-17A3-4115-BBFF-36D083A837E8}&documentTitle=20164-120135-01

[416] Minn. Stat. § 216B.2422 Subd. 2c.

[417] Order not available at time of writing. *See* Mike Hughlett, *'Social cost' of carbon dioxide emissions from power plants increased*, Minn. Star Tribune (July 27, 2017), http://www.startribune.com/minnesota-regulators-increase-social-cost-of-co2-emissions-but-not-as-much-as-asked/437066353/.

[418] Calif. Pub. Util. Code §454.52. (a) (1)

[419] CO Rev. Stat. § 40-2-123(1)(a) *(emphasis added).*

[420] CO Rev. Stat. §40-2-123(1)(b)

these requirements.[421] It therefore ordered that a utility price potential resources planning portfolios incorporating a social cost of carbon starting at $43 per ton in 2022 and increase to $69 per ton in 2050.

As described in more detail in section V.E.1. Energy Planning below, the New Jersey Energy Master Plan Statute requires an Energy Master Plan Committee to develop a 10-year "master plan" (with updates every three years) for the "production, distribution, and conservation of energy" in New Jersey. Later legislation also added GHG planning requirements to this process. For example, NJDEP must coordinate the required evaluation of greenhouse gas reduction policies and measures with the Energy Master Plan Committee. The GWRA also required that the Energy Master Plan include a list of "recommended policies and measures to reduce the emission of greenhouse gases from the production, processing, distribution, transmission, storage, or use of energy that will contribute to achieving the 2020 limit."[422]

Policies to Promote Energy Storage

Energy storage technologies, including batteries, flywheels, pumped hydroelectric storage, and compressed air energy storage, can store electric energy for later deployment to the grid.[423] Energy can be stored at grid scale or at a smaller, residential level.[424] Until recently, most energy storage was not very energy efficient or cost-effective. Recent advances in battery and flywheel technologies, however, combined with state policies identified below, are driving rapid advances in grid-scale energy storage. Grid-scale storage deployments have increased dramatically, with 6 gigawatts of storage capacity projected to be installed in 2017, up from just 340 megawatts in 2012-2013.[425]

Energy storage helps reduce GHG emissions by allowing higher levels of deployment of variable renewable electricity like wind and solar.[426] It can store surplus electricity produced when the sun is shining or the wind is blowing, and discharge that electricity during periods of higher demand, for example in the early evening which is typically the period of peak electricity demand or when the sun is no longer shinning and the wind no longer blowing.[427] It can also reduce the need for fossil fuel-fired capacity through maintaining reliability in the face of grid congestion or changes in grid frequency.[428] Energy storage is often identified as a component of the grid of the future.

Several states are promoting development of storage resources through procurement mandates, demonstration projects, and incentive programs. In 2015, following the passage of a state law requiring an energy storage mandate, the California Public Utilities Commission established an energy storage target of 1,325 MW by 2020 for Pacific Gas & Electric, Southern California Edison, and San Diego Gas & Electric.[429] The Oregon legislature passed legislation in 2015 that required electric companies in the state

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421 CO Pub. Util. Comm. Decision No. C17-0316 (March 23, 2017).

422 N.J.S.A. 26:2C-42(a).

423 United States Dep't of Energy, Quadrenial Energy Review: Energy Transmission, Storage, and Distribution Infrastructure 3-10 (2015).

424 *See* Bruce Dunn et al., *Electrical Engery Storage for the Grid: A Battery of Choices*, Science 928, 929 (2011); *see generally* Patrice Pinel et al., *A Review of Available Methods for Season Storage of Solar Thermal Energy in Residential Applications* 15 Renewable and Sustainable Energy Reviews 3341 (2011).

425 Facts and Figures, Energy Storage Administration, http://energystorage.org/energy-storage/facts-figures (last retrieved August 17, 2017).

426 Aligning Grid of the Future.

427 *Id; Energy Storage*, Dep't of Energy, https://energy.gov/oe/services/technology-development/energy-storage (last retrieved June 1, 2017) (Based on energy capacity from funded projects listed in the New Jersey Renewable Energy Storage project report).

428 Aligning Grid of the Future.

429 *Advancing Energy Storage Technology in California*, Cal. Energy Comm., http://www.energy.ca.gov/research/energystorage/tour/ (last retrieved Feb. 17, 2017).

to procure up to five MWh of energy storage by 2020.[430] New York, through its REV proceeding, has funded storage demonstration projects or scaled up storage projects to reduce the need for fossil fuel-fired generation and to better integrate renewable energy into the grid.[431] Other states—including New Jersey—have created programs to provide financial incentives for the installation of renewable electric storage systems.[432] New Jersey's Renewable Electric Storage Program administered by the NJBPU has helped install 6,625 kWh of energy storage capacity.[433] This program is authorized by NJBPU's authority to fund programs to advance renewable energy and efficiency,[434] and funded by New Jersey's societal benefits charge.[435] The host sites for these projects include Princeton University, water treatment plants in Delran Township (applicant: Advanced Microgrid Solutions) and Atlantic City (Viridity Energy), and commercial facilities in Edison (Conti Group) and West Windsor Township (Solar City).[436] The program is funded for $3 million in fiscal year 2017.[437]

IV.D. Transportation Sector Strategies for Reducing Emissions

The transportation sector has consistently been the largest source of GHG emissions in New Jersey.[438] In the United States as a whole, carbon dioxide emissions from transportation now exceed those from electric power for the first time since the 1970s.[439]

Cutting emissions from the transportation sector presents unique challenges, in large part because of the large number and diversity of individual vehicles producing emissions.[440] In 2015, New Jersey had 2,877,891 registered vehicles,[441] in contrast to 57 fossil-fuel fired power plants in the state.[442]

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[430] Or. House Bill 2193 § 2 (2015).

[431] Press Release, *N.Y. State Energy Research and Dev. Auth., NYSERDA Announces Support for Seven NY-Based Energy Storage Projects to Expand Customer Energy Choices Under Reforming the Energy Vision*, New york State (May 27, 2015), https://www.nyserda.ny.gov/About/Newsroom/2015-Announcements/2015-05-27-NYSERDA-Announces-Support-for-Seven-NY-Based-Energy-Storage-Projects.

[432] *Renewable Electric Storage*, N.J. Clean Energy, http://www.njcleanenergy.com/renewable-energy/programs/energy-storage (last retrieved Feb. 17, 2017).

[433] *Id.*

[434] N.J.S.A. 48:3-60(a)(3).

[435] *See* NJBPU, Order in The Matter of the Clean Energy Programs and Budget for Fiscal Year 2016, http://www.njcleanenergy.com/files/file/Board%20Orders/12-16-15-8B.pdf (last retrieved Aug. 17, 2017).

[436] *Renewable Electric Storage*, N.J. Clean Energy, http://www.njcleanenergy.com/renewable-energy/programs/energy-storage (last visited Feb. 17, 2017) [download "RES Project Report].

[437] *Renewable Electric Storage*, N.J. Clean Energy, http://www.njcleanenergy.com/renewable-energy/programs/energy-storage (last visited Feb. 17, 2017).

[438] Since at least 1990, the base year from which GHG emissions inventories have been developed for New Jersey. Michael Aucott et al., *2012 Update to New Jersey's Statewide Greenhouse Gas Emission Inventory*, Rutgers University (2015), http://climatechange.rutgers.edu/docman-list/special-reports/354-2012-update-to-new-jersey-s-statewide-greenhouse-gas-emission-inventory/file.

[439] *Power sector carbon dioxide emissions fall below transportation sector emissions*, U.S. Energy Information Administration (Jan. 19, 2017), http://www.eia.gov/todayinenergy/detail.php?id=29612.

[440] Vicki Arroyo, et al., *State Innovation on Climate Change: Reducing Emmissions from Key Sectors While Preparing for a New Normal*, 10 Harv. L. & Pol'y Rev. 385, 389 (2016).

[441] *Highway Statistics Series, State Motor Vehicle Registrations – 2015, Table MV-1*, Federal Highway Administration (2017), https://www.fhwa.dot.gov/policyinformation/statistics/2015/mv1.cfm.

[442] Computed from Energy Information Adminsitration, Form 860 data.

Strategies to reduce emission from the transportation sector are often categorized as three legs of a "stool:"[443]

- Improving the fuel efficiency of conventional vehicles and shifting to zero-emission vehicles, such as electric or hydrogen fuel cell vehicles;
- Reducing the carbon intensity of vehicle fuels, for example by avoiding high-carbon-intensity petroleum fuels, shifting to advanced biofuels, or shifting to electrified transportation;
- Reducing high-carbon-intensity travel, for example by reducing single-occupancy travel and promoting alternative modes including transit, cycling, and walking.

As described below, the federal government plays an important role in transportation policy but does not preempt states from taking important steps. The EPA and National Highway Traffic Safety Administration (NHTSA) have established joint GHG and fuel economy standards for new cars and trucks that are projected to achieve very significant emissions reductions. Under the current Administration, however, the EPA and NHTSA have reopened the possibility of reducing these standards. California has the unique ability under the federal Clean Air Act to set more stringent vehicle standards, and other states can adopt California's standards, which New Jersey has already done. The federal Renewable Fuels Standard also promotes some production of biofuels, but does not preempt states from setting their own low-carbon fuel standards. Finally, the federal government conditions federal transportation funding, requiring states and metropolitan areas to engage in transportation planning. This framework provides a useful foundation for state policies.

States have implemented a variety of policies to support emission reductions from all legs of the transportation stool.

[443] *See* Cambridge Systematics, Inc., Moving Cooler: An Analysis of Transportation Strategies for Reducing Greenhouse Gas Emissions 29 (2009) [hereinafter Moving Cooler]. Improving the efficiency of the transportation system, for example by using signal timing to reduce congestion (this category is sometimes omitted, in part because reducing congestion causes more travel, reducing the effectiveness of these strategies).

Summary Table of Key State Transportation Sector Policy Models

State Policy Model	Notable Implementations	Related New Jersey Actions?	Notes
Adopt CA GHG, ZEV standards and join MOU	CA, MD, MA, NY, OR, RI, VT adopted GHG, ZEV standards and joined MOU	NJ adopted GHG and ZEV standards but has not signed ZEV MOU	ZEV MOU establishes EV deployment goals for each participating state and states jointly work to support meeting goals
Electric vehicle incentives	Drive Clean Rebate in New York State. California Clean Vehicle Rebate Project. Maryland's Electric Vehicle Supply Equipment Tax Credit Program. Colorado's Innovative Motor Vehicle Credit	NJ does not offer a consumer rebate, but does exempt ZEVs from sales tax New Jersey implemented *It Pay$ to Plug In* workplace charging incentive program, but the program has allocated all available funding and is no longer providing rebates.	Many states provide funding for residential, workplace, and public vehicle charging. The California Clean Vehicle Rebate Project is designed to provide more equitable access to clean transportation by providing an additional vehicle purchase incentive for lower-income residents and limiting the rebate for high-income earners.
Low-Carbon or Renewable Fuel Standard	CA's Low Carbon Fuel Standard (LCFS); Oregon Clean Fuels Program	No	The CA LCFS complements CA's cap-and-trade system by promoting development of low-carbon-emission transportation fuels Northeast Clean Fuels Standard not currently moving forward.
State transportation and land use planning policy that identifies regional GHG targets and provides support for implementation	CA's Sustainable Communities and Climate Protection Act (S.B. 375) NY Cleaner, Greener Communities	NJ has a long history of growth management and smart growth, but has not integrated GHG considerations to the extent of other states	Despite robust state planning law, NJ state plan has only been updated once. NJ a leader in "complete streets"
Environmental review policy that incorporates GHG impacts	MA Environmental Policy Act	No	NJDEP permit readiness checklist used to implement NJ Executive Order 215 addresses green design, air quality and renewable energy considerations but does not address GHG impacts.
Freight improvement	Lower highway speed limits for freight trucks in 8 US states	No	Mode-shifting freight from truck to train or ship has been proposed in several NJ government plans, but not implemented
EV-ready building codes	New York City	No	New York City amended its building code in 2013 to require any parking garage or parking lot that is expanding electrical service to install electrical capacity sufficient to support EVSE to 20 percent of parking spaces
Programs to inventory and address black carbon emissions in onroad and offroad mobile sources	CA has developed a statewide emission inventory for black carbon in support of its proposed Short-Lived Climate Pollutant Reduction Strategy and a goal of 50 percent reduction in anthropogenic black carbon from 2013 levels by 2030 and in. In 2017, CA adopted regulations to accelerate efforts to turn-over on-road diesel engines to cleaner engines by requiring diesel trucks and buses that operate in California to be upgraded to reduce emissions.	New Jersey implemented the 2005 New Jersey Diesel Retrofit Law to address school buses, solid waste vehicles, commercial buses, publicy owned onroad vehicles and large publicly owned nonroad vehicles. In 2011, New Jersey Governor Christie signed Executive Order 60 which established a pilot program to reduce emissions from private nonroad diesel powered equipment used in selected publicly funded state construction contracts	Black Carbon emissions are not included in the New Jersey GHG inventory, New Jersey Global Warming Response Act defines Greenhouse Gas to include an identified list of gases as well as *"any other gas or substance determined by the Department of Environmental Protection to be a significant contributor to the problem of global warming."* Black Carbon is not monitored as an individual pollutant as part of New Jersey's National Ambient Air Quality Standard monitoring network

IV.D.1 Adoption of California GHG Standards for New Vehicles

The Clean Air Act (CAA) requires the EPA to regulate emissions from new motor vehicles and new motor vehicle engines, and it also generally preempts—or prohibits—states from enacting their own similar regulations.[444] The CAA provides California unique authority to adopt its own, more stringent standards, requiring EPA to grant the state a waiver of preemption unless EPA finds that California's standards are arbitrary, not necessary, or inconsistent with the federal standards.[445] The Act also authorizes other states to adopt California standards under Section 177 of the Clean Air Act.[446]

Under this authority, California adopted first-ever GHG standards for cars in 2005 for model year (MY) 2009 to 2016 vehicles.[447] The EPA subsequently adopted GHG and fuel economy standards for cars and trucks,[448] and worked with California to "harmonize" the standards so that there is effectively one set of nation-wide GHG standards for cars and trucks.[449] The EPA and the California Air Resources Board (CARB) have each promulgated GHG standards for passenger cars and light trucks through MY 2025.[450] EPA has also promulgated standards for medium and heavy trucks through MY 2027, and California has set standards for these trucks through MY 2018 and is preparing to issue a proposal for a next phase of truck standards.[451] As part of its program of reducing vehicle emissions, California also adopted zero-emission vehicle (ZEV) standards, which mandate that an increasing portion of new car sales be ZEVs. These ZEV standards are discussed in the next section.

The existing federal GHG and fuel economy standards are projected to achieve substantial GHG emission reductions.[452] A 2015 analysis conducted by the Georgetown Climate Center and Cambridge Systematics

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[444] 42 U.S.C. § 7543(a). This discussion is developed in co-authors' article Vicki Arroyo et al., *State Innovation on Climate Change: Reducing Emmissions from Key Sectors While Preparing for a New Normal Symposium: State of the States: Laboratories of Democracy*, 10 HARV. L. & POL'Y REV. 385 (2016) [hereinafter State Innovation on Climate Change].

[445] 42 U.S.C. § 7543(a). This unique authority was granted to California because of its historic leadership in setting environmental policy and its unique air pollution problems. State Innovation on Climate Change at 389.

[446] *See* 42 U.S.C. § 7507.

[447] Under the Clean Air Act § 209 waiver process California first adopts the standards and then applies to EPA for a waiver. California adopted the MY 2009-2016 standards in 2005. Final Regulation Order, Amendments to Sections 1900 and 1961, and Adoption of new Section 1961.1, Title 13, California Code of Regulations, (Sep. 15, 2005), https://www.arb.ca.gov/regact/grnhsgas/revfro.pdf. California was granted a waiver to implement these standards by the EPA on June 30, 2009. The waiver was previously denied under the Bush administration on March 6, 2008. Decision Granting a Waiver of Clean Air Act Preemption for California's 2009 and Subsequent Model Year Greenhouse Gas Emissions Standards for New Motor Vehicles, 74 Fed. Reg. 32,744 (July 8, 2009).

[448] Separate federal laws mandate the establishment fuel economy standards and GHG standards. The Energy Policy and Conservation Act (EPCA), as amended by the 2007 Energy Independence and Security Act (EISA), requires NHTSA to set fuel economy standards. The Clean Air Act requires EPA to set GHG standards. Increasing fuel economy is the chief strategy for decreasing GHG emsisions from motor vehicles, and therefore improving GHG emissions in motor vehicles requires improving fuel economy. The two agencies worked together to make sure that the two standards—a GHG emissions-per-mile standard and a mile-per-gallon standard—were consistent with each other.

[449] State Innovation on Climate Change at 390.

[450] 2017 and Later Model Year Light-Duty Vehicle Greenhouse Gas Emissions and Corporate Average Fuel Economy Standards, 77 Fed. Reg. 62,624 (Oct. 15, 2012); Cal. Code Regs. 13 § 1961.3.

[451] Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles-Phase 2, 81 Fed. Reg. 73478 (Oct. 25, 2016); California Air Resources Board, 2017 Rulemaking Calendar 5 (2016), https://www.arb.ca.gov/regact/2017/2017rmcal.pdf.

[452] So long as the GHG standards for light duty vehicles are enacted as planned and not revised in a way that weakens them.

found that the federal standards in conjunction with New Jersey's zero emission vehicle (ZEV) policies could achieve a 30 percent reduction in transportation-sector emissions in New Jersey by 2030.[453]

New Jersey adopted California's standards in 2006.[454] As long as the federal standards are maintained at current levels, there is no additional emission reduction benefit from having adopted California's GHG standards. Adopting the California standards could maintain these levels of reductions if the federal standards are weakened, however. President Trump indicated in March 2017 that his administration will consider weakening the federal standards. The EPA and DOT have subsequently announced that they are reconsidering whether the MY 2022-2025 standards are appropriate.[455]

If the federal standards are weakened, states that have adopted California's standards would maintain the higher level of emission reduction,[456] as long as California maintains its authority to set more stringent standards.[457]

IV.D.2 Policies to Promote Electrification of the Transportation Sector

As discussed in Section III, electrification of the transportation sector is projected to be a key strategy for achieving deep decarbonization. Electric vehicles have zero tailpipe emissions, and show significant GHG benefits even when calculating "well-to-wheel" emissions, which include the electricity generated to power the vehicles (see Figure IV.D-1). The average annual "well-to-wheel" emissions for an all-electric vehicle in New Jersey is 2,527 pounds CO_2e; compared to 11,435 pounds CO_2e average annual emissions for a gasoline-powered vehicle—a nearly 80 percent reduction.[458]

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[453] Gabe Pacyniak Et Al., Reducing Greenhouse Gas Emissions from Transportation: Opportunities in the Northeast and Mid-Atlantic 17 (2015). Appendix 2, http://www.georgetownclimate.org/reports/reducing-greenhouse-gas-emissions-from-transportation-opportunities-in-the-northeast-and-mid-atlantic.html [Hereinafter Reducing GHG Emissions from Transportation].

[454] N.J. Admin. Code § ***7:27-29.1 et seq. (2016); 38*** N.J. Reg. ***497(b) (Jan. 17, 2006).***

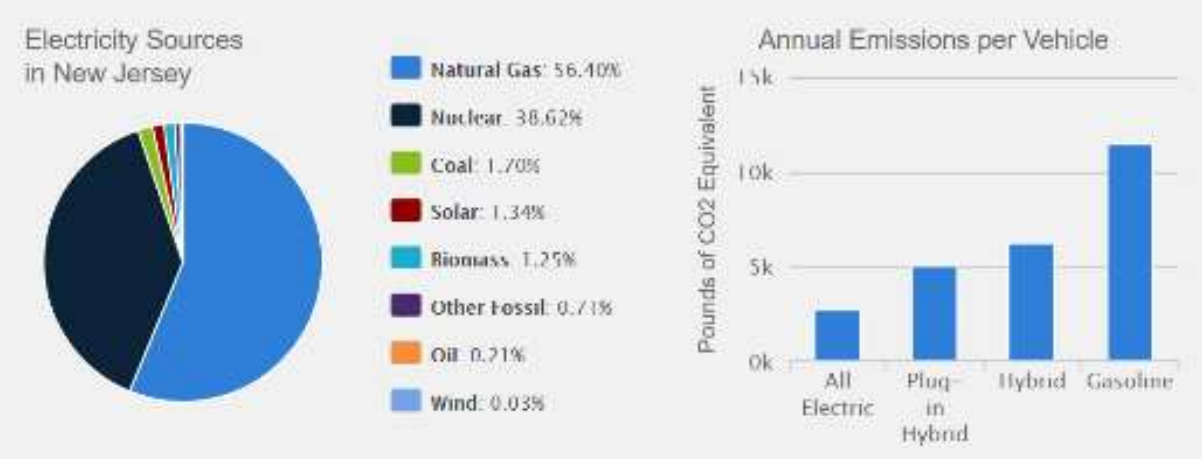
[455] Notice of Intention To Reconsider the Final Determination of the Mid-Term Evaluation of Greenhouse Gas Emissions Standards for Model Year 2022–2025 Light Duty Vehicles, 82 Fed. Reg. 14671 (March 22, 2017); Request for Comment on Reconsideration on the Final Determination of the Mid-term Evaluation of GHG Standards for Model Year 2022-2025 Light Duty Vehicles, NHTSA-2016-0068 (signed Aug. 10, 2017).

[456] California's standards currently allow manufacturers to comply with California standards by complying with the federal standards. In a March 23, 2017 resolution, the California Air Resources Board (CARB) suggested that if the current federal standards are "substantially changed" the board would likely find that it was no longer apporpriate to maintain this provision. California Air Resources Board, Resolution 17-3 at 15 (Mar. 23, 2017), https://www.arb.ca.gov/board/res/2017/res17-3.pdf.

[457] The Administration could attempt to revoke California's waiver for setting GHG standards, although it would have to demonstrate that the conditions had been met that would allow for a denial of the waiver. Historically, EPA has approved every California waiver petition, with the singular exception that EPA initially denied California's waiver petition to establish first-ever GHG standards for new motor vehicles toward the end of President George W. Bush's final term in office. Decision Denying Clean Air Act Preemption Waiver for California's 2009 and Subsequent Model Year Greenhouse Gas Emission Standards for New Motor Vehicles, 73 Fed. Reg. 12156 (Mar. 6, 2008). The EPA subsequently granted this waiver petition under President Barack Obama. Decision Granting Clean Air Act Preemption Waiver for California's 2009 and Subsequent Model Year Greenhouse Gas Emission Standards for New Motor Vehicles, 74 Fed. Reg. 32744 (July 8, 2009). EPA Administrator Scott Pruitt declined to say during Congressional hearings on his nomination whether he would grant such waivers in the future. Stuart Leavenworth, Trump's EPA Pick Won't Guarantee California's Right to Tougher Auto Emission Rules, McClatchy (Jan. 18, 2017), http://www.mcclatchydc.com/news/politics-government/congress/article127330159.html.

[458] *Emissions from Hybrid and Plug-In Electric Vehicles, Compare Electricity Sources and Annual Vehicle Emissions*, U.S. Departmnet of Energy Alternative Fuels Data Center, http://www.afdc.energy.gov/vehicles/electric_emissions.php (last retrieved June 3, 2017) (State Averages for NJ calculated January 25, 2017).

Figure IV.D-1: Emissions from an Electric Vehicle in New Jersey



Source: U.S. Department of Energy, Alternative Fuels Data Center

A cumulative total of 12,721 battery-electric and plug-in hybrid vehicles have been sold in New Jersey, and vehicle sales are growing—2016 set an EV sales record, and in 2017 electric vehicles make up an even higher percent of vehicle sales at the time of publication.[459] Other states have achieved significantly higher levels of adoption; for example, Georgia has seen over 26,000 EV sales, and California over 283,000.[460]

States can promote electric vehicle adoption through manufacturer sales requirements, incentive programs, and public fleet adoption goals.

States can also accelerate the deployment of EV charging infrastructure. Currently, EV adoption is inhibited by a chicken-or-egg problem—drivers are not purchasing EVs until sufficient charging infrastructure is installed, but charging infrastructure providers will not have a viable business model for charging infrastructure until enough EV drivers are on the road.[461] Thus, states are adopting policies to enable the deployment of electric vehicles and charging infrastructure, as well as engaging in multi-state and regional partnerships to share best practices and coordinate policies.

Zero-Emission Vehicle Sales Requirement

California has enacted Zero-Emission Vehicle (ZEV)[462] regulations through its Clean Air Act authority to set its own pollution standards for vehicles.[463] The California ZEV regulations require automobile

[459] In 2016, battery-electric and hybrid-electric vehicles comprised 0.67 percent of new vehicle sales in New Jersey. In 2017 from January to March, these ZEVs made up .79 percent of new vehide sales; *ZEV Sales Dashboard*, Alliance of Automobile Manufacturers Dashboard (data from R.L. Polk & Co.), https://autoalliance.org/energy-environment/zev-sales-dashboard/ (last retrieved June 3, 2017).

[460] *ZEV Sales Dashboard*, Alliance of Automobile Manufacturers Dashboard (data from R.L. Polk & Co.), https://autoalliance.org/energy-environment/zev-sales-dashboard/ (last retrieved June 3, 2017).

[461] *See generally* Business Models for Financially Sustainable Ev Charging Networks, Center for Climate and Energy Solutions 35-37 (March 2015), http://leg.wa.gov/JTC/Documents/Studies/EV/FinalReport_EVChargingNetworksWEB.pdf.

[462] *Zero Emission Vehicle (ZEV) Program*, California Air Resources Board https://www.arb.ca.gov/msprog/zevprog/zevprog.htm (last retrieved June 3, 2017).

[463] Clean Air Act section 209, 42 U.S.C. § 7543.

manufacturers to sell an increasing percentage of ZEVs relative to total vehicle sales through 2025.[464] The ZEV regulation provides manufacturers with compliance flexibility by awarding credits for the sale of hybrid-electric and other low-emission vehicles, allowing the trading and banking of compliance credits, and providing additional credits for long-range battery-electric vehicle sales.[465] As described above, other states may adopt California's regulations under Section 177 of the Clean Air Act.[466] New Jersey adopted the California Clean Cars Program, which includes the Zero Emission Vehicle regulation, in 2006.[467] To date, the ZEV regulation's impact on EV sales in New Jersey and the other "177 States" (states that have adopted the ZEV regulation)[468] has been limited by the "travel" provision of the regulation, which allows manufacturers to use credits generated by ZEV sales in California for compliance in the other 177 states.[469] However, the travel provision will phase out at the end of 2017, and for the first time automobile manufactures will be required to sell ZEVs in New Jersey in order to comply with the ZEV regulation.[470] The ZEV regulation requires that automakers have ZEV credits for 22 percent of vehicles sales by 2025.[471]

Eight of the ten states that adopted the ZEV regulation signed the Zero-Emission Vehicle Memorandum of Understanding (ZEV MOU) in October 2013, collectively pledging to have 3.3 million ZEVs on the road by 2025.[472] The eight states—California, Connecticut, Maryland, Massachusetts, New York, Oregon, Rhode Island, and Vermont—created a Multi-State ZEV Action Plan in 2014 and worked together through a Multi-State ZEV Task Force on issues including consumer education and awareness, state incentives, and dealership outreach. New Jersey is not a signatory of the ZEV MOU.[473] States have an opportunity to send a market signal by signing the ZEV MOU and announcing a vehicle adoption target for 2025, which would provide additional certainty to state regulators, utilities, and EV stakeholders about the number of

[464] The California Air Resources Board projected in 2012 that compliance with the ZEV regulation credit requirement would result in 15.4 percent of new vehicle sales being ZEVs by 2025. In a 2016 program review, the Air Resources Board revised that projection downward due to significant compliance credit banking and sooner-than-expected development of long-range EVs, which are awarded additional credits. California Air Resources Board, California's Advanced Clean Cars Midterm Review, A-3 (January 18, 2017).

[465] Cal. Code Regs. 1962.2 "Zero-Emission Vehicle Standards for 2018 and Subsequent Model Year Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles."

[466] Clean Air Act section 177, 42 U.S. C. § 7507.

[467] N.J. Admin. Code 7:27-29.6.

[468] The 'Section 177' ZEV states are Connecticut, Maine, Maryland, Massachusetts, New York, New Jersey, Oregon, Rhode Island, and Vermont.

[469] *See NJ Low Emission Vehicle Program*, State of New Jersey Department of Environmental Protection, http://www.nj.gov/dep/cleanvehicles/LEV.pdf, (last retrieved August 2017).

[470] The California Air Resources Board voted in March 2017 to maintain the California Advanced Clean Cars program, including the phase-out of the travel ban as scheduled at the end of 2017. The California regulations have been effectively non-binding in non-California states due to the travel provision. See Questions and Answers Regarding the 2016 ZEV Tutorial and ZEV Regulatory Requirements for 2018 and Subsequent MY Vehicles, California Air Resources Board, https://www.arb.ca.gov/msprog/zevprog/zevtutorial/zev_tutorial_questions_and_answers_jun2016.pdf (last retrieved September 1, 2017).

[471] Cal. Code Regs. 1962.2 "Zero-Emission Vehicle Standards for 2018 and Subsequent Model Year Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles."

[472] Governors from Eight States Pledge to put 3.3 Million Zero-Emission Vehicles on the Road by 2025, Georgetown Climate Center, (Oct. 28, 2013), http://www.georgetownclimate.org/articles/governors-from-eight-states-pledge-to-put-3-3-million-zero-emission-vehicles-on-the-road-by-2025.html.

[473] The ZEV Task Force is facilitated by the Northeast States for Coordinated Air Use Management (NESCAUM). *About the ZEV Task Force*, Multi-state ZEV Task Force, https://www.zevstates.us/about-us/ (last retrieved August 2017).

vehicles expected on the road within a decade. For example, Massachusetts (a state with approximately 2 million fewer residents than New Jersey) announced a goal of 300,000 ZEVs on the road by 2025.[474]

Consumer Incentives

States have enacted a broad range of incentives for electric vehicle drivers, including purchase price subsidies through tax credits or rebates, HOV lane access, reduced license or registration fees, exemptions from emission tests, and parking incentives.[475] Purchase price remains a barrier to widespread electric vehicle adoption, particularly among moderate- and low-income households. While battery costs continue to decrease and EVs have a competitive total cost of ownership (including lifetime costs of fuel and maintenance), the upfront purchase cost of an EV is generally higher than a comparable internal combustion engine (ICE) vehicle at this time.[476] Twenty-one states and the District of Columbia have implemented programs to reduce this price difference through consumer tax credits, rebates, or sales tax exemptions for the purchase or lease of an electric vehicle.[477] An analysis of state EV policies has found consumer purchase incentives to be among the most cost-effective strategies for increasing rates of EV adoption,[478] and states that have removed purchase incentives have seen significant declines in EV purchases.[479]

State consumer rebate policies differ in value and structure, and several states have recently modified programs to provide rebates to consumers at the time of purchase and increase the share of rebates provided to low- and middle-income residents. For example, the Massachusetts Offers Rebates for Electric Vehicles (MOR-EV) program provides up-front consumer rebates up to $2,500 for plug-in hybrid electric vehicles and battery electric vehicles (the program provides a reduced rebate for vehicles with an MSRP greater than $60,000).[480] Colorado offers a tax credit worth up to $5,000, and recently amended its tax code to allow consumers to receive the value of the credit at the time of purchase.[481] New Jersey currently provides a sales tax exemption for zero emission vehicles,[482] exempts fully electric vehicles from emissions testing requirements, offers a toll discount for low emission vehicles, and provides additional

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[474] The Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs, Massachusetts Zero Emission Vehicle Action Plan: A Roadmap to Reach 300,000 Zero Emission Vehicles on Massachusetts Roads by 2025 (August 2015), http://www.mass.gov/eea/docs/doer/dean-cities/massachusetts-zero-emission-vehicle-action-plan2015.pdf.

[475] *See State Laws and Incentives,* U.S. Department of Energy Alternative Fuels Data Center, http://www.afdc.energy.gov/laws/state (last retrieved Aug. 2017).

[476] *See, e.g.*, Geng Wu et. al., *Total cost of ownership of electric vehicles compared to conventional vehicles: A probabilistic analysis and projection across market segments*, 80 Energy Policy 196–214 (May 2015), http://www.sciencedirect.com/science/article/pii/S0301421515000671.

[477] Many state programs are subject to funding restraints and may not make incentives available once allocated funding is exhausted. The states which have established consumer incentive programs are AZ, CA, CO, CT, DE, GA, HI, KS, LA, MA, MD, NJ, NY, PA, RI. SC. TN. UT, VT, WA, WV, and DC. *See* State Efforts Promote Hybrid and Electric Vehicles, National Conference of State Legislatures (Dec. 3, 2015), http://www.ncsl.org/research/energy/state-electric-vehide-incentives-state-chart.aspx; *State Incentives*, Plug In America https://pluginamerica.org/why-go-plug-in/state-federal-incentives/ (last retrieved Aug. 2017).

[478] Lingzhi Jin et. al, *Evaluation of State-Level U.S. Electric Vehicle Incentives*, The International Council on Clean Transportation, 26 (2014).

[479] After Georgia ended its $5000 state purchase incentive, EV sales decreased 90 percent in the following 18 months. Chris Joyner, *Here's why electric car sales are plummeting in Georgia*, The Atlanta Journal-Constitution (January 12, 2017), http://www.myajc.com/news/state--regional-govt--politics/here-why-electric-car-sales-are-plummeting-georgia/lNGjfnDMALGkv2iUzwwXIO/.

[480] *Massachusetts Offers Rebates for Electric Vehicles*, Commonwealth of Massachusetts, https://mor-ev.org/ (last retrieved Aug. 2017).

[481] The vehicle purchaser may assign the value of the tax credit to a financing entity in exchange for receiving the full value of the credit at time of purchase (minus a small administrative fee). Colorado House Bill 16-1332, 2016.

[482] For purposes of the sales tax exemption, zero emission vehicles include "battery-powered or fuel-cell powered vehicles certified pursuant to the California Air Resources Board zero emission standards for the model year." N.J.S.A. 54:32B-8.55

HOV lane access to hybrid electric vehicles.[483] The sales tax exemption would provide a benefit of approximately $2,600 for a mid-price electric vehicle such as the Chevy Bolt.[484] New Jersey does not offer a consumer purchase rebate or cash incentive at this time. One consideration related to a sales tax exemption is that this provides a benefit in proportion to the vehicle's price (and would provide a higher benefit for more expensive vehicles, which may be purchased by higher-income residents). Some states have added income caps on rebates or provide additional incentives to low-income residents to allocate state funds in a way that promotes more equitable EV adoption across income levels. For example, the California Air Resources Board imposed an eligibility cap for high-income residents (gross annual income above $250,000 for individuals) and increased rebate levels for low-income residents.[485] States fund EV incentive programs from a variety of sources, including proceeds from cap-and-trade programs such as the Regional Greenhouse Gas Initiative, environmental and utility settlement agreements, general funds, and other sources.[486]

State Electric Vehicle Commission and Planning Processes

Several states have created formal or informal state electric vehicle commissions to promote inter-agency and stakeholder collaboration. A state commission can be an effective mechanism for developing a general planning and policy framework and identifying and addressing important EV policy questions, including the anticipated levels of EV adoption, charging infrastructure requirements, consumer outreach and education, the impact of EVs on the grid, and social equity considerations. The Massachusetts Zero Emission Vehicle Commission, led by the Executive Office of Energy and Environmental Affairs, was created by legislation to create a state EV action plan and propose legislation to the state.[487] The Commission released the state's ZEV Action Plan in August 2015. The Maryland Electric Vehicle Infrastructure Council (EVIC), chaired by the Maryland Department of Transportation, also meets regularly to review state goals and priorities and develop legislative and policy recommendations for the state.[488] Both commissions have active stakeholder involvement, including by utilities, automakers, EV advocates, and private EV infrastructure providers.

State Fleet Adoption and Electric Bus Transit

State governments can directly advance EV adoption and benefit from the lower total cost of ownership of electric vehicles through "lead by example" fleet procurement policies. The State of Washington has committed that EVs will make up 20 percent of new fleet purchases by 2017[489] and has joined the West

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[483] *Green Driver State Incentives in New Jersey*, New Jersey Department of Motor Vehicles (Aug. 16, 2017), http://www.dmv.org/nj-new-jersey/green-driver-state-incentives.php.

[484] Calculation of 6.875 percent sales tax as applied to a Chevy Bolt (MSRP $37,495). *Vehicles exempt from sales tax*, State of New Jersey Motor Vehicle Commission, http://www.state.nj.us/mvc/Vehicle/VehidesExempt.htm (last retrieved Aug. 16, 2017); *Bolt EV*, Chevrolet, http://www.chevrolet.com/bolt-ev-electric-vehicle-2 (last retrieved Aug. 2017).

[485] *Income Eligibility*, California Clean Vehicle Rebate Program, https://cleanvehiderebate.org/eng/income-eligibility (last retrieved Aug. 2017).

[486] Cassandra Powers, *Finding the Funds: Options for State Plug-In Electric Vehicle Programs*, Georgetown Climate Center (2015) http://www.georgetownclimate.org/files/report/GCC-Finding%20the%20Funds-April%202015.pdf.

[487] *Zero Emission Vehicle Commission*, Massachusetts Executive Office of Energy and Environmental Affairs, http://www.mass.gov/eea/waste-mgnt-recycling/air-quality/ma-zero-emission-vehicle-commission-and-mass-drive-clean-campaign/zero-emission-vehicle-commission.html (last retrieved Aug. 2017).

[488] Maryland Electric Vehicle Infrastucture Council, Maryland Department of Transportation (2017), http://www.mdot.maryland.gov/newMDOT/Planning/Electric_Vehicle/About_the_Council.html.

[489] *Washington State Electric Fleets Initiative*, State of Washington Office of Governor, http://www.governor.wa.gov/sites/default/files/documents/ElectricFleetsInitiative12_07_2015.pdf (last retrieved Aug. 2017).

Coast Electric Fleets initiative.[490] New Hampshire is adding electric vehicles to its state fleet under Executive Order 2016-03, which requires a 30 percent emission reduction from the state passenger vehicle fleet by 2030 from a 2010 baseline.[491] In Massachusetts, recent electric vehicle legislation requires the Massachusetts Department of Transportation to study additional opportunities for state fleet electrification.[492] New Jersey does not have an explicit state goal or requirement for fleet electrification. States led by California are currently working to develop a multi-state aggregate procurement process for electric vehicles through the EV Smart Fleets initiative, which may increase the availability and reduce the costs of EVs for state fleets and provide an opportunity for increased fleet electrification.[493]

In addition to state fleet vehicles, there are increasing opportunties for states and cities to electrify public transit fleets. Initiatives such as bus electrification can provide significant GHG and criteria pollutant benefits and provide a greater number of travelers with the benefits of electric transportation. Cities such as Los Angeles[494] and the District of Columbia[495] have already added electric buses to transit fleets and made commitments for additional procurements. While the higher upfront purchase price of electric buses remains a major barrier to widespread deployment, state incentive and grant programs can accelerate the near-term deployment of electric buses and support a market transformation that will provide widespread air quality benefits. Additionally, states currently have a significant opportunity to provide funding for vehicle and engine replacements that reduce nitrogen oxide (NOx) emissions (such as electric school buses and transit buses) through the State Mitigation Trust from the Volkswagon settlements.[496] As part of the settlement agreements with the U.S. federal government and the State of California,[497] Volkswagon will pay over $2.9 billion dollars to a State Mitigation Trust, which can be used to fund NOx emissions reductions in 10 eligible categories, including bus, truck, and ferry vehicle or engine replacements.[498] New Jersey will be allocated over $70 million from the State Mitigation Trust.

Charging Infrastructure Incentives or Grants

Many states, including New Jersey, offer or have offered financial incentives for the installation of electric vehicle supply equipment (EVSE), i.e., charging infrastructure. State EVSE incentive programs take the form of tax credits, rebates, and grants. Different programs offer incentives to individuals for home charging and businesses for workplace or fleet charging, as well as sites that install public charging infrastructure. Policy considerations for states include the amount of funding available for each charger (both the maximum amount available and the percent of costs covered by the incentive), the type of

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[490] *Home*, West Coast Electric Fleets http://www.westcoastelectricfleets.com/ (last retrieved Aug. 2017).

[491] Governor Hassan Sets New Renewable Energy Goals For State Government, NH Labor News (May 17, 2016), http://nhlabornews.com/2016/05/governor-hassan-sets-new-renewable-energy-goals-for-state-government.

[492] Massachusetts Bill S.2505 189th (2015 - 2016) https://malegislature.gov/Bills/189/S2505.

[493] The Georgetown Climate Center is a project partner for the EV Smart Fleets initiative. *About EV Smart Fleets*, EV Smart Fleets, http://evsmartfleets.com/ (last retrieved Aug. 2017).

[494] Laura Nelson, *L.A. Metro wants to spend $138 million on electric buses. The goal: An emission-free fleet by 2030*, The Los Angeles Times (July 21, 2017) http://www.latimes.com/local/lanow/la-me-ln-metro-electric-buses-20170721-story.html.

[495] Council of the District of Columbia, CA22-0144 - Proposed task order cooperative agreement with Proterra, Inc., http://lims.dccouncil.us/Legislation/CA22-0144?FromSearchResults=true.

[496] *Webinar for Prospective Beneficiaries to the Mitigation Trust Under the Partial Settlement with Volkswagen*, U.S. Environmental Protection Agency (November 18, 2016), https://www.epa.gov/enforcement/presentation-prospective-beneficiaries-mitigation-trust-under-volkswagen-partial.

[497] The settlement agreement alleges that Volkswagon sold vehicles that emitted nitrogen oxide emissions higher than EPA-compliant and California ARB-compliant levels due to the installation of "defeat devices."

[498] In Re: Volkswagen "Clean Diesel" Marketing, Sales Practices, and Products Liability Litigation, MDL No. 2672 CRB (JSC), Appendix D-2 (September 30, 2016).

charging infrastructure eligible for funding (Level 1, Level 2, or DC Fast Chargers), whether the EVSE should be publicly accessible, and whether the funding should strategically target identified gaps in charging infrastructure or be broadly available.

Maryland's Electric Vehicle Supply Equipment Tax Credit Program, administered by the Maryland Energy Administration, offers residents and businesses a state income tax credit up to $400 for the purchase of EVSE.[499] Connecticut's Workplace Charging Incentive was established to promote the installation of publically available EV charging infrastructure by providing a rebate up to $10,000 (up to 50 percent of the project cost) for the installation of charging infrastructure that is publically accessible at no cost.[500] The California Energy Commission identified interstate highway charging infrastructure gaps and provided nearly $9 million in grant funding for the installation of 61 DC fast chargers at 41 identified sites.[501]

In 2016, New Jersey launched *It Pay$ to Plug In* Electric Vehicle Workplace Charging Grants, which provides up to $250 for the installation of a Level 1 charging station and up to $5,000 for a Level 2 charging station.[502] However, as of June 2017, the allocated $725,000 funding for the program has been disbursed and no grant funding is currently available.[503] States have the opportunity to accelerate the development of a robust charging infrastructure network by funding incentive programs for residential, workplace, fleet, and public charging infrastructure. States have an opportunity to use up to 15 percent of the allocated funding from the Volkswagon settlements State Mitigation Trust for investments in EV charging infrastructure for light-duty vehicles.[504]

Utility Investment in Charging Infrastructure

Several states have already approved or are soliciting proposals from electric utilities for utility investments in EV charging infrastructure, including proposals from utilities to recover the cost of investment through rate recovery. These proposals have been filed as part of a larger utility rate case, as a stand-alone proposal by a utility, or in response to state legislation that requires electric utilities to support transportation electrification. The California Public Utility Commission has approved rate-based EV infrastructure pilot investment programs by three major investor-owned utilities: San Diego Gas & Electric, Southern California Edison, and Pacific Gas & Electric. The San Diego Gas & Electric 'Power Your Drive' program includes the installation of up to 3,500 Level 2 EV charging stations, which it will own and operate, at 350 business and multi-unit dwelling (MUD) sites. The charging stations will be grid-integrated and use dynamic pricing to promote managed vehicle charging at times that are most beneficial to the grid.[505] The Southern California Edison 'Charge Ready' program will install 'make-ready' infrastructure (Southern California Edison will build the infrastructure up to the charging stations; the

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[499] *Electric Vehicle Supply Equipment (EVSE) Rebate Program 2.0*, Maryland Energy Administration (2017), http://energy.maryland.gov/transportation/Pages/incentives_evse.aspx.

[500] EV Connecticut Charger Incentives, State of Connecticut (2017), http://www.ct.gov/deep/cwp/view.asp?a=2684&q=561884&deepNav_GID=2183.

[501] Press Release, *Energy Commission Funds Electric Vehicle Chargers along Major State Routes*, California Energy Commission (April 13, 2016) http://www.energy.ca.gov/releases/2016_releases/2016-04-13_ev_chargers.html.

[502] Drive Green New Jersey, State of New Jersey Department of Environmental Protection, http://www.drivegreen.nj.gov/programs.html (last retrieved June 3, 2017).

[503] *Id.*

[504] In Re: Volkswagen "Clean Diesel" Marketing, Sales Practices, and Products Liability Litigation, MDL No. 2672 CRB (JSC), Appendix D-2 8 (September 30, 2016).

[505] *In re San Diego Gas and Electric Co.*, Cal. P.U.C. Dec. No. 16-01-045 (2016).

host sites will purchase, own, and operate the charging stations) for 1,500 EV charging stations in its Los Angeles service area.[506] Pacific Gas & Electric's 'Charge Smart and Save' program includes the installation of 7,500 EV charging stations at MUDs and workplaces, and will include a combination of make-ready charging sites and stations owned by the utility.[507] All three utility investment plans approved by the California Public Utility Commission have a significant focus on social equity and require that at least 10 percent of the charging infrastructure be installed in disadvantaged communities.[508]

Electric utilities in Massachusetts have recently proposed investments in EV charging infrastructure to support Massachusetts' ambitious EV adoption goals. Eversource Energy included a $45 million investment in EV charging infrastructure and consumer education in a broader grid modernization investment proposal filed with the Massachusetts Department of Public Utilities (DPU) in January 2017. The proposed investment includes make-ready infrastructure to support Level 2 charging at workplaces, MUDs, and public sites, and DC Fast Charging along travel corridors and high-density travel areas.[509] National Grid proposed an Electric Vehicle Market Development Program in a separate filing submitted to the DPU in January. The National Grid proposal would cost $23.8 million, and would include incentives for customers who install charging stations, EV consumer education campaigns, and research into EV grid integration.[510]

Electric utilities in New Jersey have not yet submitted proposals to the New Jersey Board of Public Utilities to seek rate recovery for investments in EV charging infrastructure. However, utilities in New Jersey have taken a number of actions to support the development of EVs in the state. For example, PSE&G started a program to provide up to 150 charging stations to companies that promote workplace employee charging.[511]

EV-Ready Building Codes

A cost-effective opportunity to prepare for future EVSE expansion is to incorporate EV charging infrastructure requirements into city and state building codes. It is far less expensive to install electric conduit and electrical capacity during building construction—particularly for parking garages and urban structures—than to retrofit a parking space to support EVSE. New York City amended its building code in 2013 to require any parking garage or parking lot that is expanding electric service to install electrical capacity sufficient to support EVSE to 20 percent of parking spaces.[512]

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[506] Press Release, *CPUC Supports State's Zero Emission Vehicle Goal with Approval of Program for Edison*, California Public Utilities Commission (Jan. 14, 2016) http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M157/K724/157724767.PDF.

[507] In the Matter of the Application of Pacific Gas and Electric Company for Approval of its Electric Vehicle Infrastructure and Education Program (U39E) (2016) Cal. P.U.C. Dec. A.15-02-009; S*ee also* Robert Walton, California PUC approves PG&E electric vehicle infrastructure plan, Utility Dive (December 20, 2016), http://www.utilitydive.com/news/california-puc-approves-pge-electric-vehicle-infrastructure-plan/432710/.

[508] Communities identified as 'disadvantaged' by the CalEnviroScreen tool. *About CalEnviroScreen*, California Office of Environmental Health Hazard Assessment, http://oehha.ca.gov/calenviroscreen (last retrieved Aug. 17, 2017).

[509] The Commonwealth of Massachusetts Department of Public Utilities, DPU 17-05, Exhibit ES-GMBC-2, Grid Modernization Base Commitment Investment Plan, 66-73 (Filed January 17, 2017).

[510] The Commonwealth of Massachusetts Department of Public Utilities, DPU 17-13, Revised Electric Vehicle Market Development Program Revision, M.D.P.U. No. 1331, 27-43 (Revised Exhibit JAL-2), (Filed February 13, 2017).

[511] *Press release: PSE&G Announces Program Incenting Companies To Provide Charging for Employees Who Drive Electric Cars*, PSG&E (July 22, 2014).

[512] New York City Local Law 130 of 2013 (Int. No. 1176-A), https://www1.nyc.gov/site/buildings/codes/local-laws.page.

Multi-state and regional coordination

To develop the national network of EV charging infrastructure necessary to support widespread transportation electrification, states are engaging in regional and multi-state collaborations to coordinate policies at a regional level, share best practices, and amplify individual state efforts. California, Oregon, and Washington established the West Coast Electric Highway—a network of DC fast charging stations along Interstate 5 and other major roadways[513]—and pursue regional emission reduction policies together with British Columbia in the Pacific Coast Collaborative.[514] New Jersey participates in the Transportation and Climate Initiative, the collaboration of the transportation, energy, and environment agencies from the 11 northeast and mid-Atlantic states and D.C. The TCI electric vehicle working group is currently conducting an analysis of fast charging infrastructure along highways in the northeast and mid-Atlantic region.[515]

IV.D.3 Low Carbon Fuel Standards

Greenhouse gas emissions from transportation can be reduced by shifting to transportation fuels that are less carbon-intensive on a life cycle basis. Assessing emissions on a life cycle basis—sometimes referred to as well-to-wheel analysis—involves determining the GHG emissions from each stage of fuel production, transportation, and combustion.[516] This is important because biofuels sequester GHGs during their growth cycle, reducing net GHG emissions on a life cycle basis, although this benefit can be partially or fully offset by the energy emissions associated with the agricultural process. Emissions from different production processes can also vary significantly—for example extracting petroleum through hydraulic fracturing or from oil sands is significantly more emissions intensive than extracting oil from conventional wells.

Two states—California and Oregon—have established clean fuels programs that require improvements in the aggregate carbon intensity of fuels supplied in those states. These programs create an incentive to avoid higher-carbon-intensity petroleum fuels, increase the use of biofuels (especially advanced biofuels),[517] and potentially switch to hydrogen, electricity, or natural gas transportation fuels.

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[513] *West Coast Electric Highway*, West Coast Electric Highway, http://www.westcoastgreenhighway.com/electrichighway.htm (last retrieved Aug. 17, 2017).

[514] *Pacific Coast Collaborative*, Pacific Coast Collaborative, http://pacificcoastcollaborative.org/ (last retrieved Aug. 17, 2017).

[515] The Transportation and Climate Initiative is facilitated by the Georgetown Climate Center. *Transportation and Climate Initiative*, Transportation and Climate Initiative, http://www.transportationandclimate.org/ (last retrieved Aug. 17, 2017).

[516] It includes assessing both direct GHG emissions and significant indirect emissions, such as the indirect effects of land use changes involved in growing biofuel feedstocks

[517] Biofuels can be blended with petroleum products for use in standard internal combustion engines. Currently, most gasoline in the United States contains 10 percent ethanol—referred to as E-10. This is typically corn ethanol, a fuel that provides a minimal lifecycle GHG benefit over gasoline. Any standard gasoline-fueled vehicle can use E-10, but gasoline blends with a higher level of biofuel can only be used by certain vehicles. A 15 percent ethanol blend (E-15) can be used by vehicles newer than 2001. Blends that are as high as 85 percent ethanol (E-85) can be used by special "flex-fuel" vehicles. These constraints mean that there is a limit as to the overall degree to which biofuels can be substituted for gasoline in the existing combustion engine vehide fleet – a limit referred to as the "blend wall." This limit has already been reached in New Jersey and most other states. *See* EIA, Biofuel Ethanol and Biodiesel Explained, https://www.eia.gov/energyexplained/index.cfm?page=biofuel_ethanol_use#tab2; In this context, clean fuels policies can reduce emissions by driving the substitution of lower carbon-intensity biofuels for corn ethanol in the manufacture of E-10, E-15, or E-85 (i.e., without exceeding the blend wall), and they can also disincentivize reliance on high-carbon intensity petroluem fuels extracted through hydraulic fracturing or from tar sands. The affect of financial incentives from clean fuel policies on relative fuel prices can also incentivize purchase and adoption of flex fuel vehicles and electric vehicles, which are also less carbon-intensive than petroleum fuels.

California's Low Carbon Fuel Standard (LCFS) was established by the California Air Resources Board (CARB) in 2010, pursuant to state legislation in 2006 and a governor's executive order in 2007.[518] California's LCFS has been operating since January 2013 and requires a ten percent improvement in the carbon intensity of transportation fuels by 2020 from 2010 levels.[519]

California's LCFS requires gasoline and diesel fuel suppliers to demonstrate that they are meeting an annual fuel emissions intensity target for the total amount of fuel that they sell each year.[520] Suppliers of cleaner fuels such as biofuels generate credits because these fuels have a lower carbon intensity than required by the standard, and regulated entities can procure those credits to meet their compliance obligation.[521] The program also credits electricity and hydrogen supplied for transportation purposes, due to their potential lower carbon intensity than petroleum.

For example, in 2020 a gasoline supplier will need to demonstrate an average fuel intensity of 88.62 grams CO_2e per megajoule of energy (gCO_2e/mj) for the fuels sold that year.[522] The average carbon intensity of gasoline used in California is 99.78 gCO2e/mj; in constrast, different biofuel ethanols have been determined to have carbon intensities ranging from 40 to 99 gCO2e/mj.[523] In order to meet the 88.62 standard, the gasoline supplier will need to either blend cleaner fuels into its gasoline or procure credits from other market participants (including credits from electricity or hydrogen fuel suppliers) such that the average emissions intensity of fuels sold is 88.62 after adjusting for credits.

California's LCFS complements its cap-and-trade program, which covers the carbon content of petroleum-based transportation fuels as part of its economy-wide GHG cap but does not include life-cycle assessment. The cap-and-trade program sets an absolute limit on GHG emissions in the state, and emissions resulting from the direct combustion of petroleum fuels are included in that limit.[524] The cap-and-trade program creates a market incentive to shift from petroleum fuels (which are covered under the cap) to other fuels like biofuels and hydrogen (which are not covered under the cap), but it does not take into account the important differences in life cycle emissions among either petroleum fuels or alternatives like biofuels.

In contrast, the LCFS is effectively an emission rate standard—it requires that the rate of life cycle pollution resulting from transportation fuels be reduced instead of limiting the absolute quantity of emissions. It creates a regulatory signal that promotes the development of transportation fuels that are cleaner on a life cycle basis, complementing the cap-and-trade program.

[518] *Id.* at I-1.

[519] *Id.* at I-2.

[520] Cal. Code Regs. tit. 17, §§ 95483-84 (2017).

[521] *See* Cal. Code Regs. tit. 17, § 95487 (2017).

[522] Cal. Code Regs. tit. 17, §§ 95484 (2017).

[523] LCFS Pathway Certified Carbon Intensities, California Air Resources Board, https://www.arb.ca.gov/fuels/lcfs/fuelpathways/pathwaytable.htm.

[524] The cap-and-trade program does not cover biofuels, as the program assesses compliance based on the carbon-content of fuels (reflecting the pollution that would be released from combustion of the fuels, but not from transportation or production). In the case of biofuels, a portion of the direct emissions from combustion is offset by the carbon dioxide that is aborbed by the feedstock plants during their grow cycle, and this process has led to biofuels being exempted from the cap-and-trade program.

The state of Oregon implemented a similar Clean Fuels Program in 2016,[525] pursuant to legislation passed in 2015.[526] The Oregon Clean Fuels Program is modeled on California's LCFS. The Oregon program requires a ten percent improvement in 2025 emissions intensity from 2015 levels.[527]

Both the California and Oregon progams have been challenged in court, chiefly on grounds that the policies are either preempted by federal fuels policy or illegally burden interstate commerce. In both cases, federal courts have upheld the programs.[528]

Beginning in 2009, Northeast and Mid-Atlantic states—including New Jersey—explored the development of a Clean Fuel Standard for the region. A series of reports and public stakeholder meetings were held in 2009, 2010, and 2011.[529] Ultimately, a regional Clean Fuel Standard was not adopted.

There is no federal low-carbon fuel policy. Instead, the federal Renewable Fuel Standard focuses on increasing the production of renewable fuels (i.e., biofuels).[530] The program has succeeded in promoting production of corn ethanol—a biofuel that is typically found to have minimally lower greenhouse gas benefits on a life-cycle basis than petroleum—but has not succeeded in promoting production of large quantities of "second generation" renewable fuels that have significantly lower GHG emissions.[531] For these reasons the program is not expected to drive significant additional reductions of GHG emissions from transportation.[532]

Some states have other policies that promote renewable fuel usage in a way similar to an RFS; those policies are catalogued by the US Department of Energy in its Alternative Fuels Data Center.[533] For example, the state of Iowa has a requirement that the equivalent of 25 percent of all gasoline sales by 2019 be from renewable sources.[534]

Canada has signaled its intention to adopt a national Low Carbon Fuel Standard that would complement other national and provincial efforts on carbon pricing.[535] The Canadian government published a

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[525] *Oregon Clean Fuels Program*, Oregon Department of Environmental Quality, http://www.deq.state.or.us/aq/cleanFuel/index.htm (last retrieved August 17, 2017).

[526] S.B. 324-A, 2015 Reg. Sess. (Or. 2015, enacted).

[527] *Id*.

[528] *Rocky Mt. Farmers Union v. Corey*, 730 F.3d 1070 (9th Cir. 2013); *Am. Fuel & Petrochemical Mfrs. v. O'Keeffe*, 2015 U.S. Dist. LEXIS 128277 (D. Or. Sept. 23, 2015). *See* Vicki Arroyo et al., *New Strategies for Reducing Transportation Emissions and Preparing for Climate Impacts*, 43 Fordham Urb. L.J. (accepted for publication Spring 2017).

[529] *Clean Fuels Standard*, NESCAUM, http://www.nescaum.org/topics/clean-fuels-standard (last retrieved Aug. 17, 2017).

[530] The RFS was enacted by the Energy Policy Act of 2005 and expanded in the Energy Independence and Security Act of 2007. *See Renewable Fuel Standard Program*, U.S. Environmental Protection Agency, http://www.epa.gov/renewable-fuel-standard-program (last retrieved Aug. 17, 2017). *See* Vicki Arroyo et al., *New Strategies for Reducing Transportation Emissions and Preparing for Climate Impacts*, 43 Fordham Urb. L.J. (accepted for publication Spring 2017).

[531] Final Renewable Fuel Standards for 2014, 2015 and 2016, and the Biomass-Based Diesel Volume for 2017, 80 Fed. Reg. 77420, 77422 (Dec. 14, 2015) (noting that shortfalls in production of cellulosic and other advanced biofuels). *See also* Jeremy Martin, Fueling a Clean Transportation Future: Smart Fuel Choices for a Warming World, Union of Concerned Scientists (2016), http://www.ucsusa.org/clean-vehicles/dean-fuels/transportation-fuels-future#.WJ492TvafmE.

[532] *See Uncertainty Surrounds Ethanol's Impact on GHG Emissions*, Institute for Energy Research, http://instituteforenergyresearch.org/analysis/uncertainty-surrounds-ethanols-impact-ghg-emissions/ (last retrieved Aug. 17, 2017).

[533] *State Laws and Incentives*, US Department of Energy Alternative Fuels Data Center (Jan. 2017), http://www.afdc.energy.gov/laws/state.

[534] Gail Mosey & Claire Kreycik, *State Clean Energy Practices: Renewable Fuel Standards*, National Renewable Energy Laboratory (July 2008), http://www.nrel.gov/tech_deployment/state_local_governments/pdfs/43513.pdf.

[535] *Government of Canada to work with provinces, territories, and stakeholders to develop a clean fuel standard*, Government of Canada (Nov. 25, 2016), http://news.gc.ca/web/artide-en.do?nid=1160579.

discussion paper in March 2017 that began a series of public meetings, workshops, and technical groups that will inform development of the standard.[536]

IV.D.4 Reducing Carbon-Intensive Travel[537]

The third leg of the stool involves reducing carbon-intensive travel, particularly by reducing the number of miles driven in single occupancy vehicles. Strategies that can be used to reduce travel include:

- promoting compact land use patterns, which require people to drive less and can make it easier to use alternative modes of travel;
- promoting cleaner modes of travel, including transit, ridesharing, biking, and walking;
- reducing the need for high-intensity travel, for example by promoting telework programs; and
- changing price incentives to promote lower-carbon forms of travel, for example through parking pricing or tolling.[538]

These strategies are sometimes referred to as "sustainable communities" strategies, reflecting that they provide many benefits beyond GHG reduction, including congestion reduction, additional transportation options and accessibility, criteria pollution reduction, quality of life benefits, and economic benefits.[539]

Since the 2007 recession, New Jersey has already seen a significant change in development patterns. Population growth is taking place mostly in already built-out communities, as opposed to through new development in exurbs that was typical during the 1990s.[540] This change is consistent with evidence of a nationwide increase in preference for transit-accessible neighborhoods and walkable communities, among other factors.[541] Another important factor in New Jersey is that the state already has a high rate of transit ridership—over 11 percent of New Jersey commuters use transit, second only to New York.[542] The share of transit commuters has increased significantly over the past 20 years.

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[536] Government of Canada, Clean Fuel Standard: Discussion Paper (Mar. 6, 2017), https://www.ec.gc.ca/lcpe-cepa/default.asp?lang=En&n=D7C913BB-1.

[537] This section draws from co-author's 2012 report. Gabe Pacyniak et al., *State-Level Programs and Policies Supporting Sustainable Communities within Transportation & Climate Initiative Jurisdictions*, Georgetown Climate Center (2012), http://www.georgetownclimate.org/files/report/report-tci-state-level-programs-policies-supporting-sustainable-communities.pdf. [Hereinafter GCC Sustainable Communities Report].

[538] U.S. National Research Council, Committee for a Study of Potential Energy, Savings and Greenhouse Gas Reductions from Transportation, Policy Options for Reducing Energy Use and Greenhouse Gas Emissions from U.S. Transportation 160-67 (2011), http://www.nap.edu/catalog.php?record_id=13194 [NRC Transportation GHG Study]; Vicki Arroyo & Kathryn A. Zyla, *Transportation Policy*, Climate Change and Public Health (2015).

[539] *See Home*, Partnership for Sustainable Communities, https://www.sustainablecommunities.gov/ (last retrieved Aug. 17, 2017).

[540] According to analysis by New Jersey Future, the 271 municipalities that were at least 90 percent built out as of 2007 (meaning that they have already built on most or all of their buildable land) accounted for a full two-thirds (66.8 percent) of total statewide population growth between 2008 and 2016. Tim Evans, *Census Numbers Confirm Renewed Growth in Urban Areas*, New Jersey Future (May 26, 2017), http://www.njfuture.org/2017/05/26/census-urban-growth/.

[541] *See* Tim Evans, *Special Report: Is Transit-Oriented Demand on the Rise?*, New Jersey Future (2016), http://www.njfuture.org/wp-content/uploads/2016/03/New-Jersey-Future-Analysis-of-Population-Growth-in-Transit-Areas-March-2016.pdf.

[542] Public Transit Share, based on Census American Community Survey. AASHTO, Commuting in America 8 (2013), http://traveltrends.transportation.org/Documents/B13_Transit%20Commuting_CA13-4_web.pdf.

At the same time, vehicle travel in New Jersey has continued to increase post-recession despite these beneficial trends, albeit at a slower rate than in the years leading up to the recession.[543] Enhanced sustainable community policies can sustain and further such trends toward compact development and alternative travel modes, helping to achieve the significant GHG reductions required in the transportation sector. In the absence of such policies, VMT growth could return to previous levels—making it that much harder to achieve GHG reductions.

In many cases, policies to promote these strategies can be most directly implemented at the local level or the metropolitan region.[544] This includes local land use planning and zoning, control of parking, and administration of local roads, sidewalks and bicycle facilities, among others powers.[545] Local or regional governments typically have legal jurisdiction over land use[546] and share jurisdiction over local roads.[547]

States do have policy options that can be used to directly and indirectly reduce carbon-intensive travel. As a matter of legal doctrine, states control how much authority local governments have, even if in practice local governments typically have primacy over land use and local travel.[548] This means that states can engage in statewide land use planning and can require or promote compact land use practices among local governments and metropolitan regions. New Jersey is also one of a relatively few states that administers public transit at the state, instead of local, level.[549] States can also direct financing incentives and funding—and especially transportation funding—in ways that promote the reduction of carbon intensive travel. Finally, states can incorporate GHG impacts of travel into state permitting and review.[550]

The federal government's chief involvement in this "third leg of the stool" is in the provision of federal transportation funding. Federal gas and diesel taxes provide nearly half of transportation infrastructure funding and approximately one quarter of all government funding for highways and public-transit,[551] and those funds are passed down to the states.[552] Some of those funds are also passed down through states to metropolitan regions and local governments. The federal government places conditions on this funding that states need to meet in order to receive this funding, and these include requirements that states and

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[543] Between 1996 and 2006 VMT grew between 1.79 and 2.11 percent a year. In contrast, VMT has grown between 0.25 and 1.27 percent between 2010 and 2015. *Public Roadway Mileage and Vehicle Miles Traveled*, New Jersey Department of Transportation, http://www.state.nj.us/transportation/refdata/roadway/vmt.shtm (last retrieved Aug. 17, 2017). The increased VMT reflects in part increased population. New Jersey population increase 1.7 percent from 2010 to 2016. *New Jersey Quick Facts*, U.S. Census https://www.census.gov/quickfacts/NJ (last retrieved Aug. 17, 2017).

[544] NRC Transportation GHG Study at 162; National Research Council, Committee for the Study on the Relationships Among Development Patterns, Vehicle Miles Traveled, and Energy Consumption: Driving and the Built Environment: The Effects of Compact Development on Motorized Travel, Energy Use, and CO2 Emissions (2009), http://www.trb.org/Publications/Blurbs/162093.aspx [hereinafter TRB Driving and the Built Environment].

[545] Id.

[546] Richard Briffault, *Our Localism: Part I--The Structure of Local Government Law*, 90 Col. L. Rev. 7, 7-8 (1990).

[547] New Jersey Rev. Stat. § 39:4-8 (2013).

[548] "As a matter of conventional legal theory, the states enjoy complete hegemony over local governments." Id. In practice, however, local governments have traditionally held authority over land use and vehicle travel within their boundaries, and in many cases, states have explicitly conferred this authority to localities through their state constitutions or statutes. Many states have passed some form of "Home Rule" constitutional amendments and statutes, which confer a degree of legislative autonomy to local governments, often explicitly or implicitly including authority over land-use and local vehicle traffic. Paul S Weiland, *Federal and State Preemption of Environmental Law: A Critical Analysis*, 24 Har. Envnt'l L. Rev. 237 (2000).

[549] N.J.S.A. 27:1A-5

[550] *See generally*, Transportation Policy at 306-08.

[551] Robert Jay Dilger, CONGRESSIONAL RESEARCH SERVICE, Federalism Issues in Surface Policy: Past and Present, R40431, at 3 (2015) [hereinafter CRS FEDERALISM ISSUES].

[552] *Id.*

metropolitan regions engage in transportation planning.[553] States with air pollution challenges[554]—including New Jersey—are also required to ensure that their transportation plans "conform" with federal Clean Air Act requirements. That is, states need to show through emissions modelling that their transportation investments and activities will not cause new air quality violations, worsen existing violations, or delay attainment of national air quality standards.[555] These statewide and regional transportation planning processes create an obvious venue for incorporating GHG planning into transportation infrastructure planning and investment.[556]

New Jersey has a long history of statewide planning, going back to the passage of the State Planning Act in 1934,[557] however the state's planning process has been irregular.[558] At the same time, the state also has a long tradition of local government autonomy and "Home Rule."[559]

New Jersey has implemented a number of policies to promote cleaner modes of transportation, including a "complete streets" policy that requires the New Jersey Department of Transportation to "provide safe access for all users" when planning, designing, constructing, maintaining and operating transportation facilities within public rights of way that are federally or state funded, and a transit village voluntary designation program.

This section provides an overview of some of the state policy models that have been used to achieve reductions in carbon-intensive travel. These include:

- Statewide planning efforts and state policies to promote or require local planning;
- State policies to target funding and incentives (including "complete streets" policies);
- State policies to align infrastructure permitting and review.

Statewide Planning and Strategies to Require or Promote Consistent Local Action

Policymakers have long recognized that integrating GHG emissions considerations into transportation and land use planning is a foundational step to reducing high-carbon-intensive travel. Such planning can help decisionmakers evaluate the GHG emissions consequences of infrastructure investment decisions as well as transportation and land use policies. California has gone further, requiring metropolitan regions to use such processes to develop and implement plans to meet regional GHG emission limits.

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[553] Vicki Arroyo et al., *New Strategies for Reducing Transportation Emissions and Preparing for Climate Impacts*, 43 FORDHAM URB. L.J. (forthcoming).

[554] States that are in non-attainment or maintenance status for criteria air pollutants. See Clean Air Act § 176(c); 42 U.S.C. § 7506(c). New Jersey is in non-attainment for more than one pollutant. *See New Jersey Attainment Areas Status*, N.J. Department of Environmental Protection, http://www.nj.gov/dep/baqp/aas.html (last retrieved August 17, 2017).

[555] Clean Air Act § 176(c); 42 U.S.C. § 7506(c); *General Information about Transportation and Conformity*, U.S. Environmental Protection Agency, https://www.epa.gov/state-and-local-transportation/general-information-transportation-and-conformity (last retrieved August 17, 2017); Vicki Arroyo et al., *New Strategies for Reducing Transportation Emissions and Preparing for Climate Impacts*, 43 FORDHAM URB. L.J. (forthcoming)

[556] *Id.*

[557] State Planning Act (P.L. 1934, c. 178); *Chronology of Statewide Planning,* State of New Jersey Department of State (2017), http://www.nj.gov/state/planning/spc-research-chronology.html.

[558] See discussion below.

[559] New Jersey's Home Rule Act of 1917 directs courts to liberally interpert powers granted by the legislature to municipalities. See also Robert W. Burchell et al., Rutgers Edward J. Bloustein School of Planning and Public Policy, A National Survey of Local Land-Use Regulations: Steps Toward a Beginning (2008), bloustein.rutgers.edu/wp-content/uploads/2015/03/HUDLandUse-pdf.pdf (describing New Jersey as "A home-rule state where cities have a reasonable level of autonomous discretion regarding land-use decision.").

Such planning is challenging in part because it incorporates both transportation and land use planning. Land use planning and land use decisions such as zoning are historically carried out by individual municipalities. Travel activity crosses municipal boundaries, however, and federal transportation funding conditions require that transportation planning be undertaken by metropolitan planning organizations (MPOs). MPOs must meet requirements established in federal law but are governed by a board of trustees that generally consist of representatives of state and local government.[560] Importantly, MPOs themselves typically do not have land use powers, but include in their governance representatives of local governments.

Despite the traditional primacy of local jurisdictions in the sphere of land use,[561] beginning in the 1970s many states took a more active role in regulating land use in response to concerns about unconstrained development.[562] These states typically passed legislation that provides state governments with an increased role in land use and often requires local governments to engage in some type of planning that is consistent with statewide goals or plans. In many cases, this local planning is subject to state and/or regional review, encouraging "consistency and coordination among state, regional, and local planning and regulatory programs."[563] Building on a long history of statewide planning,[564] New Jersey passed a statewide planning law in 1986 that requires the adoption of a statewide plan through a "cross-acceptance" process with local jurisdictions (described below).

In addition, under the federal transportation funding framework, states are required to develop long-range transportation plans and shorter three-year investment plans (called "statewide transportation improvement programs").[565] The planning process is to take into account all modes of transportation (including transit, biking, and walking) and provide for "consideration and implementation of projects, strategies, and services that will…protect and enhance the environment, promote energy conservation, … and promote consistency between transportation improvements and State and local planned growth and economic development patterns."[566] MPOs are also required to develop both types of plans.[567] In recent years many MPOs, although not in New Jersey, have incorporated some form of land use planning at the regional level, recognizing the important role that land use decisions play in transportation outcomes.[568]

Several states have implemented statewide transportation and land use processes to require or promote integration of GHG planning or to more generally promote compact development outcomes that can reduce travel or slow growth.

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[560] 23 U.S.C. Sec. 134(c)-(d).

[561] Richard Briffault, *Our Localism: Part I--The Structure of Local Government Law*, 90 Col. L. Rev. 7, 7-8 (1990).

[562] Oregon's growth management legislation in 1973 was the first such act. Or. Rev. Stat. 197.005-.860 (2010); *See* William E Buzbee, *Urban Sprawl, Federalism, and the Problem of Institutional Complexity*, 68 Fordham L. Rev. 57 (1999).

[563] Douglas R Porter, *State Framework Laws for Guiding Urban Growth and Conservation in the United States*, 13 Pace Envt'l L. Rev. 547, 549 (1995); *see also* Jerry Anthony, *Do State Growth Management Regulations Reduce Sprawl?*, 39 Urban Affairs Rev. 376, 379 (2004).

[564] *See Chronology of Statewide Planning,* State of New Jersey Department of State (2017), http://www.nj.gov/state/planning/spc-research-chronology.html.

[565] 23 U.S.C. § 135(a).

[566] 23 U.S.C. § 135(d).

[567] 23 U.S.C. § 134(c).

[568] Wilbur Smith Associates, Noteworthy MPO Practices in Transportation-Land Use Planning Integration 7 (2004), http://www.ampo.org/assets/library/4_ampotranlanduserptfinal05.pdf.

Setting Targets for GHG or VMT

A few states have established GHG or VMT goals for metropolitan regions. California requires MPOs to develop plans to meet transportation-sector GHG goals. Oregon requires the Portland region to develop a plan to meet a regional transportation-sector GHG emissions goal and has established voluntary goals for other MPOs. Washington has similarly set voluntary benchmarks for MPOs. Several states require that transportation or land use plans address statewide GHG reduction goals. Earlier this year the Federal Highway and Transportation Administration (FHWA) finalized a requirement that all state departments of transportation would have to establish a GHG performance measure, but this requirement has been indefinitely suspended by the current Administration.

California's Sustainable Communities and Climate Protection Act of 2008—known as S.B. 375[569]—requires CARB to set GHG targets for MPOs and requires MPOs to develop Sustainable Communities Strategies to meet those targets. In 2010, CARB adopted 2020 and 2035 targets for the eighteen regions in the state, expressed as the percent change in per capita GHG emissions relative to 2005.[570] The targets range from a one percent per capita GHG increase to a 16 percent reduction by 2035.[571] The strategy plans developed by MPOs become part of their federally required long range transportation plan.[572] The targets are to be updated at least every eight years, consistent with MPO timeframes for updating regional plans.[573] SB 375 does not establish any penalties for regions that fail to meet their targets.[574] Instead, it creates an incentive for developers to build new residential or mixed-use projects consistent with approved plans.[575] California's S.B. 391 law also requires the statewide transportation plan "to address how the state will achieve maximum feasible emissions reductions" from transportation in order to meet the state's economy-wide GHG targets.[576] A portion of the auction proceeds from California's cap-and-trade program—described above in section IV.B.—are used to support implementation of S.B. 375.[577] One recent report found that S.B. 375 has "has led to innovative policymaking to support healthy, equitable, and sustainable patterns of development."[578]

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[569] *Sustainable Communities*, California Air Resources Board, https://www.arb.ca.gov/cc/sb375/sb375.htm (last retrieved Aug. 17, 2017).

[570] Attachment to California Air Resources Board Executive Order G-11-024 (Sept. 23, 2010), https://www.arb.ca.gov/cc/sb375/final_targets.pdf. CARB is currently in the process of considering updates to the targets. *See Target Update Activities, Sustainable Communities*, California Air Resources Board, https://www.arb.ca.gov/cc/sb375/sb375.htm.

[571] *Id.*

[572] Cal. Gov't Code § 14522.1; Mary D. Nichols, *Sustainable Communities for a Sustainable State: California's Efforts to Curb Sprawl and Cut Global Warming Emissions Policy Paper*, 12 VT. J. ENVTL. L. 185, 188 (2010). California's Transportation Commission (CTC) revised California's regional transportation plan (RTP) guidelines to incorporate greenhouse gas emissions reductions into the regional transportation planning process, suggesting specific policies, strategies, and performance measures for regional smart growth. These guidelines suggest modeling and analysis techniques for transportation GHG emissions. They also promote technical assistance by Caltrans and the CTC to regional transportation planning agencies for GHG modeling.

[573] Cal. Gov't Code § 65080(b)(2)(iv).

[574] Mary D. Nichols, *Sustainable Communities for a Sustainable State: California's Efforts to Curb Sprawl and Cut Global Warming Emissions Policy Paper*, 12 Vt. J. Envtl. L. 185, 188 (2010).

[575] *Id.*; CAL. PUB. RES. CODE §§ 21155, 21155.1, 21155.2, 21159.28.

[576] Cal. Gov't Code § 14000.6, 65072.2. The first statewide plan developed pursuant to this requirement was issued in 2016. California Transportation Plan (CTP) 2040 (2016), http://www.dot.ca.gov/hq/tpp/californiatransportationplan2040/2040.html.

[577] For example, California has awarded $71 million to affordable housing and sustainable communities climate programs programs which "Invests in projects that reduce vehicle miles traveled by supporting compact, infill development patterns, encouraging active transportation and transit usage, and protecting agricultural land from sprawl development." California Air Resources Board, Annual Report to the Legislature on California Climate Investments, Using Cap-and-Trade Auction Proceeds at xiii (2017), https://arb.ca.gov/cc/capandtrade/auctionproceeds/cci_annual_report_2017.pdf.

[578] Climate Plan, Leading the Way: Policies and Practices for Sustainable Community Strategies (2016), http://cal.streetsblog.org/wp-content/uploads/sites/13/2016/10/ClimatePlan-Full-Report-WEB.pdf.

In 2009 and 2010 Oregon enacted state laws (H.B. 2001 and S.B. 1059, respectively) requiring the state DOT to develop a Statewide Transportation Strategy for reducing transportation-sector GHGs in accordance with voluntary MPO GHG reductions targets set by the state's Land Conservation and Development Commission.[579] The laws also required the Portland MPO to engage in scenario planning designed to meet the targets and encouraged other MPOs to do the same.[580] In 2011, the Commission set 2035 goals for each MPO of reducing *per capita* GHG emissions between 17 and 21 percent from 2005 levels.[581] A 2015 review found that the 2035 MPO targets were achievable based on three MPO scenario planning projects and the development of the statewide transportation strategy.[582] Meeting the targets will require "a comprehensive, coordinated strategy that includes a combination of complementary state, regional, and local efforts that promote walkable communities and expand transportation options to reduce the amount of driving people need to do," including substantial new funding and policies.[583] In 2017 the Commission adopted 2040 per capita GHG emission targets of 25 percent for Portland and 20 percent for the other MPOs from 2005 levels.[584] The 2040 targets will match the planning horizon for updates to MPO long range plans.[585]

Washington also passed statewide climate change legislation in 2008 that includes a mandate to reduce transportation sector emissions.[586] The law, H.B. 2815, includes a provision that sets statewide goals to reduce light duty vehicle per capita VMT 18 percent by 2020, 30 percent by 2035, and 50 percent by 2050.[587] The law describes these goals as "benchmarks," and a Washington appellate court held that these VMT goals were not requirements.[588]

Several states also explicitly require that transportation planning take into account the states' GHG emission reduction goals. In Maryland, a 2010 law (Ch. 725), requires the state's annual consolidated transportation plan to include a description of the extent to which the proposed construction projects satisfy state goals, including the state's climate goals.[589] Connecticut's planning statute requires the state's

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[579] Chapter 865 Oregon Laws 2009 (House Bill 2001); Chapter 85 Oregon Laws 2010 Special Session (Senate Bill 1059).

[580] Chapter 865 Oregon Laws 2009 (House Bill 2001) §37(5); Chapter 85 Oregon Laws 2010 Special Session (Senate Bill 1059) §§3-6. See also Oregon Land Conservation and Development Commission, Metropolitan Greenhouse Gas Reduction Targets, Oregon Administrative Rule (OAR) 660-012, (May 19, 2011).

[581] Oregon Land Conservation and Development Commission, Metropolitan Greenhouse Gas Reduction Targets, Oregon Administrative Rule (OAR) 660-012, (May 19, 2011).

[582] The three MPOs were Portland Metro, Eugene-Springfield, and Corvalis. Oregon Department of Land Conservation and Development, Target Rule Review Report: Review of Metropolitan Greenhouse Gas Reduction Targets and Scenario Planning 2 (2015), https://www.oregon.gov/LCD/CLIMATECHANGE/Documents/Target__Recommendations_Report_Final.pdf.

[583] *Id.*

[584] At the time of writing an amendment to the rule had not been published, but the adoption was reported on the website of the Oregon Department of Land Conservation and Development, https://www.oregon.gov/LCD/CLIMATECHANGE/pages/metropolitan_greenhouse_gas_reduction_targets.aspx. See also Oregon Department of Land Conservation and Development, Staff Report to Oregon Land Conservation and Development Commission (Jan. 12, 2017), https://www.oregon.gov/LCD/docs/meetings/lcdc/012517/Item_13_GHG_Targets.pdf (recommending adoption of new targets).

[585] Oregon Department of Land Conservation and Development, Staff Report to Oregon Land Conservation and Development Commission (Jan. 12, 2017), https://www.oregon.gov/LCD/docs/meetings/lcdc/012517/Item_13_GHG_Targets.pdf (recommending adoption of new targets).

[586] Wash. Rev. Code Ann. § 70.235.020 (LexisNexis)

[587] Wash. Rev. Code. § 47.01 (2010). In 2009 then-Washington Governor Christine Gregoire issued an executive order directed the Department of Transportation to work with four MPOs to achieve the statutory VMT reduction benchmarks. Governor Christine Gregoire, Exec. Order No. 09-05 (May 21, 2009), www.governor.wa.gov/sites/default/files/exe_order/eo_09-05.pdf.

[588] *Cascade Bicycle Club v. Puget Sound Reg'l Council*, 175 Wash. App. 494, 515-516 (2013).

[589] Md. Code Ann., Transp. § 2-103.1 (c)(3)(vi).

land use plan to include a goal for reducing carbon dioxide emissions, and state and MPO plans must be consistent with the state plan.[590] Massachusetts' Department of Transportation's GreenDOT initiative establishes as a matter of policy that state and regional transportation improvement programs are to be developed in a manner that aligns with the state's overall GHG reduction target.[591]

In January 2017, the FHWA finalized a requirement that states would need to identify a GHG performance measure and report on progress toward the measure.[592] This was one of several new performance measures required by the 2012 and 2016 federal transportation reauthorizations (known respectively as MAP-21 and the FAST Act).[593] MAP-21 in particular required FHWA to identify performance measures in several categories and provide guidelines for their use, and requires states to set goals and measure progress using these measures. In May 2017, however, FHWA announced that it was indefinitely delaying the effective date of these requirements and would be reopening comment on these rules in the coming weeks.[594]

State Planning for Sustainable Communities and Encouraging Local Planning and Action

Apart from setting explicit GHG or VMT goals intended to reduce high-carbon intensive travel, states can encourage compact land use and sustainable transportation through planning and related policies. Many states including New Jersey have a long history of such growth management or smart growth policies. Given that localities and regions exercise control over land use activities and significant control over transportation investments, an important consideration is whether and how state policies require or promote local planning and action consistent with state plans or policies.

The strategies that states have implemented include the following:

- Conducting statewide land-use planning accepted by local jurisdictions;
- Establishing incentives for or requirements that local plans align with state goals; and
- Provide funding for the development and implementation of sustainability plans.

Some states—including New Jersey—conduct statewide land use planning, usually with a focus on promoting compact development patterns and preserving open space.[595]

New Jersey's State Planning Act established the State Planning Commission and required the commission to develop and amend a Development and Redevelopment plan for the state.[596] The plan is to "represent a balance of development and conservation objectives best suited to meet the needs of the State," and is

[590] Conn. Gen. Stat. § 16a-32a (2011).

[591] MassDOT, GreenDOT Policy Directive 1, http://www.massdot.state.ma.us/main/Documents/HealthyTransportationCompact/P-10-002.pdf.

[592] National Performance Management Measures; Assessing Performance of the National Highway System, Freight Movement on the Interstate System, and Congestion Mitigation and Air Quality Improvement Program, 82 Fed. Reg. 5979, 5993-6003 (Jan. 18, 2017).

[593] Moving Ahead for Progress in the 21st Century Act, Pub. L. No. 112-141; Fixing America's Surface Transportation Act, Pub. L. No: 114-94. *See Fact Sheet, Performance Management*, Federal Highway Administration (2013), https://www.fhwa.dot.gov/map21/factsheets/pm.cfm.

[594] National Performance Management Measures; Assessing Performance of the National Highway System, Freight Movement on the Interstate System, and Congestion Mitigation and Air Quality Improvement Program, 82 Fed. Reg. 22879 (delay of effective date May 19, 2017).

[595] GCC Sustainable Communities Report at 17.

[596] State Planning Act, N.J. Stat. Ann. §§ 52:18A-196 to 18A-206 (2011).

to establish "statewide planning objectives" for land use and transportation, as well as other areas.[597] The State Planning Commission votes on whether to adopt a plan after an extensive "cross-acceptance" process required by statute, where the commission negotiates with county planning boards to achieve consistency between state and local plans. The statute calls for a three-year revision cycle,[598] though in practice, the state plan has only been updated once, in 2001.[599] The State Planning Commission also completed a draft plan update in 2011, but has not adopted this plan.[600] In addition to New Jersey, in the Mid-Atlantic region states that conduct such planning include Connecticut, Delaware, Maryland, New Hampshire and Rhode Island.[601]

A further policy strategy is to require or encourage local governments to align local planning efforts to state plans or goals. New Jersey[602] and several other states require localities to develop local land use plans, but many states simply enable, but do not require, such plans.[603] Within these different legal frameworks, a few states require local plans to be consistent with state plans or sustainability principles. For example, Delaware and Rhode Island require state and county plans to be reviewed by the state for approval as consistent with the state plan.[604] New Jersey's "cross acceptance" process is also a mechanism for achieving consistency between state and local planning, although the unadopted 2011 draft State Strategic Plan recognized the complexities of the process and proposed moving towards a comprehensive but less cumbersome process in the future.[605]

In other cases, states promote local planning and action. New York's Cleaner, Greener Communities Program (GCP) is a two-phase grant program totaling $100 million to provide the necessary resources for each economic region in the state to develop and implement regional sustainability plans.[606] Phase one provided up to a $1 million grant in each of New York's 10 economic development regions to develop a regional sustainability plan. An applicant must be a city or town acting on behalf of a representative consortium of the region's municipalities. The plans are to outline strategies consistent with the statewide limit of achieving 80 percent GHG reductions by 2050, including specific GHG reduction goals for transportation and land use sectors. Phase two funded GHG reduction, energy efficiency, and renewable energy projects consistent with a region's sustainability and strategic plans over the three-year

[597] *Id.*

[598] *Id.*

[599] New Jersey State Planning Commission, New Jersey State Development and Redevelopment Plan (2001), http://www.state.nj.us/state/planning/spc-state-plan.html.

[600] *Id.*

[601] *Id.* States without a statewide land use planning authority or function often establish principles intended to guide state and local land use—two examples are New York and New Hampshire, which have both established principles in statute. N.Y. Envtl. Conserv. Law § 6-0107(2); N.H. Rev. Stat. Ann. § 9-B:3; see GCC Sustainable Communities Report at 5.

[602] N.J. Stat. Ann. § 40A:12A-7 (2011).

[603] GCC Sustainable Communities Report at 27.

[604] GCC Sustainable Communities Report at 29.

[605] Comment from New Jersey state staff; New Jersey State Planning Commission, State Strategic Plan: New Jersey State Development and Redevelopment Plan, Draft Final (2011), http://www.nj.gov/state/planning/spc-state-plan.html.

[606] *Governor Cuomo Awards $10 Million Under His Cleaner, Greener Communities Program*, NY State Office of the Governor (June 25, 2012), http://www.governor.ny.gov/news/governor-cuomo-awards-10-million-under-his-cleaner-greener-communities-program.

life of the program.[607] Funding for the Cleaner, Green Communities program came from proceeds from the Regional Greenhouse Gas Initiative, and the program was administered by NYSERDA.[608]

New Jersey DOT has created a set of strategies to address land use in transportation planning, including use of Complete Streets policies and a guide to linking transportation and land use at the local level. New Jersey previously administered transit-oriented design incentives and had established the Mobility and Community Form partnership that worked with pilot municipalities to link community planning, zoning and transportation decisions.

These programs may also help local communities compete for federal sustainable communities grant awards.[609] New Jersey's Transit Village Initiative (a program encouraging transit-oriented development) provides benefits to designated areas including priority funding, technical assistance and eligibility for NJDOT grants.[610] In addition, developers, owners, or tenants within a designated New Jersey Urban Transit Hub may qualify for tax credits up to 100 percent of qualified capital investments.[611]

Targeting Funding and Incentives

States have developed a variety of models to target funding in ways that promote compact land use consistent with state plans or goals. Also, how a state chooses to invest its transportation funding is a major factor in sustainable community outcomes.

One of the most comprehensive approaches to leveraging funding is to prioritize or limit state infrastructure investments to geographical areas designated as priority growth areas.[612] One of the most prominent examples is Maryland's Priority Funding Areas approach, which prohibits the state from funding growth-related infrastructure outside of areas self-designated by communities.[613] Delaware similarly guides state infrastructure investment on the basis of five land area categories, including categories that prohibit or severely limit investments.[614]

A related approach is to designate areas to focus development incentives and assistance (as opposed to limiting state funding in non-growth areas). Maryland's Sustainable Communities initiative provides designated communities eligibility to coordinate incentives and assistance from multiple agencies, including historic tax credits, infrastructure support, and project-level gap finance.[615] Vermont's Growth

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[607] *NYS Energy Research and Development Authority – Cleaner, Greener Communities Program, Phase II Implementation Grants*, NYSERDA (2014), https://www.nyserda.ny.gov/-/media/Files/FO/Closed-Opportunities/2014/2721Summary.pdf.

[608] *Governor Cuomo Launches Grant Program for Projects to Support Cleaner, Greener Communities Sustainability Plans in Western New York*, NY State Office of the Governor (June 27, 2013), https://www.governor.ny.gov/news/governor-cuomo-launches-grant-program-projects-support-cleaner-greener-communities-0.

[609] Unclear whether the Sustainable Communities Grant Program will continue under the Trump administration. *Parnership Grants, Assistance & Programs*, Partnership for Sustainable Communities, https://www.sustainablecommunities.gov/partnership-resources (last retrieved Aug. 17, 2017).

[610] *Transit Village Initiative*, New Jersey Department of Transportation, http://www.state.nj.us/transportation/community/village/ (last retrieved Aug. 17, 2017).

[611] P.L. 2007, c. 346; P.L. 2009, c. 90; P.L. 2011, c. 149; N.J.S.A. 34:1B-207 et seq.

[612] GCC Sustainable Communities Report at 39.

[613] Md. Code Ann., State Fin. & Proc. §§ 5-7B-01 to 5-7B-10 (LexisNexis 2011); Maryland Department of Planning, Smart, Green, and Growing: Planning Guide (2010), http://www.mdp.state.md.us/PDF/OurProducts/Publications/OtherPublications/SGG_Guide_09_Web.pdf.

[614] Del. Exec. Order No. 26 (Jack Markell), http://governor.delaware.gov/wp-content/uploads/sites/24/2016/12/EO026.pdf (2011); replacing and rescinding Del. Exec. Order No. 59 (Ruth Ann Minner), 95 Del. Gov. Reg. 2 (2004).

[615] Md. Code Ann., State Fin. & Proc. § 5A–303(b) (LexisNexis 2011); Maryland Sustainable Communities Act of 2010, M.d. H.B. 475 (2010), http://mgaleg.maryland.gov/2010rs/bills/hb/hb0475t.pdf.

Center designations similarly provide preference in certain state grant scoring and make available tax increment financing, a form of financing where municipalities can generate capital for a specific development project on the basis of projected tax revenue from future growth related to that development.[616] New Jersey's current State Development and Redevelopment Plan designates land as one of five planning areas based on existing conditions, and also uses "centers" designations for areas that are targeted for future growth or infill. The 2011 draft State Strategic Plan focuses instead on Priority Growth Investment Areas.[617]

Some states guide state funding and investment on the basis of sustainable communities-related criteria or principles: New York's Smart Growth Public Infrastructure Policy Act requires state-supported infrastructure projects to be consistent, to the extent practicable, with statutory smart growth criteria, and applies to all projects administered by the state DOT, including projects selected through the MPO process.[618]

Principle-based approaches can also include broader policies tied to transportation investment: Fix-it-First policies prioritize maintenance of existing transportation infrastructure over new construction. The New Jersey legislature instituted a Fix-it-First policy in the 2000 Transportation Trust Fund reauthorization, [619] and this policy has been maintained in recent capital improvement programs. New Jersey's 2017 State Transportation Capital Program prioritizes resources for "safety, fix-it-first and state-of-good-repair initiatives."[620] Connecticut, Maryland, Massachusetts, New Hampshire, New York, Pennsylvania, Rhode Island and Vermont also have such policies.[621]

Complete Streets policies require transportation infrastructure projects to be designed to accommodate all modes of travel, including pedestrian and bicycle travel. New Jersey's complete streets policy has been recognized as one of the leading policies in the nation. NJDOT trained all of its in-house engineers and planners in its complete streets policy, and conducted workshops for hundreds of county and municipal decision makers, planners and engineers across the state.[622] The department has also established Complete Streets incentives in its Local Aid and Economic Development grant program by providing extra points to municipalities that meet benchmarks, such as having a state-approved Complete Streets policy.[623] NJDOT has provided resources that include a Complete Streets curriculum, a guidebook and

[616] Vt. Stat. Ann. tit. 24, §§ 2790-97; Vermont Planning Coordinating Group, Growth Center Planning Manual for Vermont Communities 5-8 (2007), http://accd.vermont.gov/sites/accdnew/files/documents/CD/CPR/DHCD-GC-Planning-Manual.pdf.

[617] New Jersey State Planning Commission, State Strategic Plan: New Jersey State Development and Redevelopment Plan, Draft Final 39 (2011), http://www.nj.gov/state/planning/df.html; *See* New Jersey Office of Planning Advocacy, Advance Notice of Rules: Priority Investment Criteria (2011), http://www.state.nj.us/state/planning/docs/priority-investment-criteria.pdf.

[618] State Smart Growth Public Infrastructure Act, N.Y. Envtl. Conserv. Law § 6 *et seq*. (Consol. 2011).

[619] New Jersey Department of Transportation, Transportation Capital Program FY 2012 (2011), http://www.state.nj.us/transportation/capital/tcp12/pdf/tcp12.pdf.

[620] *Id.*

[621] GCC Sustainable Communities Report at 42.

[622] Comments from New Jersey state staff; *See Complete Streets Workshops and Training,* State of New Jersey Department of Transportation, http://www.state.nj.us/transportation/eng/completestreets/training.shtm (last retrieved Oct. 5, 2012).

[623] *Id.*

recently launched website.[624] Through the department's outreach efforts, the state has 134 municipalities and eight counties that have adopted policies.[625]

Aligning infrastructure permitting and environmental review with sustainable communities outcomes

Finally, some states have incorporated GHG or sustainability considerations into permitting programs, including into environmental reviews of intrastructure projects that many states require. (These laws are often called "baby NEPAs" in that they are similar to the federal National Environmental Policy Act (NEPA)). Massachusetts provides a prominent example. The state developed a Greenhouse Gas Emissions Policy and Protocol as part of its environmental impact assessment program under the Massachusetts Environmental Policy Act.[626] The policy requires that certain projects undergoing review by the MEPA Office quantify their GHG emissions and identify measures to avoid, minimize, or mitigate such emissions. In addition to quantifying project-related GHG emissions, the policy also requires developers to evaluate project alternatives that may result in lower GHG emissions and to quantify the impact of proposed mitigation in terms of emissions and energy savings. The policy requires that applicants model the indirect emissions from transportation, including travel by employees, vendors, customers, and others, and should also identify and quantify proposed transportation emission mitigation strategies.[627] New Jersey's Executive Order 215 requires an environmental assessment or impact statement of major state-funded construction projects (over $1 million) including a review by the New Jersey Department of Environmental Protection (NJDEP) prior to commencing site preparation or activity.[628] NJDEP's review process includes its permit readiness checklist as a mechanism through which both NJDEP and applicants with projects subject to EO 215 can determine before a project is subject to environmental review, if it will meet NJDEP technical and policy requirements.[629] The checklist includes air quality impacts, green design provisions and innovative technology (including renewable energy) considerations but does not address GHG impacts.

IV.D.5 Promoting Low-Carbon Freight

Use of diesel fuel, a robust proxy for emissions from ground-based freight, accounted for 8.9 million metric tons or 21 percent of New Jersey's transportation CO_2 emissions in 2015.[630] The freight industry encompasses the ships, railroads, trucks, ports, warehouses, airplanes, and other implements that make up the global system that moves goods from place to place. Although global in scale, states can adopt

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[624] *New Jersey Bicycle & Pedestrian Resource Center*, New Jersey Bicycle & Pedestrian Resource Center, http://www.njbikeped.org (last retrieved Oct. 5, 2012).

[625] Comments from New Jersey state staff. *Complete Streets Policy Compilation*, New Jersey Bicycle and Pedestrian Resource Center (Jan. 31, 2017), http://njbikeped.org/complete-streets-2/.

[626] Mass. Gen. Laws ch. 30, §§ 61-62I (2011).

[627] Massachusetts Executive Office of Energy and Environmental Affairs, Revised MEPA Greenhouse Gas Policy and Protocol 8-9, 11 (2010), http://www.mass.gov/eea/agencies/mepa/greenhouse-gas-emissions-policy-and-protocol-generic.html.

[628] State of New Jersey Executive Order 215, http://www.nj.gov/infobank/circular/eok215.htm (last retrieved July 14, 2017).

[629] State of New Jersey Department of Environmental Protection, Office of Permit Coordination and Environmental Review, Permit Readiness Checklist, http://www.nj.gov/dep/pcer/introcklist.htm (last retrieved July 14, 2017).

[630] *State Energy Data System: New Jersey*, U.S. Energy Information Administration, https://www.eia.gov/state/seds/data.php?incfile=/state/seds/sep_fuel/html/fuel_mg.html&sid=NJ (last retrieved Aug. 17, 2017); *New Jersey Table F7: Distillate Fuel Oil Consumption Estimates, 2015*, U.S. Energy Information Administration, https://www.eia.gov/state/seds/data.php?incfile=/state/seds/sep_fuel/html/fuel_use_df.html&sid=NJ (last retrieved Aug. 17, 2017).

policies that affect the parts of the freight system that fall within their jurisdiction. Opportunities for reducing GHG emissions from freight can be thought of using the IF-TOLD framework:[631]

- Intermodalism/Infrastructure – use of efficient modes and infrastructure
- Fuels – use of low-carbon fuels
- Technology – application of efficient technologies
- Operations – best practices in operator behavior
- Logistics – improvement in supply chain management
- Demand – reduction in consumption and associated goods movement.

Examples of state policies that can reduce emissions from freight include investments in infrastructure that promotes shifts to cleaner freight modes, electrification of port facilities, and reducing highway speed limits for trucks. States in the near future may also be able to encourage automated and connected truck platooning.

Promoting Shifts to Cleaner Freight Modes

An example of intermodal strategies would be efforts to make it easier, simpler, cheaper, and faster to move freight using less polluting modes like rail or sea craft rather than trucking. Multiple transportation mode networks can be connected at intermodal transfer facilities.[632]

The Fixing America's Surface Transportation Act, or FAST Act, passed Congress in 2015 and led to the establishment of the National Multimodal Freight Network in the United States.[633] A map of the interim National Multimodal Freight Network has been published by the USDOT.[634] Opportunities for improving intermodalism, and thus reducing emissions along with other co-benefits, can be preliminarily identified using the NMFN map.

States can promote intermodalism by investing in improvements to their rail corridors. For example, the state of Massachusetts improved its freight capacity by enlarging its rail corridors to allow for double stacking of containers on rail cars.[635]

Where the transportation infrastructure allows for mode shifting, mode shift decisions can be encouraged through taxes, subsidies, and regulations. The State of Victoria in Australia has a Mode Shift Incentive Scheme that pays industry to shift freight from road to rail, investing $20 million over 4 years

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[631] James Winebrake, Achieving Emissions Reductions in the Freight Sector: Understanding Freight Flows and Exploring Reduction Options (2012), http://www.georgetownclimate.org/files/report/Freight%20Seminar%20Presentation%20-%2020120321.pdf (presentation on analysis commissioned by the Georgetown Climate Center).

[632] *Id.*

[633] Federal Register Vol. 81, No. 108, Pages 36381-36385 (June 6, 2016), https://www.gpo.gov/fdsys/pkg/FR-2016-06-06/pdf/2016-13261.pdf.

[634] *Interim Multimodal Freight Network*, U.S. Department of Transportation, https://www.transportation.gov/sites/dot.gov/files/docs/US_Interim_MFN_4_28_16_alt_text.pdf (last retrieved Aug. 17, 2017).

[635] MassDOT, State Freight and Rail Plan: Draft Findings and Recommendations Southeast Regional Meeting (Mar. 30, 2010), https://www.massdot.state.ma.us/portals/12/docs/RailPlan/SFRP_FindingsSoEastRgnl033010.pdf; *CSX opens New England double-stack cleared route, plans Quebec intermodal facility*, RT&S (Jan. 25, 2013), http://www.rtands.com/index.php/freight/class-1/csx-opens-new-england-double-stack-cleared-route-plans-quebec-intermodal-facility.html.

through 2018.[636] New Jersey's most recent Statewide Freight Plan was completed in 2007, but an update is currently underway in line with the guidance in the FAST Act.[637] New Jersey released a Statewide Freight Rail Strategic Plan in 2014.[638]

The *Meeting New Jersey's 2020 Greenhouse Gas Limit: New Jersey's Global Warming Response Act Recommendations Report* released in 2009 recommended that New Jersey explore opportunities for rail shuttle operations. Short-line railroads would be used to move freight inland for processing from Port Newark/Port Elizabeth. This niche is currently being filled by semi trucks, and the short distance does not lend itself well to the more traditional large freight railroad business. The 2014 New Jersey Statewide Freight Rail Strategic Plan includes in their highest priority recommendations:[639]

- Upgrading New Jersey's shortlines to handle the current industry standard 286K rail cars
- Elimination of tunnel and bridge height and width constraints that restrict the movement of today's larger industry standard rail cars
- Enhancing connectivity between Class I and short line railroads
- Expanding intermodal yard capacity throughout the State, particularly in northern New Jersey.

The report finds that increasing such investment in rail would facilitate the transition from trucks to rail, thereby producing economic and environmental benefits. For example, the report cites analysis from the American Association of State Highway and Transportation Officials (AASHTO) finding that it would cost shippers $70 billion more per year if all freight moved by rail were shifted to truck.[640] The report also finds that shifting from trucks to rail would produce environmental benefits by reducing emissions and traffic congestion. This finding is supported by the state's earlier 2007 Comprehensive Statewide Freight Plan which finds that "actions to reduce growth in peak period demand for truck travel, such as shifting a portion of truck traffic to rail, or utilizing off peak period capacity, as well as localized capacity improvements, can be assembled into an action plan for each… [area] of significant freight activity."[641] Pursuant to these goals, the 2016 renewal of the New Jersey Transportation Trust Fund included an annual appropriation of $25 million for freight rail projects.[642]

The *Meeting New Jersey's 2020 Greenhouse Gas Limit: New Jersey's Global Warming Response Act Recommendations Report* also recommended that New Jersey investigate the development of a Marine Highway Program for New Jersey. The federal Marine Highway Program was established by the Energy Independence and Security Act of 2007 and it is a program to "to expand the use of our Nation's navigable waterways to relieve landside congestion, reduce air emissions, provide new transportation

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[636] *Mode Shift Incentive Scheme*, Victoria State Government, http://economicdevelopment.vic.gov.au/transport/freight/mode-shift-incentive-scheme (last retrieved Aug. 17, 2017).

[637] New Jersey Dep't of Transp., New Jersey Statewide Freight Rail Strategic Plan (June 2014), http://www.state.nj.us/transportation/freight/plan/pdf/FRSP.pdf.

[638] New Jersey Dep't of Transp., New Jersey Statewide Freight Rail Strategic Plan (June 2014), http://www.state.nj.us/transportation/freight/plan/pdf/FRSP.pdf.

[639] *Id.* at ES-7.

[640] New Jersey Dep't of Transp., New Jersey Statewide Freight Rail Strategic Plan (June 2014), http://www.state.nj.us/transportation/freight/plan/pdf/FRSP.pdf.

[641] New Jersey Dep't of Transp., The New Jersey Comprehensive Statewide Freight Plan 6-29 (2007), http://www.state.nj.us/transportation/freight/plan/pdf/2007statewidefreightplan.pdf.

[642] Transportation Trust Fund Statute, N.J.S.A. 27:1B-1 (2016).

options, and generate other public benefits by increasing the efficiency of the surface transportation system."[643]

Port Electrification

The electrification of ports and port equipment, particularly cargo handling equipment, presents an opportunity to reduce emissions from the freight sector that falls under the fuel category. The Port of Los Angeles has pursued electrification as an emissions reduction strategy. A side-by-side life-cycle comparison of electrified equipment vs diesel equipment found that a significant reduction in emissions was possible by electrification at the Port of Los Angeles.[644] The Port of Los Angeles has also taken efforts to encourage use of electricity instead of fossil fuel by docked ships,[645] electric freight trucks,[646] other zero emission technologies,[647] and tracks its progress towards sustainability goals.[648]

The Port of New York and New Jersey has made investments to encourage clean vessels,[649] clean trucks,[650] and shifting freight to rail.[651] The Port Authority's Clean Vessel Incentive Program provides incentive funding to ocean-going vessels for reducing nitrogen oxide emissions, using low-sulfur fuels, tracking fuel consumption, and installing an onshore power system.[652]

Restricting Highway Speeds for Freight Trucks

Another state policy option for reducing emissions from freight is to reduce truck speed limits on highways. Research from the US Government Accountability Office has shown that reducing speed limits also reduces overall fuel usage.[653] New Jersey's speed limits are the same for cars and trucks: 65 mph on rural interstates and other limited access roads, and 55 mph on urban interstates.[654] Lowering the speed limit for trucks would decrease fuel usage from on-road freight. Eight states already have lower speed limits for trucks than for cars, and three of those states—California, Michigan, and Washington—have set speed limits for trucks lower than 65 mph.

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643 *America's Marine Highway Program*, U.S. Department of Transportation, https://www.marad.dot.gov/ships-and-shipping/dot-maritime-administration-americas-marine-highway-program/ (last retrieved Aug. 17, 2017).

644 Jae Kim, Mansour Rahimi & Josh Newell, *Life-Cycle Emissions from Port Electrification: A Case Study of Cargo Handling Tractors at the Port of Los Angeles*, 6 International Journal of Sustainable Transportation 321-337 (2012), http://urbansustainability.snre.umich.edu/wp-content/uploads/2012/10/Life-Cycle-Emissions-from-Port-Electification-A-Case-Study-of-Cargo-Handling-Tractors-at-the-Port-of-Los-Angeles..pdf.

645 *Alternative Maritime Power*, Port of Los Angeles, https://www.portoflosangeles.org/environment/amp.asp (last retrieved Aug. 17, 2017).

646 *Truck Electrification System to be Tested at Ports of Los Angeles*, Long Beach, Heavy Duty Trucking (Aug. 8, 2014), http://www.truckinginfo.com/channel/fuel-smarts/news/story/2014/08/truck-electrification-system-to-be-tested-at-ports-of-los-angeles-long-beach.aspx.

647 *Zero Emission Technologies*, Port of Los Angeles, https://www.portoflosangeles.org/environment/zero.asp (last retrieved Aug. 17, 2017).

648 *Sustainable Progress*, Port of Los Angeles, https://www.portoflosangeles.org/environment/progress/ (last retrieved Aug. 17, 2017).

649 *Clean Vessel Incentive Program*, Port Authority of New York & New Jersey http://www.panynj.gov/about/clean-vessel-incentive-program.html (last retrieved Aug. 17, 2017).

650 *Clean Truck Progress Report*, Port Authority of New York & New Jersey (2017), http://www.panynj.gov/about/clean-truck-progress-report.html.

651 *Intermodal Rail*, Port Authority of New York & New Jersey, http://www.panynj.gov/port/intermodal-rail.cfm (last retrieved Aug. 17, 2017).

652 *Id.*

653 *Potential Fuel Savings Generated by a National Speed Limit Would Be Influenced by Many Other Factors*, U.S. Government Accountability Office (Nov. 7, 2008), http://www.gao.gov/products/GAO-09-153R.

654 *Speeding and Aggressive Driving*, Governors Highway Safety Association http://www.ghsa.org/state-laws/issues/Speeding-and-Aggressive-Driving (last retrieved Aug. 17, 2017).

Figure V.D-2: states with differing speed limits for cars and trucks

California	55mph on all interstates and limited access roads, 65mph or 70mph for cars.
Idaho	70mph on rural interstates, 65 mph on urban interstates. Higher for cars.
Illinois	some limited access roads are 55mph for trucks and 65 mph for cars.
Indiana	65mph on rural interstates, 70mph for cars.
Michigan	60 or 55mph for trucks, 70mph for cars.
Montana	65mph for trucks on rural interstates, 80mph for cars.
Oregon	55mph for trucks on rural interstates, 65mph for cars.
Washington	60mph for trucks on rural interstates, 70mph for cars.

Source: Data from Governors Highway Safety Association.

Autonomous Truck Platooning

Heavy-duty semi trucks can reduce their fuel usage and improve their fuel economy through "drafting" off of other trucks (which decreases wind resistance).[655] Connected and automated vehicle functionality could significantly improve the feasibility and safety of this strategy. Vehicle-to-vehicle communications capability is at the advanced stage of testing and pilot deployment in the United States and internationally, and is expected to have commercial deployment by the end of 2017.[656] There are a number of regulatory challenges for intersate travel of truck platoons, including differing legal separation distances required between heavy-duty vehicles on highways.

IV.D.6 Cross-Cutting: Other Transportation Pricing Policies

Federal and State Fuel Taxes

The majority of public transportation investments are funded through federal and state gas and diesel taxes. Higher fuel taxes increase the overall cost of driving, and therefore act as an incentive for travelers to shift to other forms of transportation or to use fuel more efficiently. Because higher fuel costs lead to less fuel usage, fuel taxes are a policy option that indirectly leads to fewer greenhouse gas emissions.

In addition to federal fuel tax of 18.4 cents per gallon, most states also impose a tax on motor vehicle fuel. In 2016 legislation was passed in New Jersey to raise the fuel tax from 14.5 cents (one of the lowest in the country) to 37.5 cents per gallon.[657]

As the fuel efficiency of the vehicle fleet increases, due in large part to federal vehicle fuel efficiency standards, revenue from federal and state gas taxes decreases. The problem is exacerbated because the federal gas tax, and most state gas taxes, are fixed and do not increase with inflation. This is a serious

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[655] *See, e.g.*, Kevin Dopart, U.S. Dep't of Transportation, Connected Automation 10 (June 12, 2016) https://www.its.dot.gov/pilots/pdf/ITSA2016_CVtechnology_Dopart.pdf.

[656] Larry E. Hall, V2V Semi Truck Platooning Coming at End of This Year, HybridCars (Jan. 4, 2017), http://www.hybridcars.com/v2v-semi-truck-platooning-coming-at-end-of-this-year/; James Menzies, *Daimler Demonstrates Autonomously Driven Truck Platoon*, trucknews.com (Mar. 21, 2016), http://www.trucknews.com/transportation/daimler-demonstrates-autonomously-driven-truck-platoon/1003071203/ (three truck platoon test in Germany where "[t]ests have shown an aggregate fuel savings of 7% for the trucks in the platoon, ranging from 2% for the lead truck to 11% for the next and 9% for the trailing truck in a three-truck formation").

[657] New Jersey Assembly Bill 12 (2016); Christopher Maag & John Ensslin, *Legislature OKs 23-cent gas-tax hike*, NorthJersey.com. (Oct. 7, 2016), http://archive.northjersey.com/news/legislature-oks-23-cent-gas-tax-hike-1.1673142.

funding problem, in that current levels of transportation spending can not be supported under these existing revenue structures. Between 2008 and 2014, Congress needed to transfer funds six separate times to keep the federal Highway Trust Fund solvent.[658] In August 2014 the Congressional Budget Office estimated that $157 billion in additional revenue would be needed to maintain current spending levels plus inflation between 2015 and 2024.[659]

Mileage-based Fees

A mileage-based fee sets a fee based on the amount of vehicle travel, for example a cents-per-mile fee. The revenue raised by a simple cents-per-mile fee would depend solely on vehicle miles traveled, and would therefore not decrease as the vehicle fleet became more efficient and less dependent on petroleum fuels.

Mileage-based fees have been discussed as a possible replacement to the fixed cents-per-gallon tax used to fund transportation at the federal level and in many states. While there is broad interest in mileage based fees, there are no examples of broad-based adoption in the U.S. The state of Oregon has successfully implemented a limited program that can be used by up to 5,000 volunteer users, and has pioneered promising approaches to address implementation issues. Other states are following Oregon in developing demonstration programs; for example, California passed SB 1077 in 2014 requiring the implementation of a statewide pilot program by 2017, and the state is currently recruiting volunteer participants.[660]

Oregon's Road Usage Charge Program was established by the Oregon state legislature in 2013. It is a limited-use program implementing a mileage-based fee for up to 5,000 voluntary participants driving passenger cars and light trucks. The program, now branded OReGO, began implementation in July 2015.[661] Participants pay a 1.5 cent per mile fee and are refunded the 30 cent per gallon state tax from fuel they purchase. The fee is simple in structure, and does not provide an incentive for cleaner vehicles or fuels (mileage-based fee programs can be structured to charge based on vehicle size or fuel economy, in addition to miles traveled, in order to more directly reduce emissions).[662] Participants can choose from two third-party vendors that track mileage through a GPS device, or they can choose to have mileage tracked by the Oregon Department of Transportation using a non-GPS device.[663] There were over 950 participants in the program as of November 2015. The program builds on two smaller pilot programs successfully completed by the state in recent years. An Oregon Road User Fee Task Force that includes members of the state legislature is in the process of developing recommendations to the legislature for next steps.[664]

The 2015 federal transportation reauthorization, the Fixing America's Surface Transportation (FAST) Act, created a $35 million grant program to provide funds to states (including groups of states) for user fee

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[658] *See* Vicki Arroyo, et al., *New Strategies for Reducing Transportation Emissions and Preparing for Climate Impacts*, 43 Fordham Urb. L.J. (forthcoming).

[659] *See* U.S. Gov't Accountability Office, Funding the Nation's Surface Transportation System, http://www.gao.gov/key_issues/funding_nations_surface_transportation_system/issue_summary.

[660] *California Road Charge Pilot Program*, California Department of Transportation, http://www.dot.ca.gov/road_charge/.

[661] Oregon S.B. 810 §4(d), http://www.oregon.gov/ODOT/HWY/RUFPP/docs/SB_810_Enrolled_Road_User_Charges_(2013).pdf.

[662] Owners of less-efficient vehicles have an incentive to participate in the program, as they will pay less on a per-mile basis than they would on a per-gallon basis.

[663] *About participating*, OReGO, http://www.myorego.org/about/volunteer/ (last retrieved Aug. 17, 2017).

[664] *Road User Fee Task Force*, State of Oregon, http://www.oregon.gov/odot/hwy/rufpp/pages/ruftf.aspx (last retrieved Aug. 17, 2017).

demonstration projects.[665] The Delaware Department of Transportation was awarded $1,490,000 to work in collaboration with Connecticut, Pennsylvania, and Rhode Island and the I-95 Corridor Coalition on user fees based on on-board mileage counters.[666]

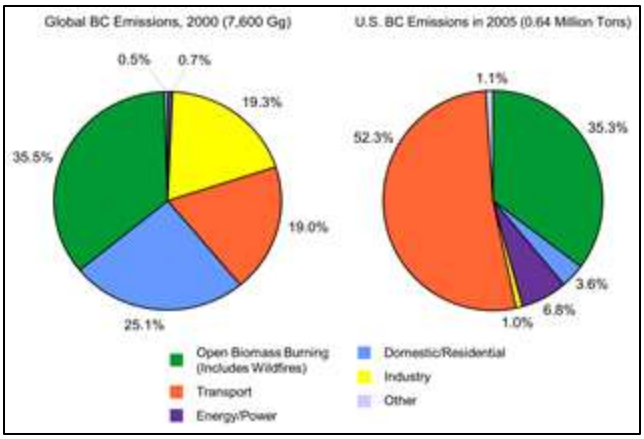
Automated Open-Road Tolling

Another alternative option for transportation pricing involves setting up and expanding automated open-road tolling. Toll-roads exact a user fee on vehicles using the road; the proceeds from these fees can be used for maintenance and other purposes. The technology now exists to eliminate toll booths and toll-takers. Motorists are able to pass through the toll plaza at highway speeds without slowing down to pay the toll. The state of New York is establishing open road tolling on all MTA bridges and tunnels.[667]

IV.D.7. Reducing Black Carbon Emissions from Transportation

Black carbon (BC), a major component of "soot," is estimated by the Intergovernmental Panel on Climate Change, to be the "third most important individual contributor to warming after carbon dioxide and methane (IPCC 2013). This warming effect is a result of BC's high global warming potential (GWP) of 900 over a 100-year time frame, and 3,200 over a 20-year time frame (IPCC 2013)."[668] BC particles absorb solar radiation during their short life in the atmosphere (days to weeks) and when deposited on snow and ice, these particles darken the surface and reduce the reflection of incoming solar radiation back to space.[669] Although not well-quantified, the influence of BC particles on cloud formation indicates a net contribution to warming.[670] Black carbon, which is highly light-absorbing, is emitted into the atmosphere in the form of fine particulate matter (PM 2.5) and is estimated to account for approximately 12 percent of all PM 2.5 emissions in the U.S.[671] Black Carbon has long been associated with adverse health impacts such as cardiovascular

BC Emissions by Major Source Category



Source: USEPA
https://www3.epa.gov/airquality/blackcarbon/basic.html#where

[665] FAST Act Pub. L. No. 114-94, Sec. 6020.

[666] *Federal Highway Administration Announces More than $14 Million in Grants to Test New Ways of Funding Highways*, U.S. Department of Transportation (Aug. 2016), https://www.fhwa.dot.gov/pressroom/fhwa1648.cfm.

[667] *Governor Cuomo Announces Open Road Tolling to be Completed on All MTA Bridges and Tunnels in 2017*, New York State Office of Governor (Dec. 21, 2016), https://www.governor.ny.gov/news/governor-cuomo-announces-open-road-tolling-be-completed-all-mta-bridges-and-tunnels-2017.

[668] Intergovernmental Panel on Climate Change, Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (2013), https://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WGIAR5_SPM_brochure_en.pdf.

[669] U.S. Environmental Protection Agency, Report to Congress on Black Carbon (Mar. 2012), https://www3.epa.gov/airquality/blackcarbon/2012report/fullreport.pdf; Intergovernmental Panel on Climate Change, Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (2013), https://www.ipcc.ch/pdf/assessment-report/ar5/wg1/WGIAR5_SPM_brochure_en.pdf.

[670] *Id.*

[671] U.S. Environmental Protection Agency, Report to Congress on Black Carbon (Mar. 2012), https://www3.epa.gov/airquality/blackcarbon/2012report/fullreport.pdf.

and respiratory effects. [672] Black carbon is emitted as a result of combustion of organic matter such as fossil fuels, biofuels and biomass.

Most U.S. emissions of BC come from mobile sources (52 percent), especially diesel engines used in onroad vehicles such as trucks and cars and nonroad equipment such as locomotives, small generators, and construction equipment. EPA reports that 93 percent of all mobile source emissions came from diesel engines in 2005. Other sources in the U.S. include open biomass burning (including wildfires) and residential and commercial heating and power plants. Federal standards for nonroad engines lag behind those for onroad engines, for which engine standards required a >90 percent reduction in PM2.5 emissions by model year 2007. EPA notes that efforts to reduce BC through reductions in PM 2.5 and other co-pollutants including air toxics have substantial benefits to public health that often exceed the costs of control. According to NJDEP, the major sources of diesel particulate matter in New Jersey are:

> "on-road and off-road vehicles powered by diesel engines. In addition to cars, trucks, and buses, diesel engines are used in construction vehicles, agricultural equipment, trains, and marine vessels. Diesel engines are also used to generate electricity on both an emergency and routine basis, and are also found on cranes, drilling equipment, and portable pumps. There are hundreds of diesel engines in New Jersey that are used to produce power for small-scale operations or are kept to generate RPS electricity in an emergency. Emissions from these diesel engines are not accounted for in USEPA's diesel PM inventory, but these numerous small sources can contribute significant amounts of pollutants to the air that we breathe. As the larger engines apply for or renew New Jersey Air Pollution Control Permits, they are being required to include particulate control measures and/or cleaner fuel in their operations."[673]

In 2012, EPA released an inventory of major sources of U.S. Black Carbon emissions and in 2015 California developed an emissions inventory for Black Carbon as part of its Short-Lived Climate Pollutant Strategy.[674] Black Carbon emissions are not included in the New Jersey GHG inventory, however the New Jersey Global Warming Response Act defines greenhouse gas to include an identified list of gases as well as *"any other gas or substance determined by the Department of Environmental Protection to be a significant contributor to the problem of global warming."* [675] Additionally, Black Carbon is not monitored as an individual pollutant as part of New Jersey's National Ambient Air Quality Standard monitoring network.

Federal emissions standards are in place for newer diesel engines. Nonroad and onroad heavy-duty diesel engines have a long service life meaning they are able to pollute for a long time before replacement. The 2005 New Jersey Diesel Retrofit Law[676] advances use of retrofit emissions control technology on certain on-road, diesel-powered motor vehicles and non-road vehicles/equipment. The

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[672] *Id.*

[673] *Diesel Emissions*, State of New Jersey Department of Environmental Protection (2017), http://www.nj.gov/dep/airtoxics/diesemis.htm.

[674] U.S. Environmental Protection Agency, Report to Congress on Black Carbon (Mar. 2012), https://www3.epa.gov/airquality/blackcarbon/2012report/fullreport.pdf; California Air Resources Board & California Environmental Protection Agency, California's Black Carbon Emission Inventory Technical Support Document (2015), https://www.arb.ca.gov/cc/inventory/slcp/doc/bc_inventory_tsd_20160411.pdf.

[675] N.J.S.A. 26:2C-43.

[676] N.J.S.A. 26:2C-8.26 et seq.

regulations implementing the law required a variety of vehicles and equipment to install "retrofits" by established deadlines at state expense. Diesel sources that are addressed by the New Jersey law include school buses, publicly owned or contracted solid waste vehicles, commercial buses, publicly owned onroad vehicles, and large publicly owned nonroad vehicles.[677] As of July 2017, all approved retrofits have been installed. Approximately 70 percent of these retrofits were installed on publicly owned vehicles and the rest were privately owned vehicles. The state's priority for retrofits were diesel sources that were cost effective to retrofit and that offered the greatest benefit to residents due to their presence in neighborhoods and on regular routes, making them disproportionate contributors to chronic exposure to diesel exhaust (e.g. garbage trucks, public utility vehicles and commercial buses traveling through residential neighborhoods). Through the program, 5,915 tailpipe retrofits were installed, reducing annual PM 2.5 emissions by 73 tons which is equivalent to the amount emitted annually by over 3 million passenger vehicles. Additionally, 7,429 school buses were also retrofit with Closed Crankcase Ventilation Systems to prevent emissions from entering the cabin. Statewide, the 73 tons is a portion of the 19,900 tons of PM 2.5 emissions estimated in the 2017 PM 2.5 inventory. The expectation is that the focus on reducing emissions that have the greatest impact on citizens results in important reductions in local impacts and exposures. New Jersey has also used millions of federal grant dollars to reduce emissions from privately owned construction equipment and other nonroad sources in the State. [678]

Notable State Policies:

- California has developed a statewide emission inventory for black carbon in support of its proposed Short-Lived Climate Pollutant Reduction Strategy and a goal of 50 percent reduction in anthropogenic black carbon from 2013 levels by 2030.[679]
- In 2017, California adopted regulations to accelerate current efforts to turnover on-road diesel engines to cleaner engines, by requiring diesel trucks and buses that operate in California to be upgraded to reduce emissions.[680]
- In 2011, New Jersey Governor Christie signed Executive Order 60 which established a pilot program to reduce emissions from private nonroad diesel powered equipment used in selected publicly funded state construction contracts. The pilot project was intended to inform policies regarding continuing, modifying or expanding the diesel emission reduction requirements and whether modifications are needed before continuing or expanding emission reduction requirements.[681]

[677] N.J.A.C. 7:27-32 and amendments to N.J.A.C. 7:27-14, 7:27A-3.10

[678] *Personal communication with Peg Hanna, Assistant Director; Division of Air Quality,* New Jersey Department of Environmental Protection (Aug. 2, 2017).

[679] California Air Resources Board, The 2017 Climate Change Scoping Plan Update (2017), https://www.arb.ca.gov/cc/scopingplan/2030sp_pp_final.pdf.

[680] *Truck and Bus Regulation, On-Road Heavy Duty Diesel Vehicles (In-Use) Regulation*, California Air Resources Board (June 2017), https://www.arb.ca.gov/msprog/onrdiesel/onrdiesel.htm.

[681] N.J. Exec. Ord. 60 (2011), http://nj.gov/infobank/circular/eocc60.pdf.

IV.E. Strategies for Reducing Emissions Through Building Efficiency and Systems

Building energy use accounts for 40 percent of total U.S. energy use. According to the 2012 New Jersey Greenhouse Gas Inventory, commercial and residential buildings together accounted for 22.2 mmtCO2e or 21.2 percent of New Jersey's greenhouse gas emissions.[682] There are many possible policies that New Jersey could undertake to help reduce emissions through improving the energy performance of its building stock. Some of these measures refer to all types of buildings – new and existing, commercial, industrial and residential – whereas others are targeted by building type. Where applicable, these distinctions are noted below.

[682] Michael Aucott et al., *2012 Update to New Jersey's Statewide Greenhouse Gas Emission Inventory*, Rutgers University (2015), http://climatechange.rutgers.edu/docman-list/special-reports/354-2012-update-to-new-jersey-s-statewide-greenhouse-gas-emission-inventory/file.

State Policy Model	*Notable Implementations*	*Related New Jersey Actions?*	*Notes*
Building energy benchmarking disclosure ordinance – typically for existing commercial buildings including multi-family, but can include single-family or multi-family low-rise residential buildings.	New York City; Philadelphia, Washington, DC; Austin, TX; California; Washington have established mandatory benchmarking provisions	New Jersey's Clean Energy Program (NJCEP) offers a free voluntary benchmarking program for commercial (including multifamily) & industrial building sectors. As a result, limited building performance data are available on NJCEP's website	Benchmarking disclosure ordinances are considered transformational in that they generate publicly-available data on energy use and costs by building, which in turn informs real estate market decision-making. This is an example of a regulation that helps markets to function more efficiently. Additionally, these detailed building baseline studies provide data that can target public investment and other policy strategies.
Point of sale measures –typically implemented for single-family or low-rise multi-family residential buildings	Kansas; Ann Arbor, Michigan; Davis, California	Some listing services and real estate brokers are beginning to share more energy performance information with potential buyers of properties	This is essentially energy disclosure for the residential marketplace, providing better information to real estate market decision-makers typically framed in code compliance terms.
Building regulations to curtail energy use during peak load. Beyond voluntary/market-based measures, building code regulations can help manage peak energy demand. Relevant measures include demand response smart grid building systems, and renewable energy requirements, either grid-tied or distributed (e.g., battery storage). An additional area of focus in newer building codes, which can help address peak load, is building energy plug load.	14 states and the District of Columbia have adopted the International Green Construction Code (IgCC), a model code for new and existing buildings. The IgCC includes a provision for demand response and for renewable energy at the building or site level. These provisions are more practical for new buildings, although can be applied in some cases of existing building improvements.The IgCC also includes provisions to help manage plug load.	NJ has a voluntary market-based demand response program and also incentivizes the use of building-tied renewable energy systems. In January 2008, NJ enacted legislation mandating the use of high performance green building standards in new construction of state-owned commercial facilities. This legislation did not directly address demand response or other peak load strategies	NJ does not have a green building code to govern private sector buildings. However, the NJ Legislature authorized the creation of the New Jersey Green Building Manual to define baseline performance for green buildings and to provide best practice guidance to owners and builders. Associated policy recommendations included expedited permitting for privately-owned buildings that adhere to green building guidelines or a green building code, including the IgCC. A version of this recommendation was introduced on May 8, 2017 to the NJ Legislature as S3129.
Adoption of a building code amendment concerning energy saving opportunities that may result when the use of a building changes (in commercial buildings). Change of occupancy is a natural inflection point for public policy seeking to reduce energy use by leveraging significant building investment.	Jursidictions that adopt the IECC model code for existing commercial buildings have a "change of occupancy" requirement for when a change in building use involves increased use of fossil fuel or electrical energy. However, this provision is poorly defined, poorly understood and inconsistently enforced. Rutgers Center for Green Building developed alternate language for this requirement that can be use to amend either the IECC or ASHRAE 90.1 An example of a jurisdiction that is adopting this improved language and requirements for the "change of occupancy" provision is Washington, DC. Seattle, Washington also has amended this area of its building code.	NJ's Rehabilitation Subcode for existing commercial buildings, which is based on ASHRAE 90.1, does not contain a change of occupancy requirement nor does it require an existing buiding to which work is being done to meet the new building requirements of the current code (e.g., ASHRAE 90.1), with the exception of 4 specific alterations	At the time that the NJ Rehabilitation Subcode was written, a main concern was to incentivize the use of existing assets, without overly burdening the property owner in terms of cost. Thus, many energy code requirements were excluded. Change of occupancy is one of several areas of the existing building code for commercial buildings in NJ that could be re-considered in seeking further energy savings opportunities.
Energy Code Collaborative to increase compliance with energy codes and promote market transformational policies.	There are many examples of codes collaboratives – e.g., TX, PA, DE, NH, VT, KY, MN. Additionally, there are 6 Regional Energy Efficiency Organizations (REEOs) that address energy codes, of which NEEP is the organization that covers the mid-Atlantic and New England states.	NJ does not have a dedicated codes collaborative. Some NJ stakeholders (including members of the NJ DCA Division of Codes and Standards and Rutgers Center for Green Building) participate in broader regional codes meetings organized by NEEP or US DOE	Energy code collaboratives require dedicated funding. Typically, this is provided by utilities, a board of public utilities, and/or foundation(s) interested in energy conservation. REEOs receive some portion of their funding from the US Department of Energy. The Building Codes Assistance Project (BCAP), also funded by US DOE, works closely with the energy code collaboratives and the REEOs. Other organizations that collaborate with BCAP and the REEOs include the Institute for Market Transformation and the New Buildings Institute.

IV.E.1 Reducing GHGs through Building Energy Code and Related Policies

Building energy use is a public policy concern, accounting for 40 percent of total U.S. energy use.[683] According to the 2012 New Jersey Greenhouse Gas Inventory, commercial and residential buildings together accounted for 22.2 mmtCO_{2e} or 21.2 percent of New Jersey's greenhouse gas emissions.[684] As a rule of thumb, for every 14,000 kilowatt hours saved (the amount of electricity used annually by an average residential building), 7 MTCO_{2e} emissions are avoided.[685]

The regulation of building construction in the United States establishes the minimum standards of acceptable building practice. This body of regulation is comprised of inter-related codes, each addressing a specific building system or attribute. Energy codes define the *least efficient* buildings that may be constructed; in other words, energy codes set minimum standards for energy efficiency.

The greatest emphasis of building code compliance and enforcement is on health and safety provisions of buildings (e.g., fire exits, structural integrity). In general, energy codes are less familiar to many codes officials and tend to receive less attention in terms of compliance, jeopardizing building energy performance. At the same time, multiple states and municipalities have identified energy codes and related policies as a cost-effective means to address concerns including energy cost and carbon emissions.

The State Energy Efficiency Scorecard published annually by the American Council for an Energy Efficiency Economy (ACEEE) benchmarks state-level progress towards saving energy via building codes and other energy efficiency programs. In the 2016 scorecard, NJ scored 17.5 out of 50 points, ranking 24 nationally.[686] With regard to building energy codes, NJ lost points for failing to demonstrate compliance initiatives and because in the most recent codes adoption cycle an amendment was included for new home construction that weakened the potential for building energy savings. Energy codes in NJ reference both the International Energy Conservation Code (IECC), for new and existing residential buildings, and the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE 90.1), for new commercial buildings. NJ uses a customized code to regulate existing commercial buildings known as the NJ Rehabilitation Subcode, which is based on ASHRAE 90.1. Opportunities to improve compliance with existing energy codes in NJ and to upgrade the potential of energy savings in commercial buildings by amending the NJ Rehabilitation Subcode are discussed below, along with a number of "beyond code" innovations.

Energy Code Compliance

Despite the importance and cost-effectiveness of building energy codes in reducing energy use and, correspondingly, emissions, efforts to improve compliance are chronically under-funded, leading to

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683 *Consumption & Efficiency*, U.S. Energy Information Administration (2017), https://www.eia.gov/consumption/.

684 Michael Aucott et al., *2012 Update to New Jersey's Statewide Greenhouse Gas Emission Inventory*, Rutgers University 4 (2015), http://climatechange.rutgers.edu/docman-list/special-reports/354-2012-update-to-new-jersey-s-statewide-greenhouse-gas-emission-inventory/file.

685 *EPA GHG Equivalencies Calculator*, U.S. Environmental Protection Agency, https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator (last retrieved May 22, 2017).

686 American Council for an Energy Efficient Economy, 2016 State Energy Efficiency Scorecard, Report U1606 (2016), http://aceee.org/sites/default/files/publications/researchreports/u1606.pdf. *New Jersey*, American Council for an Energy Efficient Economy, http://database.aceee.org/state/new-jersey (last retrieved Aug. 17, 2017).

billions of dollars of missed savings.[687] For each dollar spent on code compliance and enforcement, an estimated $6 is realized in energy savings, representing a 600 percent return on investment.[688] Compliance activities may include training of building code officials as well as users of the code, outreach to building owners and their project consultants, implementation support, as well as enforcement.

A viable model that is an emerging best practice in strengthening building energy code compliance is to form statewide collaborative efforts focused on code compliance such as state Energy Code Compliance Collaboratives, developed by the non-profit Building Codes Assistance Project (BCAP).[689] Collaboratives currently exist in twelve states, not including New Jersey, and they serve as a forum for experts and diverse stakeholders to work together toward setting and achieving building energy efficiency objectives. The states that host Collaboratives find that they have distinct benefits – e.g., they serve as a source of experts to support state entities that may be struggling with declining resources, a forum for dialogue among stakeholders affected by energy codes, and may serve as a locus for various training opportunities on the energy code for a variety of users. A 2016 webinar of state Collaboratives pointed to specific examples of best practices; some excerpts appear below:[690]

> **Delaware** – to improve code compliance, investment is needed in consumer outreach materials, appraiser education and compliance evaluation strategies.
>
> **New Hampshire** – a first necessary step is to establish a baseline of current compliance and then to prepare those responsible for enforcing the code with the necessary tools and resources. Also key are strategies to increase consumer demand.
>
> **Colorado** – is focusing its collaborative on areas of most need (i.e., commercial building energy code, especially small commercial buildings) while seeking to increase participation in the collaborative from diverse stakeholders (property owners, designers, financers).

Starting in 2010, the US Department of Energy funded BCAP to assist states in achieving the 90 percent by 2017 compliance target established by the 2009 American Recovery and Reinvestment Act. In the first phase of this work, BCAP worked with 19 states, not including New Jersey, to develop a state gap analysis regarding building energy code adoption, and implementation and enforcement. In the second phase of the work, BCAP worked with states to develop Strategic Compliance Plans for advancing energy code implementation to meet the goal of 90 percent compliance by 2017. The gap analyses and compliance plans provide a wealth of information on potential best practices, which NJ could pursue.[691]

A second code compliance initiative that has produced a series of best practices is the City Energy Project, a venture between the Institute for Market Transformation (IMT) and the Natural Resources Defense Council (NRDC) that seeks to improve the energy efficiency of buildings in 20 American cities.[692]

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[687] *Code Compliance*, Institute for Market Transformation, http://www.imt.org/codes/code-compliance (last retrieved May 18, 2017).

[688] *Id.*

[689] *Who We Are*, Building Codes Assistance Project, http://bcapcodes.org/who-we-are/ (last retrieved May 18, 2017).

[690] For further information on the webinar, a guide for how to establish a compliance collaborative and other pertinent information, please see the BCAP Compliance Collaboratives Portal, http://bcapcodes.org/projects/compliance-collaboratives/how-to-form-an-energy-codes-collaborative/.

[691] Compliance Planning Assistance, Building Codes Assistance Project, http://bcapcodes.org/compliance-portal/cpa/ (last retrieved May 18, 2017).

[692] *City Energy Project*, City Energy Project, http://www.cityenergyproject.org/ (last retrieved Aug. 17, 2017).

The methodology comprises an initial assessment to determine a benchmark compliance rate, followed by improvements, and then a follow-up assessment approximately two years later. As an example of what may be accomplished: The District of Columbia's Department of Consumer and Regulatory Affairs (DCRA) improved its compliance rate with the energy code from 74 percent to 99 percent in just two years.

Energy Code Collaboratives work closely with the Regional Energy Efficiency Organizations (REEOs), funded by US DOE and others, on building energy code topics, including various training programs, and are sometimes directly managed by them (e.g, the Northeast Energy Efficiency Partnerships (NEEP) manages the Pennsylvania energy code collaborative). Another organization that is deeply involved in buiding code matters is the New Buildings Institute (NBI).

Update Change of Occupancy Requirement for Existing Commercial Buildings

The average age of commercial buildings in the United States is 41.7 years.[693] While most renovations to existing commercial buildings trigger mandatory energy upgrades under both the IECC and ASHRAE Standard 90.1, designers and code officials often overlook these requirements. Market trends, such as increased demand for urban living, tax credits and other incentives that make adaptive re-use attractive, are leading to significantly more commercial building re-use, and thus what are referred to in building code language as changes in building occupancy. (The near-equivalent term in planning language is building use, or principal use – e.g., the purpose for which the building is used.) If enforced, code provisions to upgrade the energy performance of the building when building occupancy changes could have significant impact on energy use. The IECC change of occupancy provision (Section C505) is particularly hard to enforce in its current form, as it lumps together all such possible projects into a single requirement with limited exceptions.[694] More generally, the application of the IECC to existing buildings and its relationship to the IEBC (International Existing Building Code) is not well understood. Jurisdictions tend to do much better in enforcing the building energy code for new buildings rather than for existing ones. While it may seem obvious that all building owners must comply with the building code, in 2009 New York City passed Local Law 85 (LL85) stating that all new buildings and renovations must comply with the local Energy Code, regardless of building size.

Rutgers Center for Green Building recently proposed a code change to the IECC to address this situation by substituting a scaled approach for changes in building occupancy for existing commercial buildings, already familiar to code officials, for the widely ignored and difficult to enforce provision currently in place. Specifically, the proposed code change adapted pre-existing occupancy hazard scales regarding fire safety and related issues—e.g., as found in the NAARP and IEBC—to major energy end uses in buildings (HVAC, Lighting, Domestic Water). In so doing, it sought to establish predictability and proportionality in the code while causing either no cost increase or actually decreasing compliance costs. Although the proposed code change was not voted into the 2018 version of the IECC, a number of jurisdictions indicated strong interest in this innovative approach. [695] For example, Washington, D.C., is moving

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693 *Code Compliance*, Institute for Market Transformation, http://www.imt.org/codes/code-compliance (last retrieved May 18, 2017).

694 International Existing Building Code, Section C505.

695 Clinton J. Andrews et al., *Energy-Efficient Reuse of Existing Commercial Buildings*,

B. Sherman & Jennifer Souder (2016): Energy-Efficient Reuse of Existing Commercial Buildings, 82 Journal of the American Planning Association 415-423 (2017), http://dx.doi.org/10.1080/01944363.2015.1134275.

forward now in adopting a version of the Rutgers proposal. Seattle, Washington earlier made amendments to its commercial building energy code pertaining to changes in occupancy.

As described by Hattis et al.,[696] building code treatment of existing commercial buildings in NJ is unique. Briefly, the most significant reform in the regulation of work in existing buildings, and "smart code" development, happened in New Jersey with the adoption of the New Jersey Uniform Construction Code—Rehabilitation Subcode in January 1998. The new subcode was developed because it was recognized that the existing code was constraining the re-use of older buildings. With regard to energy conservation measures, the New Jersey Rehabilitation Subcode takes a different approach. Rather than a general reference to the IECC for all new alteration work, it specifies four situations when renovation, alteration or reconstruction work must comply with commercial energy code requirements of ASHRAE 90.1. However, there are no supplemental requirements for energy efficiency and the New Jersey Rehabilitation Subcode has no energy conservation requirement in the event of a change of occupancy, which in of itself may not trigger any of the four situations (above) requiring compliance with the code. The Rehabilitation Subcode has been in place in New Jersey for over 15 years, and it has served its original purpose well. The State has reported that investment in building rehabilitation in cities such as Trenton, Newark and Elizabeth grew substantially due to the code. In the present context, adaptive re-use – and thus, changes of occupancy, creates an opportunity for better building energy performance which currently is overlooked by the existing code.[697]

Green Building Codes

The New Jersey legislature passed the Global Warming Response Act in July 2007; in an effort to drive this effort through changes to the built environment, parallel legislation directed the creation of a New Jersey Green Building Manual to encourage builders and developers, non-profits, and for-profit organizations, state and local government, and residents to adopt comprehensive green building practices.[698] With input from stakeholders, the Rutgers Center for Green Building developed a green building best practice web-based manual and key policy recommendations for its implementation were shared with the State.[699] NJ Economic Development Authority adopted many of the manual's energy efficiency provisions associating them with its grant and loan programs for developers. In January 2008, NJ enacted legislation mandating the use of high performance green building standards in new state construction (buildings larger than 15,000 square feet constructed for the sole use of the State).[700] New Jersey has not adopted a green building code to govern private sector buildings, although recently legislation was introduced to provide expedited permitting to privately-owned buildings constructed with green building guidelines or according to a green building code. This had been a recommendation of the

Journal of the American Planning Association. http://dx.doi.org/10.1080/01944363.2015.1134275

[696] David B. Hattis et al., White Paper: Energy Efficiency Provisions in Building Rehabilitation Codes for Commercial Buildings - Pennsylvania & New Jersey (2014), Rutgers Center for Green Building (prepared by the Center for Green Building at Rutgers University for the Energy Efficient Buildings Hub, Philadelphia, PA).

[697] Clinton J. Andrews et al., *Energy-Efficient Reuse of Existing Commercial Buildings*, 82 Journal of the American Planning Association 415-423 (2017), http://dx.doi.org/10.1080/01944363.2015.1134275.

[698] NJSA 52:27D-130.6

[699] *New Jersey Green Building Manual*, Rutgers University http://greenmanual.rutgers.edu/ (last retrieved Aug. 17, 2017).

[700] See more at *New Jersey*, American Council for an Energy Efficient Economy, http://database.aceee.org/state/new-jersey (last retrieved Aug. 17, 2017).

NJ Green Building Manual and a consensus of a large stakeholder group that the Rutgers Center for Green Building facilitated during the development of the manual.

Since publication of the NJ Green Building Manual, the International Green Construction Code (IgCC) for high performance buildings, except low rise residential buildings, has progressed through development and pilot phases to a thoroughly vetted model code regulation that provides clear and specific requirements for sustainable building construction and operation, including training of building owners. The IgCC, like the NJ Green Building Manual, addresses multiple aspects of green building – e.g., energy, water, waste, materials, air quality, and treatment of the building site. The IgCC is integrated within the ICC Family of Codes, and is intended to be adopted as an overlay code, meaning it works in combination with underlying codes. The IgCC is currently in use or adopted in 14 states, not including New Jersey, and the District of Columbia.[701] Chapter 6 of the IgCC is dedicated to Energy Conservation, Efficiency, and Carbon Emissions. Two important features of the IgCC are Demand Response and Plug Load Control:[702]

- Demand response (DR) refers to the ability to adjust energy use in response to a price or information signal from a grid operator or a third party aggregator who similarly provides an automated signal. DR policies are pivotal in reducing GHGs as DR capabilities typically are "called in" during periods of peak electricity demand, such as mid-afternoon during the summer when both commercial and residential buildings may be using air conditioning. During such periods, it is not uncommon for utilities to rely on so-called peaker plants, which often are the least efficient most polluting power facilities in a regional portfolio. DR-enabled buildings are an increasingly important tool for grid operators for managing electricity flows and ensuring reliability. DR capabilities are also a nice complement to the use of renewable energy to help manage peak load conditions, while also avoiding GHGs and negative impacts on immediate air quality. The IgCC requires buildings located in jurisdictions where the utility or independent system operator (ISO) has a demand response program to include certain demand response capabilities. To comply with the code in general, a building must be capable of reducing its HVAC demand by at least 10 percent automatically on the receipt of a DR signal from the utility or third party. Jurisdictions can elect to require DR capabilities of the IgCC at the time of adoption. *Chapter 6 of the IgCC further addresses renewable energy systems stating that each building or surrounding lot or building site of multiple buildings shall be equipped with at least one renewable energy system (Section 611.1). Renewable energy systems, most familarly photovoltaic electric, are useful for off-setting peak load and can perform this function as either grid-tied or distributed (battery storage) systems. With battery storage innovation and price decreases, it is only a matter of time before distributed energy systems become more widely diffused.*
- Plug Load Control is the concept of automatically switching off normal 120V wall receptacles. The General Services Administration estimates that plug loads in a typical office environment account for roughly 25% of the building's total electrical load.[703] Even while energy use in buildings has

[701] *Code Adoption Map*, International Code Council, https://www.iccsafe.org/wp-content/uploads/Code_Adoption_Maps.pdf (last retrieved Aug. 17, 2017).
[702] *2015 International Green Construction Code (IGCC) Development*, New Buildings Institute (2017), http://newbuildings.org/code_policy/model-energy-green-codes/2015-igcc-development/.
[703] *Plug Load Control*, GSA Public Building Service (Sept. 2012), https://www.gsa.gov/graphics/pbs/PlugLoadControl_508c.pdf.

decreased on a per-square-foot basis across major building energy systems, miscellaneous plug load continues to grow. This is a large topic and one that the building code community is only recently making progress towards addressing. ASHRAE 90.1 began mandating plug load control for some building types in its 2010 version. The IgCC mandates plug load control in a mostly similar fashion as ASHRAE 90.1. As with DR controls, sub-metering of individual plug loads is more practical and cost effective in new building construction than of existing buildings.

Energy Benchmarking

Benchmarking serves as a mechanism by which the energy performance of a single building can be measured over time relative to similar buildings or a specific standard. Jurisdictions at the municipal and state levels are adopting building energy benchmarking laws at an increasing rate. These laws may apply to all building types or only commercial buildings. Frequently, smaller buildings are exempted. Benchmarking data make building consumers more aware of energy use and the economic and environmental implications; a US EPA study demonstrated a 7% decline in energy consumption as a result of benchmarked energy use.[704] The Institute for Market Transformation (IMT) maintains a map of current mandatory benchmarking adoptions. Jurisdictions with mandatory benchmarking ordinances include New York City; Philadelphia, Washington, DC; Austin, TX; and the states of California and Washington, among others. New Jersey has not adopted a mandatory benchmarking law.[705]

Energy benchmarking disclosure laws may be effectively combined with incentives for energy improvements and/or additional regulations. In the case of NYC, owners of buildings that are larger than 100,000SF must annually benchmark and disclose energy and water use and conduct an energy audit and retro-commissioning of key building systems every ten years.[706] Energy audits are performed by engineers and are a professional assessment of building energy use and provide operations and maintenance (O&M) strategies for improvement. Retro-commissioning of building systems serves to help ensure their optimal performance by correcting equipment and systems settings – a basic but often overlooked O&M strategy. Whether required by law, incentivized or neither, building owners who seek to improve the energy performance of their building(s) will turn to O&M strategies. The NJ Green Building Manual contains recommended O&M strategies by building type as does virtually every green building program or guide. O&M is also a mainstay of training programs offered by industry associations for building managers and other professionals.

New Jersey's Clean Energy Program (NJCEP) offers free voluntary benchmarking for commercial & industrial sectors, including hospitals and healthcare, municipalities, industries, hospitality, multifamily, higher education, K-12 public schools, retail and others.[707] NJCEP does not maintain an energy disclosure database.

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[704] *ENERGY STAR Portfolio Manager: Data Trends: Benchmarking and Energy Savings*, U.S. Environmental Protection Agency (2012).

[705] *Institute for Market Transformation*, Institute for Market Transformation, http://www.imt.org (last retrieved Aug. 17, 2017).

[706] http://www.nyc.gov/html/gbee/html/plan/ll84.shtml

[707] *Energy Benchmarking*, New Jersey Board of Public Utilities, http://www.njcleanenergy.com/benchmarking (last retrieved Aug. 17, 2017).

Point- of- Sale Policies –Residential Buildings

Another innovative practice that improves real estate market efficiency is reporting of residential building energy performance at the point-of-sale. This requirement is placed on sellers to inform potential buyers on how a home meets, falls below, or exceeds the jurisdictional building code. These policies also are known as Residential Energy Conservation Ordinances (RECOs). Examples of innovative point-of-sale practices with direct linkage to residential building code standards include[708]:

- Kansas Energy Efficiency Disclosure form providing information on whether a residence meets the energy efficiency standards of the 2006 IECC.
- The Ann Arbor, Michigan Municipal Code, Section 528 of Chapter 105, requirement that minimum energy efficiency/weatherization standards for all rental dwellings, dwelling units, rooming units and premises in the City of Ann Arbor are met.[709]
- Davis, California provision that a building owner must show the building to be compliant with the City of Davis Building Code prior to sale or transfer of the building. The owner must make the building code compliant within 90 days of sale/transfer.[710]
- Other RECOs that target residential and/or multifamily buildings are found in Berkeley, CA, Boulder, CO, Burlington, VT, and San Francisco, CA.

IV.F. Strategies for Reducing Methane Emissions from the Natural Gas Industry

States currently take a variety of approaches to reducing methane emissions from oil and natural gas infrastructure. However, the motivations for and approaches to policy vary depending on the characteristics of emissions sources and the nature of underlying regulatory authorities.[711] Whether motivated by a desire to increase public safety, improve air quality or reduce greenhouse gas emissions, existing state policies have implications for methane emissions from all four major stages of the natural gas supply chain—production, processing, transmission and storage, and distribution. While an estimated eighty percent of life cycle GHG emissions from the natural gas sector occurs at the point of combustion,[712] in the form of CO_2, methane emissions from the upstream supply chain represent a significant, and often cost-effective, opportunity for GHG emissions abatement.

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[708] A useful guide for policymakers on residential energy disclosure is also available at Energy Code Reform, Building Codes Assistance Project, http://bcapcodes.org/policy-action-toolkit/energy-code-reform/ (last retrieved May 24, 2017); Residential Energy Use Disclosure: A Guide for Policymakers, American Council for an Energy Efficient Economy (June 2014), http://aceee.org/sector/local-policy/toolkit/residential-disclosure

[709] Basic Winterization in Rental Housing, Mich. Code 8:528, https://www.municode.com/library/mi/ann_arbor/codes/code_of_ordinances?nodeId=TITVIIIBURE_CH105HOCO_8_528BAWIREHO.

[710] Resale of Property, Davis Muni. Code Art. 8.10, http://qcode.us/codes/davis/view.php?topic=8-8_10&showAll=1&frames=on.

[711] Paranhos, E., T.G. Kozak, W. Boyd, J. Bradbury, D.C. Steinberg, D.J. Arent, 2015. "Controlling Methane Emissions in the Natural Gas Sector: A Review of Federal & State Regulatory Frameworks Governing Production, Processing, Transmission, and Distribution." Joint Institute for Strategic Energy Analysis, Technical Report NREL/TP-6A50-63416. http://www.energy.gov/epsa/downloads/controlling-methane-emissions-natural-gas-sector-review-federal-state-regulatory

[712] Recent research suggests that methane emissions from power plants may be far greater than official estimates: Lavoie, T.N. et al., 2017. "Assessing the Methane Emissions from Natural Gas-Fired Power Plants and Oil Refineries." Environ. Sci. Technol., 2017, 51 (6), pp 3373–3381. DOI: 10.1021/acs.est.6b05531. http://pubs.acs.org/doi/abs/10.1021/acs.est.6b05531

While New Jersey does not produce or process natural gas,[713] the state has several high-pressure natural gas transmission pipelines and four natural gas local distribution companies (LDCs). From the transmission segment of the natural gas supply chain, most emissions occur at compressor stations. From the distribution segment, most emissions are from pipelines made of leak-prone materials. New Jersey is home to 12.6 percent of the total remaining inventory of cast iron distribution main pipelines in the U.S., more than any other state in the country. There may be opportunities to achieve methane emissions mitigation through two strategies: 1) standards for emissions from new and existing transmission and distribution equipment, including compressor stations (e.g., leak detection and repair; LDAR) and 2) deployment by LDCs of advanced methane sensing technologies and to help prioritize ongoing natural gas distribution infrastructure replacement efforts.

State Policy Model	*Notable Implementations*	*Related New Jersey Actions?*	*Notes*
LDAR and other requirements for new and existing transmission and distribution facilities	CA has mandatory standards for reducing leaks from natural gas infrastructure. CO requires LDAR at natural gas compressor stations		NJ has the authority to develop such regulations
Prioritize replacement of distribution pipelines	Utility commissions in NY and CA have approved such programs	PSE&G collaboration with EDF and Google	NJBPU has the authority to approve similar programs proposed by LDCs

IV.F.1 Methane Emissions, the Natural Gas Industry, and New Jersey

Methane is a short-lived but potent greenhouse gas

After CO_2, methane (CH_4) emissions are the second biggest contributor to global climate change.[714] Even though methane has a relatively short atmospheric lifetime (12 years, on average), pound for pound, averaged over the course of a century, it is at least 30 times[715] more effective at trapping heat in the atmosphere than carbon dioxide.[716] This means that sustained strategies to reduce this and other short lived climate pollutants can effectively slow the rate of global temperature rise and also reduce the level of peak warming in the future.[717]

[713] *New Jersey*, U.S. Energy Info. Admin., https://www.eia.gov/state/analysis.php?sid=NJ (last updated July 21, 2016).

[714] Intergovernmental Panel on Climate Change, 2013. Climate Change 2013: The Physical Science Basis; Chapter 8: Anthropogenic and Natural Radiative Forcing." IPCC Working Group I Contribution to AR5. http://www.climatechange2013.org/images/report/WG1AR5_Chapter08_FINAL.pdf.

[715] This estimate of global warming potential is integrated over a 100 year time frame.

[716] Intergovernmental Panel on Climate Change, 2013. Climate Change 2013: The Physical Science Basis; Chapter 8: Anthropogenic and Natural Radiative Forcing." IPCC Working Group I Contribution to AR5. http://www.climatechange2013.org/images/report/WG1AR5_Chapter08_FINAL.pdf

[717] J. K. Shoemaker, D. P. Schrag, M. J. Molina, V. Ramanathan. 2013 "What Role for Short-Lived Climate Pollutants in Mitigation Policy?" Science. Vol. 342, Issue 6164, pp. 1323-1324. DOI: 10.1126/science.1240162.

Methane is the largest component of natural gas, which is typically composed of 78 to 92 percent methane.[718] Strategies to reduce emissions from natural gas systems can result in improved air quality and benefits for human health and the environment.[719] Leaked methane from oil and natural gas facilities is also co-emitted with hazardous air pollutants (HAPs),[720] which are known or suspected to cause cancer or other serious health effects,[721] and non-methane volatile organic compounds (VOCs), which are also precursors to ground-level ozone, or smog.[722] Methane is also a precursor to ozone and, because it is a well-mixed greenhouse gas, rising atmospheric concentrations of methane contribute to rising background levels of ground-level ozone throughout the world.[723]

The natural gas industry is the largest source of methane emissions

The largest source of methane emissions in the United States is from leaking and routine venting by the oil and natural gas industry. Methane emissions occur during every stage of the natural gas supply chain; the most recent U.S. Environmental Protection Agency estimates indicate that 65 percent of methane emissions from natural gas systems are from production facilities, seven percent from processing, 21 percent from transmission and storage and seven percent from distribution facilities.[724] Recent studies have found that a very small number of sources consistently account for a disproportionately large portion of total estimated methane emissions from the oil and natural gas sectors (i.e., the so-called "super-emitter" phenomenon). Typically, five percent of measured methane emission sources account for over 50 percent of total methane emissions.[725]

When these "upstream" methane emissions are accounted for, on a life cycle basis, they reduce the net greenhouse gas benefit of switching to natural gas from more carbon-intensive fossil fuels, like coal and petroleum.[726] This is of particular concern because many of the GHG emission reductions recently achieved from the power sector, as well as those projected into the future, are the result of shifts from coal-fired generation to natural gas-fired generation.[727] In New Jersey, coal-based power generation declined by over 75 percent while power generated from natural gas has increased by over 100 percent

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[718] National Energy Technology Laboratory, 2012. "Role of Alternative Energy Sources: Natural Gas Technology Assessment." *See: Table 4-3.* https://www.netl.doe.gov/energy-analyses/temp/FY12_RoleofAlternativeEnergySourcesNaturalGasTechnologyAssessment_060112.pdf

[719] D. Shindell et al., *A climate policy pathway for near- and long-term benefits*, 356 Science 493 (2017), DOI: 10.1126/science.aak9521.

[720] Lesley Fleischman, Jonathan Banks, John Graham, 2016. "Fossil Fumes: A public health analysis of toxic air pollution from the oil and gas industry." Clean Air Task Force. http://www.catf.us/resources/publications/view/221

[721] Environmental Protection Agency. "Oil and Natural Gas Production Facilities: National Emission Standards for Hazardous Air Pollutants (NESHAP)." https://www.epa.gov/stationary-sources-air-pollution/oil-and-natural-gas-production-facilities-national-emission

[722] Environmental Protection Agency. "Basic Information about Oil and Natural Gas Air Pollution Standards." https://www.epa.gov/controlling-air-pollution-oil-and-natural-gas-industry/basic-information-about-oil-and-natural-gas

[723] P. S. Monks et al., 2015. "Tropospheric ozone and its precursors from the urban to the global scale from air quality to short-lived climate forcer." Atmospheric Chemistry and Physics. 15, 8889–8973. http://www.atmos-chem-phys.net/15/8889/2015/acp-15-8889-2015.pdf

[724] U.S. EPA, 2017. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2015. Chapter 3: Energy. https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2015

[725] A.R. Brandt, G.A. Heath, and D. Cooley, 2016. "Methane Leaks from Natural Gas Systems Follow Extreme Distributions." Environ. Sci. Technol., 2016, 50 (22), pp 12512–12520.

[726] James Bradbury, Michael Obeiter, Laura Draucker, Amanda Stevens and Wen Wang. 2013. Reducing Upstream Greenhouse Gas Emissions from U.S. Natural Gas Systems. World Resources Institute, Working Paper. http://www.wri.org/publication/clearing-air

[727] Energy Info. Admin., U.S. Energy-Related Carbon Dioxide Emissions, 2014, 12 (2015); Dep't of State, U.S. Climate Action Report 2014, 136 (2014).

over the past decade (2005 to 2014).[728] The trend has continued, with PSEG recently announcing retirement of their last two coal-fired power plants in May 2017.[729]

New Jersey has no known natural gas reserves and does not produce or process natural gas.[730] However, New Jersey does have several interstate natural gas transmission pipelines—and more are being proposed—that transport natural gas from production basins, such as the Marcellus Shale, through New Jersey to neighboring states or to customers in New Jersey.[731] LDCs receive natural gas from transmissions pipelines, step down the pressure at city gate stations, and then deliver natural gas through a distribution pipeline network to residential, commercial and industrial customers. However, some large industrial customers, such as manufacturing and gas-fired electric power generation facilities, are served directly by transmission pipeline companies. New Jersey has four LDCs that serve approximately 3 million natural gas customers,[732] and over one third of electricity in the state is generated by natural gas-fired power plants.[733] LDCs in New Jersey use roughly 4 billion cubic feet of liquified natural gas (LNG) storage capacity to help ensure that adequate supplies are available during times of peak natural gas demand.[734]

Emissions from the transmission pipeline system result primarily from leakage and venting by compressor stations, not from the pipelines themselves.[735] Compressor stations use pneumatic devices that vent natural gas as a matter of routine operation and other onsite equipment, such as seals and valves, require regular maintenance to minimize leaks. From LDCs, emissions occur from aging pipelines made of leak-prone materials (e.g., cast iron and bare steel), and from metering equipment at city gate stations and at the point of sale for residential and industrial customers. For example, cast or wrought iron pipes can be brittle and prone to cracking, accounting for a disproportionately large number of high-consequence incidents.[736] Uncoated or bare steel pipes are more prone to corrosion-related leaks than pipelines made of modern plastic or coated steel pipeline materials. Though ongoing programs have resulted in significant progress on reducing the inventory of leak prone pipelines throughout the country, New Jersey is home to over 4,000 miles of cast iron mains (Figure IV.F-1).

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[728] U.S. Energy Information Administration, "Electric Power Industry Generation by Primary Energy Source, 1990 to 2014, New Jersey." State Energy Data System. https://www.eia.gov/state/search/#?1=101&2=212

[729] NJ Spotlight. "PSEG Power retires N.J.'s 2 biggest coal-burning power plants." May 30, 2017. http://www.nj.com/business/index.ssf/2017/05/pseg_power_retires_njs_2_biggest_coal-burning_powe.html

[730] *New Jersey*, U.S. Energy Info. Admin., https://www.eia.gov/state/analysis.php?sid=NJ (last updated July 21, 2016).

[731] Brian Beam, Electric and Natural Gas Distribution Systems 10 (2015), www.njslom.org/100thconf/presentations/electric-gas-distribution.pdf; U.S. Energy Info. Admin.; *Natural Gas Explained*, U.S. Energy Info. Admin., www.eia.gov/energyexplained/index.cfm?page=natural_gas_pipelines (last reviewed Nov. 30, 2015).

[732] EIA. Number of natural Gas Customers. https://www.eia.gov/dnav/ng/ng_cons_num_dcu_sNJ_a.htm

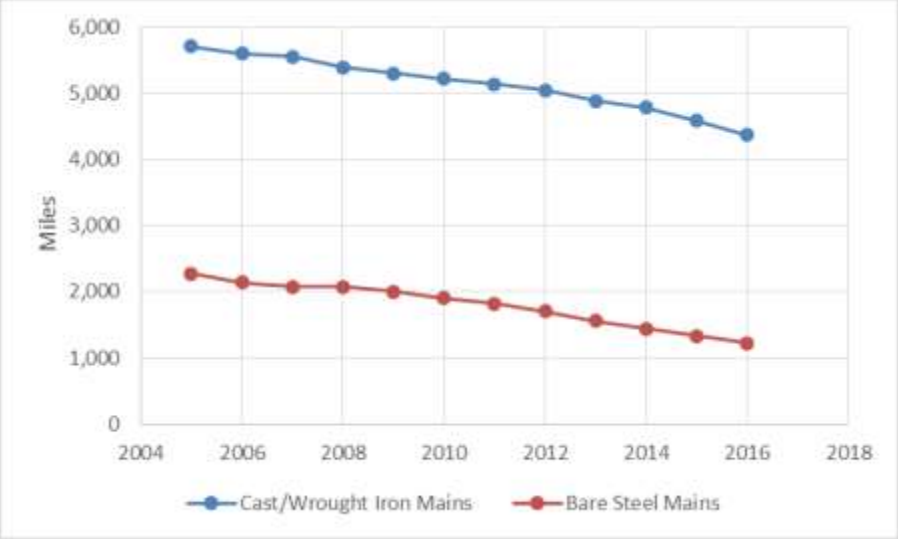
[733] EIA. New Jersey State Profile and Energy Estimates. https://www.eia.gov/state/?sid=NJ

[734] Northeast Gas Association. "The Role of LNG in the Northeast Natural Gas (and Energy) Market." Accessed June 6, 2017. http://www.northeastgas.org/about_lng.php

[735] Littlefield JA, Marriott J, Schivley GA, Skone TJ, Synthesis of recent ground level methane emission measurements from the U.S. natural gas supply chain, Journal of Cleaner Production (2017), doi: 10.1016/j.jclepro.2017.01.101.

[736] U.S. Department of Transportation. "Pipeline Replacement Updates." Pipeline & Hazardous Materials Safety Administration. https://opsweb.phmsa.dot.gov/pipeline_replacement/cast_iron_inventory.asp

Figure IV.F.-1: Miles of leak prone distribution pipelines located in New Jersey.



Source: PHMSA, 2017[737]

IV.F.2 Strategies for Reducing Emissions

Emissions Abatement Methods

Each segment of natural gas infrastructure has unique physical characteristics and emissions source types, which correspond with a range of emissions abatement methods and policy strategies. However, a common abatement strategy that applies to many segments of the natural gas supply chain is leak detection and repair (LDAR), through which oil and natural gas companies use approved methods, on a quarterly or semi-annual schedule, to inspect equipment for methane emissions and repair any detected leaks.[738] In addition to requiring LDAR, both state and federal regulations set emission limits on specific types of equipment, requiring the emissions be cut by a specified percentage.[739] Some regulations require certain equipment to be replaced on an established schedule.[740] The use of certain emission control devices, processes, or technologies, such as green completion[741] and "best available technology," is also

[737] U.S. Department of Transportation. "Pipeline Replacement Updates." Pipeline & Hazardous Materials Safety Administration. https://opsweb.phmsa.dot.gov/pipeline_replacement/cast_iron_inventory.asp

[738] *See generally* U.S. Envtl. Prot. Agency, Leak Detection and Repair–A Best Practices Guide (2007), https://www.epa.gov/sites/production/files/2014-02/documents/ldarguide.pdf.

[739] *E.g.*, 5 Colo. Code Regs. § 1001-9 XVII.B.3.b, XVII.C.1.b, XVIII.C.2.a, XVII.D.3-4 (2016); Wyo. Air Quality Div, Oil and Gas Production Facilities Chapter 6, Section 2 Permitting Guidance, 7-10 (2013) hereinafter Wyo. Permitting Guidance]; Pa. Dep't of Envtl. Prot., App'x A: Comparison of Existing and Recommended Pennsylvania Permit Requirements to Standards of the Center for Sustainable Shale Development, Colorado and EPA's Proposed Standards to Reduce Methane and VOC Emissions for the Oil and Natural Gas Sector 3-4, 8 (2015) http://files.dep.state.pa.us/Air/AirQuality/AQPortalFiles/Methane/Appendix%20A%20-%20Comparison%20of%20PA-%20EPA%20NSPS%20Proposal-%20CSSD%20-%20CO%20Requirements%20for%20the%20Oil%20and%20Gas%20Sector%20%2012-15-2015.pdf [hereinafter Penn. Comparisons].

[740] *E.g.*, 5 Colo. Code Regs. § 1001-9 XVII.B.3.c.; Penn. Comparisons at 7.

[741] *E.g.*, Wyo. Permitting Guidance at 16, 22, 27. Green completion is a form of well completion in which portable equipment is brought to the production site to separate the gas from the solids and liquids generated during the production process, so that the gas can be delivered into the pipeline. U.S. Envtl. Prot. Agency, Reduced Emissions Completions for Hydraulically Fractured Natural Gas Wells 2 (2011). This reduces methane and VOC emissions during well cleanup. *Id.*

often required.[742] The cost-effectiveness of each of these strategies varies widely, depending on the quantity of emissions avoided (i.e., natural gas conserved) and the operational and capital costs associated with each measure.[743]

Federal Regulations of Emissions from Oil and Natural Gas Facilities

Over the past five years, the federal government has promulgated various rules designed to reduce emissions from the oil and natural gas sectors. This includes new source performance standards (NSPS) promulgated by EPA in 2012 and 2016 to reduce emissions of volatile organic compounds (VOC) and methane from new and modified sources in the oil and natural gas sectors.[744] These rules included requirements for companies to use green completions technologies for all oil and natural gas wells, plus other measures at natural gas production, processing, transmission and storage facilities (but not from distribution facilities). However, in April 2017, the EPA announced the agency's intent to grant a reconsideration of the most recent NSPS and to stay a June 3 compliance date for 90 days as EPA takes public comments. In March 2017, the EPA withdrew an Information Collection Request, which had been issued in late 2016, requiring oil and natural gas companies to submit data and information to inform EPA's strategy for reducing methane and other emissions from existing oil and natural gas facilities.[745]

In November 2016, the federal Bureau of Land Management finalized regulations to limit natural gas flaring, venting and leakage from new and existing oil and natural gas infrastructure on public and tribal lands.[746] During the spring of 2017, Congress tried but failed to repeal this rule using the Congressional Review Act. However, the BLM regulations are currently undergoing review by the Department of Interior, which could ultimately decide to amend or rescind the rule.[747]

State Policies to Address Emissions from Production, Processing and Transmission

State rules to reduce emissions from the oil and natural gas sectors are designed primarily to improve air quality through reductions in VOC emissions; however, methane emissions abatement is also a stated goal for the policies in California and Colorado. Though they have only been promulgated or proposed in the last few years, state programs have succeeded in reducing emissions or have significant potential to reduce emissions. For example, it is estimated that the number of leaking oil and natural gas facilities in Colorado has dropped by 75 percent since the state's regulations went into effect in 2014.[748] Similarly,

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[742] *E.g.*, Pa. Dep't of Envtl. Prot., A Pennsylvania Framework of Actions for Methane Reductions from the Oil and Gas Sector 4 (2016), http://files.dep.state.pa.us/Air/AirQuality/AQPortalFiles/Methane/DEP%20Methane%20Strategy%201-19-2016%20PDF.pdf [hereinafter Pennsylvania Framework].

[743] ICF International, 2014. "Economic Analysis of Methane Emission Reduction Opportunities in the U.S. Onshore Oil and Natural Gas Industries." Prepared for Environmental Defense Fund. https://www.edf.org/energy/icf-methane-cost-curve-report

[744] Environmental Protection Agency, "Actions and Notices about Oil and Natural Gas Air Pollution Standards." https://www.epa.gov/controlling-air-pollution-oil-and-natural-gas-industry/actions-and-notices-about-oil-and-natural-gas#regactions

[745] Environmental Protection Agency, "Actions and Notices about Oil and Natural Gas Air Pollution Standards." https://www.epa.gov/controlling-air-pollution-oil-and-natural-gas-industry/actions-and-notices-about-oil-and-natural-gas#regactions

[746] Bureau of Land Management. "Methane Waste and Prevention Rule." November 16, 2016. https://www.blm.gov/programs/energy-and-minerals/oil-and-gas/operations-and-production/methane-and-waste-prevention-rule

[747] Executive Office of the President, "Presidential Executive Order on Promoting Energy Independence and Economic Growth." March 28, 2017. https://www.whitehouse.gov/the-press-office/2017/03/28/presidential-executive-order-promoting-energy-independence-and-economi-1

[748] Brittany Patterson, *As House moves to kill methane regs, Colo. asks why*, Climatewire (January 30, 2017). https://www.eenews.net/climatewire/2017/01/30/stories/1060049171

California's combined new and existing source methane emissions regulations, which were finalized in March 2017, are expected to reduce the equivalent of 1.4 million metric tons of carbon dioxide emissions annually.[749] Since existing sources are estimated to account for over 80 percent of total methane emissions from natural gas infrastructure,[750] it is important for policies to have strategies in place for achieving emissions abatement from existing sources, which occur at all stages of the supply chain.

Four states—California,[751] Colorado,[752] Ohio,[753] and Wyoming[754]—have adopted regulations to reduce emissions from new production, processing and transmission facilities, and Pennsylvania[755] and Maryland[756] have proposed regulations. All of these regulations include some variation of a LDAR program,[757] and all except Ohio include an emission limitation.[758] Only Colorado and Pennsylvania have replacement schedules for equipment,[759] but other states require replacement of equipment under certain circumstances (e.g., California)[760] and the adoption of specific emission control devices, processes, or technologies, over time.[761] Only California[762] and Colorado[763] have also adopted rules for emissions reductions from existing natural gas facilities. These include LDAR programs,[764] equipment replacement schedules,[765] emissions limitations,[766] and the use of certain emissions control technologies.[767]

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[749] News Release, California Air Resources Board, "CARB Approves Rule for Monitoring and Repairing Methane Leaks from Oil and Gas Facilities" (Mar. 23, 2017), https://www.arb.ca.gov/newsrel/newsrelease.php?id=907.

[750] ICF International, 2014. "Economic Analysis of Methane Emission Reduction Opportunities in the U.S. Onshore Oil and Natural Gas Industries." Prepared for Environmental Defense Fund. https://www.edf.org/energy/icf-methane-cost-curve-report

[751] *California Becomes Latest State to Regulate Oil and Gas Methane Emissions*, Envtl. Def. Fund (Mar. 23, 2017), https://www.edf.org/media/California-becomes-latest-state-regulate-oil-and-gas-methane-emissions.

[752] Fact Sheet, Colo. Dep't of Pub. Health and Env't, Revisions to Colorado Air Quality Control Commission's Regulations Numbers 3, 6, and 7 (2014), https://www.colorado.gov/pacific/sites/default/files/AP_Regulation-3-6-7-FactSheet.pdf [hereinafter Colorado Fact Sheet].

[753] Andrew Williams, *Ohio Gov. Kasich Moves to Reduce Environmental Impact of Natural Gas Industry*, Envtl. Def. Fund (Apr. 7, 2016), http://blogs.edf.org/energyexchange/2016/04/07/ohio-gov-kasich-moves-to-reduce-environmental-impact-of-natural-gas-industry/.

[754] *See generally* Wyo. Permitting Guidance.

[755] Pennsylvania Framework.

[756] The future of Maryland's proposed regulations is in doubt, following Maryland's enactment of a moratorium on hydraulic fracking that included repealing a statutory provision that required the Maryland Department of the Environment to adopt a rule to regulate hydraulic fracking and which would have reduced methane emissions. Md. House Bill 1325 (2017).

[757] Greenhouse Gas Emission Standards for Crude Oil and Natural Gas Facilities, Cal. Code. Regs. 17, § 95669 (2017) [hereinafter California Methane Regulations; https://www.arb.ca.gov/regact/2016/oilandgas2016/oilandgas2016.htm]; 5 Colo. Code Regs. § 1001-9 XVII.F (2017); Ohio Envtl. Prot. Agency, High Volume Horizontal Hydraulic Fracturing: Oil and Gas Well Site Production Operations General Permit 12.1 Template § 5(c)(2) (2016) [hereinafter Ohio General Permit]; Wyo. Permitting Guidance at 22, 27; Penn. Comparisons at 6; Oil and Gas Exploration and Production, Md. Code Regs. 26.19.39 (proposed Nov. 14, 2016).

[758] California Methane Regulations § 95668(b); 5 Colo. Code Regs. § 1001-9 XVII.B.3.b, XVII.C.1.b, XVII.D.3-4; Wyo. Permitting Guidance at 7-10; Penn. Comparisons at 3-4, 8; Md. Code Regs. 26.19.47.

[759] 5 Colo. Code Regs. § 1001-9 XVII.B.3.c.; Penn. Comparisons at 7.

[760] California Methane Regulations.

[761] 5 Colo. Code Regs. § 1001-9 XVII.B.2.d.(i), XVII.B.3.a; Wyo. Permitting Guidance at 16, 22, 27; California Methane Regulations § 95668(d)(7); Pennsylvania Framework at 4.

[762] California Methane Regulations.

[763] 5 Colo. Code Regs. § 1001-9.

[764] *E.g.*, California Methane Regulations § 95669; 5 Colo. Code Regs. § 1001-9 XVII.F.3.

[765] 5 Colo. Code Regs. § 1001-9 XVII.B.3.c.

[766] *E.g.*, California Methane Regulations § 95668(b); 5 Colo. Code Regs. § 1001-9 XVII.B.3.b, XVII.C.1.b.

[767] *E.g.*, California Methane Regulations § 95668(d)(7); 5 Colo. Code Regs. § 1001-9 XVII.B.3.b, XVII.C.1.b.

Methane emissions regulations in California and Colorado include several requirements that apply to existing natural gas compressor stations. In both cases, LDAR requirements apply to existing reciprocating and centrifugal natural gas compressors.[768]

State Policies to Address Emissions from Distribution

State agencies and Public Utility Commissions (PUCs) oversee the implementation of federal safety rules for the distribution segments of natural gas pipelines[769] and most states, including NJ, have put safety standards in place that go well beyond the minimum federal requirements.[770] To improve the safety of distribution pipelines, States have various policies and programs in place that reduce methane emissions from natural gas distribution infrastructure. The most long-standing strategy for reducing leaks from distribution infrastructure is to replace pipelines that are made of leak-prone materials, such as cast-iron and bare steel.[771] Due to the high capital costs involved, 40 states plus the District of Columbia have put into place specific rate structures to enable LDCs to recover costs associated with pipeline replacement.[772] While improved safety and reliability has been the primary motivator for these programs, there is growing interest in reducing methane emissions and a recognition that pipeline replacement programs have historically been responsible for the bulk of estimated emissions reductions achieved by natural gas distribution companies.[773] A recent report by the U.S. Department of Energy found that establishing specific timelines for infrastructure replacement, in conjunction with a reliable cost-recovery mechanism, seems to be a particularly effective method for accelerating the replacement of leak-prone pipelines.[774]

Some states have also adjusted the timelines over which leaking equipment must be repaired or replaced and changing the requirements associated with leak repair in a way that would have the same practical effect. For example, nine states require that non-hazardous leaks be repaired within at least one year.[775] The California PUC has also recently[776] adopted a set of standards for natural gas utilities, including

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[768] *E.g.*, California Methane Regulations § 95669; 5 Colo. Code Regs. § 1001-9 XVII.F.3.

[769] Pipeline and Hazardous Materials Safety Administration (PHMSA) has regulatory authority over pipeline safety. However, State commissions are also responsible for oversight of intrastate pipeline safety through certifications or agreements with PHMSA.

[770] Paranhos, E., T.G. Kozak, W. Boyd, J. Bradbury, D.C. Steinberg, D.J. Arent, 2015. "Controlling Methane Emissions in the Natural Gas Sector: A Review of Federal & State Regulatory Frameworks Governing Production, Processing, Transmission, and Distribution." Joint Institute for Strategic Energy Analysis, Technical Report NREL/TP-6A50-63416. http://www.energy.gov/epsa/downloads/controlling-methane-emissions-natural-gas-sector-review-federal-state-regulatory

[771] U.S. Department of Transportation, 2011. "White Paper on State Pipeline Infrastructure Replacement Programs." Prepared for National Association of Regulatory Commissioners by the Pipeline & Hazardous Materials Safety Administration. https://opsweb.phmsa.dot.gov/pipelineforum/docs/PHMSA%20111011-002%20NARUC.pdf

[772] U.S. Department of Energy, 2017. "Natural Gas Infrastructure Modernization Programs at Local Distribution Companies: Key Issues and Considerations." Report by the Office of Energy Policy and Systems Analysis, 78 pg. https://energy.gov/epsa/downloads/natural-gas-infrastructure-modernization-programs-local-distribution-companies-key

[773] U.S. Department of Energy, 2017. "Natural Gas Infrastructure Modernization Programs at Local Distribution Companies: Key Issues and Considerations." Report by the Office of Energy Policy and Systems Analysis, 78 pg. https://energy.gov/epsa/downloads/natural-gas-infrastructure-modernization-programs-local-distribution-companies-key

[774] U.S. Department of Energy, 2017. "Natural Gas Infrastructure Modernization Programs at Local Distribution Companies: Key Issues and Considerations." (*See page 22)* Report by the Office of Energy Policy and Systems Analysis, 78 pg. https://energy.gov/epsa/downloads/natural-gas-infrastructure-modernization-programs-local-distribution-companies-key

[775] Shanna Cleveland, 2012. "Into Thin Air; How Leaking Natural Gas Infrastructure is Harming our Environment and Wasting a Valuable Resource." Conservation Law Foundation. https://www.clf.org/wp-content/uploads/2016/03/CLF-Into-Thin-Air.pdf

[776] CPUC, Rulemaking 15-01-008. Filed June 15, 2017. "Order Instituting Rulemaking to Adopt Rules and Procedures Governing Commission-Regulated Natural Gas Pipe Lines and Facilities to Reduce Natural Gas Leakage Consistent with Senate Bill 1371. http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M186/K437/186437714.PDF

annual reporting requirements for tracking methane emissions, 27 mandatory best practices, including standards for leak detection, leak repair, and leak prevention -- and cost recovery processes to facilitate review and approval of incremental expenditures associated with compliance. The rule implements a state bill passed in 2014 (SB 1371[777]), the standards apply to a range of equipment and facilities, including pipelines, compressor stations, terminals, gas storage facilities, and city gate stations.

A regulatory approach – taken by New York[778] –reduces leaks from distribution infrastructure by capping the maximum allowable rate of lost and unaccounted for (LAUF) gas[779] that each LDC can claim and preventing LDCs from recovering from customers costs that are more than the allowable rate.[780] It should be noted that the cost of the gas commodity sold to customers and costs associated with LAUF gas are passed on directly to customers. As a result, LDCs typically cannot increase their profits by reducing leaks from the system and so capping allowable LAUF could increase the incentive for gas utilities to minimize leaks.[781] However, since LAUF is typically considered to be a very poor proxy for leaks from the system,[782] and factors such as metering error can be significant contributors to LAUF, adopting this policy would also require a broader review of how LAUF is calculated and accounted for by the NJBPU.

Finally, new methane sensing technologies are becoming more widely available, to help measure the flux of natural gas associated with leaks and not just the presence of a leak. As a result, a particularly promising opportunity is for LDCs to use these sensors to help prioritize replacement of infrastructure associated with non-hazardous leaks. LDCs already use historical leak information and other data to inform their priorities for pipeline replacement; however, new vendors are offering sensing technologies and associated analytics packages that may be used to enable emissions abatement and cost savings.[783] In particular, PSEG recently announced a new initiative that applied such techniques under an existing $900 million NJBPU-approved investment program, and they report successfully reducing methane emissions by 83 percent from targeted areas.[784] Also, in December, 2016, the New York Public Service Commission approved[785] plans for a pilot program, wherein National Grid is collaborating with EDF and Google to "gather and analyze leak flow data in an effort to prioritize system investments and leak repairs." The

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[777] California Senate Bill 1371. https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB1371

[778] In the Matter of the Filing of Annual Reconciliations of Gas Expenses and Gas Cost Recoveries, filed in C 21656, NY Pub. Serv. Comm'n, Order Establishing Methodology for Lost and Unaccounted for Gas Adjustment, Case 04-G-1278, 4 (Apr. 5, 2005).

[779] LAUF is used by regulators to account for natural gas losses from the system, which includes leaks, venting, metering error, theft, and other factors. LAUF is generally treated as a recoverable operating cost and subject to review and approval by state PUCs, or equivalent.

[780] Romany Webb, *Lost But Not Forgotten: The Hidden Environmental Costs of Compensating Pipelines for Natural Gas Losses* 23-24 (Univ. of Tex. Kay Bailey Hutchison Ctr. for Energy, Law & Bus., Research Paper No. 2015-01, 2015), https://kbhenergycenter.utexas.edu/files/2015/04/Final-White-Paper-with-Adv-Counc_4.21.2015.pdf.

[781] Shanna Cleveland, 2012. "Into Thin Air; How Leaking Natural Gas Infrastructure is Harming our Environment and Wasting a Valuable Resource." Conservation Law Foundation.

[782] ICF International, 2014. "Lost and Unaccounted for Gas." Prepared for Massachusetts Department of Public Utilities. http://www.mass.gov/eea/docs/dpu/gas/icf-lauf-report.pdf

[783] Picarro, "Pipeline Replacement and Emissions Reduction Using Picarro Emissions Quantification Analytics," White Paper. http://naturalgas.picarro.com/support/library/documents/pipeline-replacement-and-emissions-reduction-using-picarro-emissions

[784] PSEG. "PSE&G Teams with Google, EDF to Stop Methane Leaks." https://www.pseg.com/info/media/newsreleases/2016/2016-12-13.jsp#.WS8wpmfdX3g

[785] NY Public Service Commission, December 16, 2016. CASE 16-G-0058. file:///C:/Users/James%20Bradbury/Downloads/%7BA75F304F-604B-4ECA-A3B8-596DCAE1F72D%7D.pdf

parties involved were commended for their collaboration in a unique pilot program that aims to provide benefits to utility, ratepayers and the environment, at no cost to ratepayers.

IV.G. Strategies for Other Highly Warming Gases

Highly warming gases trap heat in the atmosphere more effectively than CO_2. Scientists use the concept of *Global Warming Potential* (GWP) to compare the relative global warming effects of different gases. Specifically, GWP measures how much energy the emissions of 1 ton of a gas will absorb over a given period of time, relative to the emissions of 1 ton of carbon dioxide (CO_2). The larger the GWP, the more that a given gas warms the Earth compared to CO_2 over that time period. CO_2 has a GWP of 1 because it is the point of reference. The most recent IPCC report uses multiple methods to calculate GWP to account for different future global warming scenarios.[786] While these gases are only emitted in small amounts compared to CO_2, they have a significant and measurable contribution to climate change because of their high GWP per molecule. Highly warming gases accounted for 7.2 mmt CO_{2e}, or 6.9 percent of New Jersey's total greenhouse gas emissions in 2012 and include:[787]

- **Methane (CH_4)**, which is a gas emitted during the production and transport of coal, natural gas, and oil. Lesser emissions result from agricultural practices and decay of organic waste in landfills. More detail on strategies to reduce methane emissions is in Section IV.F. Methane has a 100-year GWP of 28.[788]
- **Nitrous oxide (N2O)**, which is a gas emitted during agricultural and industrial activities, combustion of fossil fuels and solid waste. Lesser emissions result from use in medical products (e.g. as an aerosol propellant). Nitrous Oxide (N_2O) has a GWP 265–298 times that of CO_2 for a 100-year timescale.
- **Fluorinated gases**, which are gases that have the element fluorine in their molecular structure and include hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulfur hexafluoride (SF6), and nitrogen trifluoride (NF3).[789] Fluorinated gases also includes chlorofluorocarbons (CFCs) and Hydrochlorofluorocarbons (HCFCs), both of which are scheduled for phase out under the 1987 Montreal protocol.[790] Sources of fluorinated gases include: industrial and commercial operations including leaks from electronics and metals cleaning and refrigeration systems, heat pumps and air conditioning equipment; semiconductor, magnesium and aluminum manufacturing; and

[786] *Understanding Global Warming Potentials*, U.S. Environmental Protection Agency, https://www.epa.gov/ghgemissions/understanding-global-warming-potentials (last retrieved August 18, 2017).

[787] Michael Aucott et al., *2012 Update to New Jersey's Statewide Greenhouse Gas Emission Inventory*, Rutgers University (2015), http://climatechange.rutgers.edu/docman-list/special-reports/354-2012-update-to-new-jersey-s-statewide-greenhouse-gas-emission-inventory/file.

[788] All GWPs in this section are taken from Intergovernmental Panel on Climate Change. Gunnar Myhre et al., *Anthropogenic and Natural Radiative Forcing*, The Intergovernmental Panel on Climate Change (2013), http://ipcc.ch/pdf/assessment-report/ar5/wg1/WG1AR5_Chapter08_FINAL.pdf.

[789] *Overview of Greenhouse Gases*, U.S. Environmental Protection Agency, https://www.epa.gov/ghgemissions/overview-greenhouse-gases (last retrieved August 18, 2017).

[790] *International Actions - The Montreal Protocol on Substances that Deplete the Ozone Layer*, U.S. Environmental Protection Agency, https://www.epa.gov/ozone-layer-protection/international-actions-montreal-protocol-substances-deplete-ozone-layer (last retrieved August 18, 2017).

insulation in electrical transmission and distribution equipment. 791 In New Jersey, most of the emissions of halogenated gases are associated with their uses in, and releases from, air conditioning and refrigeration systems.792 Sulfur hexafluoride (SF6) is also a halogenated gas but has been treated separately in New Jersey GHG emission inventories due to its specialized uses as an insulating fluid in high voltage electrical equipment. The GWPs for these gases can be in the thousands or tens of thousands as indicated below:

- Sulfur hexafluoride (SF_6): 100-year GWP of 23,500
- Nitrogen trifluoride (NF_3): 100-year GWP of 16,100
- Hydrofluorocarbons (HFCs): 100-year GWP varies considerably between 1 and nearly 2,000
- Perfluorocarbons (PFCs): 100-year GWP varies considerably between <1 and >11,000
- Chlorofluorocarbons (CFCs): 100-year GWP varies between 4660 and 13,900
- Hydrochlorofluorocarbons (HCFCs): 100-year GWP varies between 59 and 1980.

Increases in HFCs, PFCs, and SF_6 and NF_3 emissions have been the fastest growing source of greenhouse gases globally, given their use as a replacement for CFCs and HCFCs.[793] In October 2016, nearly 200 countries adopted an amendment to the Montreal Protocol in Kigali, Rwanda, to globally phase down HFCs not previously covered under the 1987 Montreal Protocol, namely HFCs, PFCs, SF_6 and NF_3. The Kigali amendment will cut production and consumption of these substances by more than 80 percent over the upcoming 30 years. Regulatory action will be necessary in the United States to implement its commitment under Kigali.[794]

Some states have instituted policies to mitigate emissions of highly warming gases. Those policy types include multisector greenhouse gas emission standards, reporting regulations, pollution-specific regulations, and offset programs. Of note is a comprehensive strategy developed by California in 2017 to address highly warming gases which lays out a range of options to accelerate emission reductions including regulations, incentives, and mechanisms to transition markets to other gases. Among other provisions, the California comprehensive strategy includes a 40 percent emissions reduction target from 2013 levels by 2030 for HFCs.[795]

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[791] *Overview of Greenhouse Gases*, U.S. Environmental Protection Agency, https://www.epa.gov/ghgemissions/overview-greenhouse-gases (last retrieved August 18, 2017).

[792] Michael Aucott et al., *2012 Update to New Jersey's Statewide Greenhouse Gas Emission Inventory*, Rutgers University (2015), http://climatechange.rutgers.edu/docman-list/special-reports/354-2012-update-to-new-jersey-s-statewide-greenhouse-gas-emission-inventory/file.

[793] Institute for Governance & Sustainable Development. Primer on HFCs. IGSD Working Paper: 19 May 2017. http://www.igsd.org/wp-content/uploads/2017/05/HFC-Primer-19May2017.pdf

[794] *The Kigali Amendment to the Montreal Protocol: Another Global Commitment to Stop Climate Change*, United Nations Environment Program (December 2016), http://www.unep.org/africa/news/kigali-amendment-montreal-protocol-another-global-commitment-stop-climate-change.

[795] *The Short-Lived Climate Pollutant Reduction Strategy*, California Air Resources Board, https://www.arb.ca.gov/cc/shortlived/shortlived.htm (last retrieved August 18, 2017).

State Policy Model	*Notable Implementations*	*Related New Jersey Actions?*	*Notes*
Multisector greenhouse gas emissions standards that include highly warming gases	WA Clean Air Act, CA Global Warming Solutions Action	No	Not all cap-and-trade programs include highly warming gases under the cap (e.g., RGGI only covers CO_2).
Highly warming gas pollution-specific regulations	MA Global Warming Solutions Act regulations on SF_6 emission from insulated switchgear	No	
Offset programs for highly warming gases	RGGI offset protocol for highly warming gas capture, storage, destruction, and recycling	No	
Reporting regulations	WA, MA, CA	GWRA requires GHG emissions monitoring and biennial reporting and progress tracking	NJ did not adopt the GHG emissions monitoring and reporting regulations required under the GWRA. Reporting regulations are usually a necessary precursor to policies to reduce highly warming gas emissions.
Comprehensive HWG reduction strategy	California has adopted a comprehensive Short Lived Climate Pollutant Reduction Strategy which sets statewide targets of reducing methane and HFCs by 40 percent below 2013 levels by 2030 and reducing anthropogenic black carbon 50 percent below 2013 levels by 2030.		

IV.G.1 Economy-wide, Multisector GHG Emission Standards

In May 2016, Washington State proposed a regulation under the authority of the Washington State Clean Air Act[796] covering all sources of all greenhouse gases, including highly warming gases, that, among other things, requires the state to: establish an output-based baseline emissions value for each regulated entity over a defined threshold, and annually establish greenhouse gas emission pathways for every source of greenhouse gases that meet or exceed a threshold established in the rule and measured in metric tonnes CO_2e/year with 1.7 percent reductions annually.

Under California's multi-sector 2006 Global Warming Solutions Action, the state has promulgated multiple regulations aimed at curtailing production, use and release of highly warming gases, including regulatory measures that limit the use of highly warming gases in consumer products and in new motor

[796] 173-442 Washington Administrative Code

vehicle air conditioning systems, and that establish mandatory refrigerant management programs and commercial refrigeration specifications.[797]

Further discussion of the California and Washington State economy-wide programs are included in section IV.B.

IV.G.2 Reporting Regulations

Several states have implemented greenhouse gas reporting rules that include reporting annual emissions of all GHGs, including highly warming gases. These include the Washington State Clean Air Reporting Rule[798] and the Massachusetts Global Warming Solutions Act, which required establishment of a mandatory reporting system for all greenhouse gas emissions by Massachusetts' largest sources by January 1, 2009.[799] As mentioned previously, under the 2007 GWRA, New Jersey has the authority to establish rules for a greenhouse gas emissions monitoring and reporting program (which would have included highly warming gases) but NJDEP has not done so.

IV.G.3 Pollutant-Specific Regulations

California and Massachusetts use their state climate change authority to regulate SF_6 from gas insulated switchgear. In 2011, California became the first state to enact mandatory reductions in SF_6 emissions, including in gas-insulated electrical switchgear.[800] The regulations, which cover 80 percent of sources of SF_6 in California, establish an annual maximum emission rate, set initially at 10 percent of nameplate capacity, require sources to reduce SF_6 emissions rates by 1 percent annually until 2020 and, beginning in 2020, set a maximum emission rate not to exceed 1 percent, as well as establish a mandatory reporting program. In Massachusetts, the state proposed new regulations in 2016 to regulate SF_6 emissions from gas-insulated switchgear and took public comment until February 2017. The rules were proposed under Section 3(d) of the Global Warming Solutions Act (310 CMR 7.72). Generally modeled on the California rule, if adopted, the Massachusetts regulations would cover all electrical power system equipment insulated with SF_6 gas. The proposed rule would require new SF_6-containing switchgears to meet a 1.0 percent maximum annual leak rate, establish a Maximum Allowable SF_6 Emission Rate for existing SF_6 switchgear, and establish a reporting program.[801]

California also regulates SF_6 in semiconductor manufacturing and use as a tracer gas. For semiconductor manufacturing, the California Code of Regulations, under Title 17, section 95324(a), requires sources to

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[797] AB32 Scoping Plan; First Update, Appendix B. March 14, 2014. California Air Resources Board. https://www.arb.ca.gov/cc/scopingplan/document/updatedscopingplan2013.htm

[798] Chapter 173-441 Washington Administrative Code, adopted September 2016 http://www.ecy.wa.gov/programs/air/rules/wac173442/1510docs.html

[799] Massachusetts Executive Office of Energy and Environmental Affairs. Global Warming Solutions Act Background. http://www.mass.gov/eea/air-water-dimate-change/climate-change/massachusetts-global-warming-solutions-act/global-warming-solutions-act-background.html

[800] *SF_6 Reductions from Non-Electric and Non-Semiconductor Applications*, California Air Resources Board https://www.arb.ca.gov/cc/sf6nonelec/sf6nonelec.htm (last retrieved August 18, 2017).

[801] *Reducing Sulfur Hexafluoride Emissions from Gas-Insulated Switchgear*, Massachusetts Executive Office of Energy and Environmental Affairs, http://www.mass.gov/eea/agencies/massdep/climate-energy/climate/ghg/reducing-sf6-emissions.html (last retrieved August 18, 2017).

submit an initial emissions report which quantifies monthly and annual emissions from semiconductor operations. As of 2013, California bans the use of SF_6 for tracer gas testing, magnesium sand casting, magnesium investment casting, and most military applications, without a valid exemption from the state.

IV.G.4 Offset Programs

The two cap-and-trade programs in the U.S. (RGGI and California) offer offset provisions related to highly warming gases. Among the five categories of offsets under RGGI, there is allowance for reduction of emissions of SF_6 in the electric power sector through capture and storage, recycling, or destruction. To qualify for the offsets, the utility using SF_6 must demonstrate a performance standard less than current state regulations.[802] The California multisector cap-and-trade program includes an offset provision for Ozone Depleting Substances (ODS). To qualify, projects must result in quantifiable emissions reductions associated with destruction of high GWP ODS; the sources and destruction of which occur in the U.S. The provisions include ODS used in foam blowing agent and refrigerant applications.[803]

IV.G.5. Comprehensive Pollutant Reduction Planning

Senate Bill 605 (Lara, Chapter 523, Statutes of 2014) requires the California Air Resources Board to develop a plan to reduce emissions of Short Lived Climate Pollutants (SLCPs), and Senate Bill 1383 (Lara, Chapter 395, Statutes of 2016) requires the Board to approve and begin implementing the plan by January 1, 2018. SB 1383 also sets targets for statewide reductions in SLCP emissions of 40 percent below 2013 levels by 2030 for methane and HFCs and 50 percent below 2013 levels by 2030 for anthropogenic black carbon. Additionally, it provides specific direction for reductions from dairy and livestock operations and from landfills by diverting organic materials. In March 2017, California issued its Short Lived Climate Pollutant Reduction Strategy, which sets a course for future short-term anticipated action in California on HFCs including establishment of a financial incentive program to promote early adoption of actions to reduce highly warming gases in refrigeration prior to their regulatory mandates taking effect, prohibition on sales of high global warming potential refrigerants, and a prohibition on new equipment with high global warming potential refrigerants.[804]

IV.H. Forestry Practices

Carbon sequestration is the process by which forests and other systems remove CO_2 from the atmosphere and store it. Natural systems that serve as carbon "sinks" by sequestering CO_2 include trees and coastal wetlands.[805] Restoration and stewardship of these natural systems provide opportunities to reduce overall greenhouse gas emissions. Various forest practices can be implemented for carbon sequestration and

[802] Offset Categories, Regional Greenhouse Gas Initiative, https://www.rggi.org/market/offsets/categories (last retrieved August 18, 2017).
[803] *Compliance Offset Protocol Ozone Depleting Substances (ODS) Projects*, California Air Resources Board https://www.arb.ca.gov/cc/capandtrade/protocols/ods/ods.htm (last retrieved August 18, 2017).
[804] *Short Lived Climate Pollutant Reduction Strategy*, California Air Resources Board (March 2017), https://www.arb.ca.gov/cc/cc.htm.
[805] *Carbon Sequestration 101*, National Oceanic and Atmospheric Administration, http://www.habitat.noaa.gov/coastalcarbonsequestration.html (last retrieved August 18, 2017).

reducing greenhouse gas emissions from land conversion. These can include afforestation (conversion of land from a non-forested to forested condition); reforestation (restoring tree cover on land that has no or minimal tree cover); improving forest management to increase carbon stocks on forested land; avoiding conversion of forest land to a non-forest land, and by reducing forest fire risk. In addition, better forestry practices can be used to avoid greenhouse gas emissions through reduced land and forest disturbance. According to the US Forest Service, U.S. forests serve as carbon sinks offsetting approximately 13 percent of U.S. fossil fuel emissions in 2011 and from 10 to 20 percent of U.S. emissions annually.[806] The 2015 New Jersey Greenhouse Gas Inventory indicates that 7.6 percent of New Jersey's total greenhouse gas emissions are sequestered terestially each year.[807] In general, states, including New Jersey, maintain programs that are designed to restore and steward natural resources such as New Jersey's Green Acres and Community Forestry programs but there are limited programs in which policies to create and/or steward natural carbon sinks are specifically established with a nexus to GHG emissions reduction.[808] Development of policies to promote carbon sequestration through creation and stewardship of natural resources is an active area of research and policy interest in many states.[809]

State Policy Model	*Notable Implementations*	*Related New Jersey Actions?*	*Notes*
Financial incentives	WA's Wildlife and Recreation Program funds forest land conservation and restoration.	NJ Global Warming Solutions Fund Act provides statutory funding provisions for forest and tidal marsh restoration.	Washington's program is based on the amount of carbon stored by forest trees.
Forestry offsets	CA's Cap-and-Trade program. RGGI has a forestry offset protocol, but has not been used.	No	Forestry offsets under RGGI have not been used due to low allowance prices; a higher offset price is available by selling into the California market
State Environmental Quality Review for forests	MA Global Warming Solutions Act requires that projects that result in extensive land alteration or forest clearing to plant new trees.	No	New Jersey Department of Environmental Protection's NJDEP permit readiness checklist used to implement NJ Executive Order 215 addresses impacts to over ½ acre or more of forested lands owned or maintained by a state entity but does not address GHG impacts.

[806] Forests and Carbon Storage, U.S. Forest Service, https://www.nrs.fs.fed.us/niacs/carbon/forests/ (last retrieved August 18, 2017).

[807] Michael Aucott et al., *2012 Update to New Jersey's Statewide Greenhouse Gas Emission Inventory*, Rutgers University (2015), http://climatechange.rutgers.edu/docman-list/special-reports/354-2012-update-to-new-jersey-s-statewide-greenhouse-gas-emission-inventory/file.

[808] Green Acres Program, New Jersey Department of Environmental Protection. http://www.nj.gov/dep/greenacres/index.html and Community Forestry Program, New Jersey Department of Environmental Protection http://www.state.nj.us/dep/parksandforests/forest/community/ (last retreived August 30, 2017).

[809] *Personal communication with Jad Daley, American Forests* (June 1, 2017).

IV.H.1 Offsets

Forestry offsets are allowed in RGGI and California's market-based cap-and-trade programs. Cap-and-trade programs are explained in Section IV.B., and their forestry offset provisions are explained below.

RGGI CO_2 offset allowances may be used to satisfy up to 3.3 percent of a regulated source's compliance obligation during each control period. Among other categories, RGGI allows offsets that result in sequestration of carbon due to forest projects located in the United States, including reforestation, improved forest management, avoided conversion, and afforestation (afforestation is eligible for CT and NY only). No RGGI state has issued offset allowances of any kind as allowance prices in California are higher than in the RGGI region, and therefore offset-eligible projects seek to generate offset credits in the California market instead of the RGGI market.[810]

Under California's economy-wide cap-and-trade program, regulated entities may purchase offsets for up to 8 percent of their compliance requirements with offset projects being allowed in the lower 48 states. Examples of forestry-related offsets projects include the Willits Woods project and the Farm Cove Improved Forest Management Project. The Willits Woods project in northern California was the first approved forestry project covering 19,000 acres of land, providing 1.2 million carbon offset credits. The Farm Cove project in Maine also covers about 19,000 acres with 242,000 carbon offsets.[811]

In 1997, the Oregon Legislature adopted a law (HB 3283) requiring new power plants built in Oregon to reduce or offset 17 percent of CO_2 emissions in one of three ways: direct emissions reductions on-site, directly funding pollution reduction projects, and funding a state-recognized 501(c)(3) nonprofit corporation, the Oregon Climate Trust, which would be responsible for selecting and managing pollution reduction projects on behalf of the utility.[812] Eligible projects are those that directly reduce CO_2 emissions and are undertaken in the United States. To date, all regulated utilities have chosen the third option, directing funds to the Oregon Climate Trust, to meet their compliance obligation. Since its inception, the Trust has committed to purchase more than $34 million in projects reducing 3 million metric tons of greenhouse gas emissions. The Trust has developed methods to quantify, verify and register many types of offset projects including offsets associated with avoided grasslands conversion, wetlands restoration, forest-related practices, sustainable agriculture, renewable energy and energy efficiency and biogas. The Trust is also responsible for administering a voluntary Colorado offsets program and has begun to support special-purpose offset programs in Washington and California.[813]

IV.H.2 State Environmental Quality Reviews

State environmental quality review laws provide broad authorization for the consideration of environmental impacts of large-scale projects. Some states are beginning to use these authorities to

[810] *Personal communication with Joseph Fontaine*, New Hampshire Department of Environmental Services (May 17, 2017).

[811] Kelly Hamrick, California Issues First Forest Carbon Offsets, Ecosystem Marketplace (November 18, 2013), http://www.ecosystemmarketplace.com/articles/california-issues-first-forest-carbon-offsets/.

[812] H.B. 3283, 77th Leg. Assemb., Reg. Sess. (Or. 1997).

[813] *History of the Climate Trust*, The Climate Trust, https://climatetrust.org/about/history/ (last retrieved June 7, 2017).

address impacts on greenhouse gas emissions and carbon sequestration potential, for example, as a result of forest disturbance.

In March 2010, California amended its guidelines for implementation of the California Environmental Quality Act (CEQA) to, among other things, require lead state agencies to analyze greenhouse gas emissions of proposed projects regulated under CEQA, consider a range of potential mitigation options when emissions are determined to be significant, and develop programmatic project-based greenhouse gas emission reduction plans as appropriate.[814]

The Massachusetts Global Warming Solutions Act amended the state's Environmental Policy Act (MEPA) to establish a MEPA GHG protocol. The amendment stipulates that the respective state agency will consider reasonably foreseeable climate change impacts, including greenhouse gas emissions, when reviewing permits licenses and other approvals regulated under MEPA. The resultant regulations implementing the statutory amendments to the MEPA program rules were revised to incorporate provisions about climate change, including a provision that expands the authority to projects that may involve unusually large amounts of land alteration or clearing and forest conversion and, in those cases, to require new tree planting.[815]

New Jersey's Executive Order 215 requires an environmental assessment or impact statement of major state-funded construction projects (over $1 million) including a review by the New Jersey Department of Environmental Protection (NJDEP); NJDEP's permit readiness checklist includes whether a project will impact one-half an acre or more of forested lands owned or maintained by a state entity but does not specifically address GHG impacts. [816]

IV.H.3 Financial and Other Incentives

Objectives tied to carbon sequestration can be reached through financial and other incentives that support forest stewardship and afforestation as well as investment in forest-related practices. For example, states might elect to use revenue from the sale of carbon allowances or from a carbon tax to fund initiatives designed to maximize and measure carbon sequestration through afforestation, reforestation, avoided conversion, or other types of forest management.

The California Greenhouse Gas Reduction Fund (GGRF) was established by statute in 2012 to deposit and distribute proceeds from cap-and-trade auction allowances. To date, $49 million has been invested in the Forest Health Program that includes stewardship, reforestation and fire risk reduction. An additional $33 million has been invested in urban and community forestry that includes planting and maintaining trees in disadvantaged communities.[817] Several RGGI states, such as Massachusetts and Delaware, have broad

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[814] *CEQA and Climate Change*, California Governor's Office of Planning & Research, https://www.opr.ca.gov/s_ceqaanddimatechange.php (last retrieved August 18, 2017).

[815] *Greenhouse Gas Emissions Policy and Protocol Resources*, Massachusetts Executive Office of Energy and Environmental Affairs, http://www.mass.gov/eea/agencies/mepa/greenhouse-gas-emissions-policy-and-protocol-generic.html (last retrieved August 18, 2017).

[816] State of New Jersey Executive Order 215, http://www.nj.gov/infobank/circular/eok215.htm (last retrieved July 14, 2017); State of New Jersey Department of Environmental Protection, Office of Permit Coordination and Environmental Review, Permit Readiness Checklist, http://www.nj.gov/dep/pcer/introcklist.htm (last retrieved July 14, 2017).

[817] *Auction Proceeds Funded Programs and Events*, California Air Resources Board https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/ggrfprogrampage.htm (last retrieved August 18, 2017).

statutory authorization to expend auction proceeds on initiatives that result in verifiable and quantifiable reductions in carbon emissions under which forestry-related practices could be applied; however, no examples of this authority being used to invest RGGI proceeds in forestry-related practices have been identified.[818]

Washington State's Wildlife and Recreation Program has adopted a forestland preservation grant fund, which provides funding for forest projects, including land acquisition and enhancement and restoration initiatives. Local governments and nonprofit conservation organizations are eligible to apply for grants of up to $350,000 to address a variety of purposes including projects that meet a criterion that involves demonstrating benefits from the amount of carbon stored in trees and understory plants. Authorized under the Revised Code of Washington (79A.15.130) and funded by general appropriations, the program is in its first round of accepting applications.[819]

Starting in 2015, Massachusetts launched the Greening the Gateway Cities (GGC) urban tree planting program. The funding for this program is a mixture of the state Department of Energy Resources' Alternative Compliance Fund and the state capital and operating funds. Eight million dollars per year is expected to be invested in urban tree planting with a projection of 57,000 acres planted by 2026. Based on these estimates, it is expected that the program will yield a reduction of 473,600 metric tons of CO_2e per year by 2050.[820]

As previously noted, New Jersey has statutory authority to fund programs that enhance the stewardship and restoration of the state's forests and tidal marshes that "provide important opportunities to sequester" or reduce GHGs through the GWSF.

IV.I Incorporating Equity into State Climate Actions and Addressing Needs of Vulnerable Populations

Vulnerable groups of people may include low-income communities, communities of color, immigrant groups, populations with limited English proficiency, indigenous people, children and pregnant women, older adults, vulnerable occupational groups, people with disabilities, people with chronic medical conditions. Multiple factors can contribute to a population's ability to prepare for, respond to, and adapt to changing climate conditions. These factors, for people of color, low-income communities, immigrants, and people for whom English is a second language, can include:

- living in areas particularly vulnerable to climate change (for example, along the coast);
- suffering from greater levels of existing health risks when compared to other groups;
- living in low-income communities with limited access to healthcare services;

[818] *State Investment Pages*, Regional Greenhouse Gas Initiative, http://rggi.org/rggi_benefits/program_investments (last retrieved August 18, 2017).
[819] *Forestland Conservation*, Washington State Recreation and Conservation Office, http://www.rco.wa.gov/grants/ForestlandConservation.shtml (last retrieved August 18, 2017).
[820] Secretary of Environmental and Energy Affairs, Massachusetts Clean Energy and Climate Plan for 2020; 2015 Update (December 31, 2015), http://www.mass.gov/eea/docs/eea/energy/cecp-for-2020.pdf.

- having high rates of uninsured individuals who have difficulty accessing quality healthcare;
- having limited availability of information and resources in a person's native language; and
- having less ability to relocate or rebuild after a disaster.[821]

A study to identify the characteristics and geographic concentrations of populations that are particularly vulnerable to climate change in New Jersey was conducted in the fall of 2013. The study identified characteristics of socially vulnerable groups using the Social Vulnerability Index (SoVI) method.[822] The significant factors and unique vulnerability variables involved in the social vulnerability analysis have been categorized as family structure, race, and socioeconomic status; linguistic isolation, ethnicity, and population density; age; percentage of the population living in nursing and skilled-nursing facilities; and percentage of mobile homes. Using exposure to the 100-year floodplain as an indicator of flood risk, the analysis found that almost 70 percent of the most socially vulnerable populations in New Jersey are in census tracts that lie within the 100-yr floodplain representing a population of over 675,000 persons.[823]

The SoVI method identifies *populations* that are particularly vulnerable to climate change. Other research points to *communities* that may bear a greater burden of climate change impacts. In 2015, the US EPA issued a report in which it conducted a proximity analysis to assess demographic information in proximity of facilities that would have been regulated by the proposed Clean Power Plan. EPA found that a higher percentage of minority and low-income communities live near power plants than national averages.[824] The National Climate Assessment concluded that climate change threatens urban residents throughout the United States by compromising essential infrastructure such as water, energy supply, and transportation and that "climate vulnerability and adaptive capacity of urban residents and communities are influenced by pronounced social inequalities that reflect age, ethnicity, gender, income, health, and (dis)ability differences."[825]

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[821] A. Crimmins et al., *USGCRP, 2016: The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment*, U.S. Global Change Research Program (2016), http://dx.doi.org/10.7930/J0R49NQX.

[822] Kelly M. Bickers et al., Vulnerable Populations to Climate Change In New Jersey, Edward J. Bloustein School of Planning and Public Policy, Rutgers (February 2014), http://njadapt.rutgers.edu/docman-lister/conference-materials/151-rutgers-lib-44085-pdf-1/file; Kelly M. Pflicke et al., *Populations Vulnerable to Climate Change in New Jersey: Update of a Statistical Analysis*, Rutgers University (2015), http://njadapt.rutgers.edu/docman-lister/conference-materials/132-populations-vulnerable-to-climate-change-report/file.

[823] Kelly M. Pflicke et al., *Populations Vulnerable to Climate Change in New Jersey: Update of a Statistical Analysis*, Rutgers University (2015), http://njadapt.rutgers.edu/docman-lister/conference-materials/132-populations-vulnerable-to-climate-change-report/file.

[824] *EJ Screening Report for the Clean Power Plan*, U.S. Environmental Protection Agency (2015), https://archive.epa.gov/epa/cleanpowerplan/ej-screening-report-clean-power-plan.html.

[825] Jerry M. Melillo et al., *2014: Climate Change Impacts in the United States: The Third National Climate Assessment*, U.S. Global Change Research Program, doi:10.7930/J0Z31WJ2.

In addition to factors that influence social vulnerability, many states are now considering Environmental Justice-related issues as part of development of climate change policy. In September 2013, more than 70 people participated in a day-long roundtable workshop hosted by the New Jersey Climate Adaptation Alliance in partnership with the New Jersey Environmental Justice Alliance. Through presentations and deliberations among the participants, the participants pointed to the following findings regarding the intersection of climate change and environmental justice in New Jersey:

1. EJ communities are especially vulnerable to the detrimental impacts of climate change and protecting these communities should be a societal priority.
2. If society does not begin to significantly mitigate climate change, humanity will not be able to adequately protect itself through adaptation.
3. Major impacts from Hurricane Sandy included loss of power; damage to homes and cars; fallen trees; disrupted transportation; disrupted means of communication; higher rents and limited housing availability leading to displacement; and problems reaching and delivering information to seniors, especially those living in high-rise buildings.
4. A major problem with the response to Sandy was a lack of communication and information generally that included inadequate information in Spanish and about possible toxic contamination. Obtaining government assistance after the storm also proved to be difficult due in significant part to documentation requirements that seemed excessive and inflexible.
5. Climate change impacts that significantly affect EJ communities and need to be addressed include extreme weather events; air quality; food security and justice; storm surge and associated toxins and health impacts; increases in temperature and associated heat stress and disease; increases in mold; and housing and other issues associated with extreme weather events.
6. Community-level and community-specific emergency plans and climate change adaptation and preparedness plans are needed for EJ communities. Community residents, community organizations and other non-profit organizations should receive resources to ensure their effective participation in the creation and implementation of these plans. Government should help by creating the structure and resources to ensure the development of these plans and the effective involvement of community residents, community groups and other non-profits in their development and implementation. These plans should address the climate change impacts detailed above and should be reviewed on a regular basis.
7. The emergency plans need to be practiced well before the occurrence of a storm to ensure the community is prepared when a storm does occur.
8. Air pollution needs to be addressed through tighter enforcement and public policies that include using climate change policy to address toxic air pollution.
9. Climate change and climate justice education need to be instituted in schools and at a community level.
10. The use of energy efficiency and renewable energy should be increased and community controlled energy systems should be created.

11. Local resilient food systems should be created to address the insufficient availability of fresh healthy food in some communities. Local gardens should be part of these food systems.
12. Green infrastructure should be used to address the heat island effect, air pollution and storm surge.[826]

The national Environmental Justice Leadership Forum on Climate Change adopted a set of ten principles to guide development of climate change policy which are summarized below:[827]

- Establish a zero carbon economy by reducing GHG emissions in accordance with current science and through mechanisms that are transparent and publicly controlled, that generate revenue and are demonstrated to improve environmental quality;
- Protect all Americans and communities equally from the impacts of climate change and ensure that efforts to mitigate GHG emissions do not violate human rights;
- Ensure that GHG mitigation strategies do not further exacerbate existing health disparities including preventing new and eliminating existing pollution hotspots in vulnerable communities, and reducing other non-GHG pollutants near communities already burdened with environmental pollution;
- Require that costs associated with controlling GHG emissions and climate change impacts are borne by sources of greenhouse gases and that the full costs of climate change is factored into policies that impose costs;
- Establish a national goal to transition to a renewable energy economy by 2020;
- Position the public sector to drive the renewable energy economic transition;
- Create clean energy workforce development opportunities for all Americans, especially populations disproportionately burdened by climate change;
- Create an economic safety net for vulnerable populations that may be disadvantaged in a transition to a clean energy economy;
- Ensure that a clean energy economy establishes sufficient employment and retraining opportunities for people that have been historically under- or unemployed;
- Ensure that populations disproportionately affected by climate change have full opportunity to share in the development of climate change policy.

Addressing environmental justice issues in the context of climate change mitigation is a relatively new area; members of the EJ community ascribe to the premise that EJ and equity should be an integral part of climate change policy and have advocated for mandated emissions reductions and prioritized use of energy efficiency and renewable energy in EJ communities.[828] In an effort to assess benefits and impacts to disadvantaged communities, from implementation of California's cap-and-trade program pursuant to

[826] Nicky Sheats et al., *Stakeholder Engagement Report: Environmental Justice. Climate Change Preparedness in New Jersey*, New Jersey Climate Adaptation Alliance (NJCAA) (2014).
[827] *EJ Forum Principles of Climate Justice- Environmental Justice*, EJ Leadership Forum, http://www.ejleadershipforum.org/ej-forum-principles-of-climate-change/ (last retrieved August 18, 2017).
[828] Nicky Sheats, *Achieving Emissions Reductions for Environmental Justice Communities Through Climate Change Mitigation Policy*, 41 Wm. & Mary Envtl. L. & Pol'y Rev. 377 (2017), http://scholarship.law.wm.edu/wmelpr/vol41/iss2/3.

California's SB 535 law, the California Office of Environmental Health Hazard Assessment (OEHHA) examined changes in emissions of GHGs, toxic air contaminants and criteria air pollutants resulting from the initial implementation of its comprehensive climate change legislation (AB 32). In general, the California OEHHA found that:

- A disproportionate number of facilities subject to the Cap-and-Trade Program are located in disadvantaged communities.
- There were moderate correlations between GHG emissions and the emissions of criteria air pollutants. The strongest correlation was with fine particulate matter emissions (PM2.5).
- As part of a more detailed case study of 9 cement plants and 19 refineries, OEHHA found that several cement facilities showed modest positive correlations between GHG and toxicity-weighted emissions, while two cement facilities showed poorer correlations. For refineries, there generally was a positive correlation between GHG and toxicity-weighted air emissions. Facilities with high levels of GHG emissions generally had higher PM2.5 and toxicity-weighted emissions.

Overall, OEHHA found that the relationship between GHGs and other pollutant emissions is complex. GHG facilities that emit higher levels of GHGs tend to have higher emissions of toxic air contaminants and criteria air pollutants. The agency concluded that there is a need for additional investigation into the factors that drive emission changes, how GHG emission reductions are likely to be achieved in different industrial sectors, and what that may mean for concomitant changes in emissions of toxic air pollutants. OEHHA concluded that the initial analysis suggests that "reductions in greenhouse gas emissions are likely to result in lower pollutant exposures in disadvantaged communities, based overall on the positive correlations observed for the 2014 data."[829]

There are examples of federal and state action that can inform state efforts in this area. These include establishing environmental justice policies that apply to climate actions, establishing advisory groups, identifying EJ communities, designing and implementing inclusive public processes, implementing programs designed to promote equitable benefits of clean energy and climate actions, and implementing programs designed to mitigate potential disparate impacts of climate actions as well as to ensure that benefits of climate change policies occur in communities disproportionately burdened by pollution.

New Jersey Governor James McGreevey issued an executive order relating to environment justice issues in 2004.[830] That order was supplanted by a 2009 executive order issued by Governor Jon Corzine which directed state agencies and other entities "involved in decisions that affect environmental quality and public health" to "provide appropriate opportunities for all persons, regardless of race, ethnicity, color, religion, income, or education level to participate in decision-making."[831] It also directed that "programs to promote and protect human health and the environment shall be reviewed periodically to ensure that they: (a) meet the needs of persons living in low-income communities and communities of color; and (b)

[829] *Tracking and Evaluation of Benefits and Impacts of Greenhouse Gas Limits in Disadvantaged Communities: Initial Report*, California Office of Environmental Health Hazard Assessment (OEHHA) (February 2017), https://oehha.ca.gov/media/downloads/environmental-justice/report/oehhaab32report020217.pdf.

[830] Gov. James McGreevey Exec. Order No. 96 (Feb. 18, 2004), http://nj.gov/infobank/circular/eom96.htm.

[831] Gov. Jon Corzine Exec. Order No. 131 (Sept. 9, 2010), http://nj.gov/infobank/circular/eojsc131.htm.

address disproportionate exposure to environmental hazards."[832] The executive order also created an Environmental Justice Advisory Council ("Advisory Council") in the Department of Environmental Protection "charged with making recommendations from time to time … about issues involving environmental justice in this State."[833] The executive order has not been rescinded,[834] but the Advisory Council's charge expired on December 31, 2015.[835] The council has continued to meet as an internal advisory group to NJDEP.[836]

[832] *Id.*

[833] *Id.*

[834] Search of rescicions among New Jersey Executive Orders. *Executive Orders*, Nerw Jersey, http://nj.gov/infobank/circular/eoindex.htm (last retrieved August 18, 2017).

[835] *Id.*; Gov. Jon Corzine Exec. Order No. 131 (Sept. 9, 2010), http://nj.gov/infobank/circular/eojsc131.htm.

[836] *Email correspondence with Ana I. Baptista*, Assistant Professor, The New School. (June 6, 2017).

State Policy Model	Notable Implementations	Related New Jersey Actions?	Notes
State environmental justice (EJ) policy, advisory council plan	MN, NY, CA have policies and advisory councils MN developed an environmental justice framework for 2015-2018	2009 NJ Exec. Order No. 131 (not rescinded) EO created Environmental Justice Advisory Council (EJAC)	EO required "appropriate opportunities" for input on decision making for all people; directed periodic EJ reviews of policies EJAC now meeting as NJDEP internal advisory council after charge in EO expired
Identify or define environmental justice communities	CA CalEnviroScreen 3.0 uses 20 indicators to identify census tracts most impacted based on pollution burden and population characteristics to inform delivery of climate change policies.		In 2009, the NJDEP developed an analytical methodology to determine communities disproportionately burdened by pollution but the methodology was not adopted.
Programs designed to promote equitable benefits of clean energy and climate actions	California law requires that a minimum of 25 percent of the proceeds from its cap-and-trade program be invested in projects that are located within and benefiting individuals living in disadvantaged communities; an additional 5 percent of funds benefit low-income households or communities statewide; and an additional 5 percent benefit low-income households or communities that are within a 1/2 mile of a disadvantaged community.		
Programs designed to mitigate potential disparate impacts of climate actions.	CA's AB 617 requires the California Air Resources Board to work with local air districts on the development of community-focused air quality monitoring networks, including plans to reduce emissions from stationary and mobile sources in neighborhoods with existing air quality burdens. It also requires large industrial facilities in communities with significant existing air quality burdens to upgrade equipment to reduce emissions.		

IV.I.1 Background: Federal Action

In 1994, President Bill Clinton issued Executive Order (E.O.) 12898, "Federal Actions to Ensure Environmental Justice in Minority Populations and Low-Income Populations." This was the first major federal action on environmental justice in the United States. E.O. 12898 mandated that "each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies and activities on minority populations and low-income populations."[837]

In 2010, the Obama Administration launched a major new environmental justice initiative[838] that led to the adoption of a charter and signed a Memorandum of Understanding (MOU).[839] The MOU served as a formal agreement among federal agencies to recommit to addressing EJ through a more collaborative, comprehensive and efficient process. During a 2014 revision of the charter, "Impacts from Climate Change" became a focus area.[840]

The EPA also developed EJ "action agendas" that lay out strategic plans for implementing the agencies' EJ goals for upcoming years. In October 2016, the EPA released the EJ 2020 action agenda, the U.S. Environmental Protection Agency's strategic plan for environmental justice for 2016-2020. The goals for EJ 2020 include:

- Deepening environmental justice practice within EPA programs to improve the health and environment of overburdened communities, focusing on rulemaking, permitting, compliance and enforcement, and science; and
- Working with partners to expand positive impact within overburdened communities, with a focus that includes states and local Governments and community-based work.

IV.I.2 Examples of State Strategies to Address Equity Issues

State Executive Orders, Goals, Plans, and Advisory Groups

Similar to the federal executive order, now all 50 states have some kind of formal commitment to address environmental justice.[841] Recently, several states have developed environmental justice implementation plans, often developed with input from EJ advisory groups. For example, Minnesota recently completed a 2015-2018 Environmental Justice Framework.[842] Other prominent plans include New York's and California's policies on environmental justice.[843] As described above, New Jersey has an executive order

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[837] Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, http://www.archives.gov/federal-register/executive-orders/pdf/12898.pdf.

[838] *Federal Interagency Working Group on Environmental Justice (EJ IWG)*, U.S. Environmental Protection Agency, https://www.epa.gov/environmentaljustice/federal-interagency-working-group-environmental-justice-ej-iwg (last retrieved August 18, 2017).

[839] *Id.*

[840] *Id.*

[841] *See* U.C. Hastings Center for State and Local Government Law, Environmental Justice for All: A Fifty State Survey of Legislation, Policies and Cases (2010), https://gov.uchastings.edu/public-law/docs/ejreport-fourthedition1.pdf.

[842] Ned Brooks & Karen Solas, *Environmental Justice Framework 2015-2018*, Minnesota Pollution Control Agency (December 17, 2015), https://www.pca.state.mn.us/sites/default/files/p-gen5-05.pdf.

[843] *Environmental Justice*, New York State Department of Environmental Protection, http://www.dec.ny.gov/public/333.html (last retrieved August 18, 2017).

directing state agencies to provide appropriate opportunities to participate in decision-making for all groups and to periodically review environmental justice and public health programs to assess environmental justice impacts.

Approaches to identifying/defining EJ communities

One frequent challenge posed in environmental justice analysis is how to identify EJ communities. Many states have definitions of EJ communities, which typically specify demographic factors that should be taken into account when identifying communities disparately affected by pollution or benefits of environmental programs. The federal government and a number of states are experimenting with quantitative tools to identify EJ communities and disparate impacts. For example, California has developed CalEnviroScreen 3.0, an online mapping tool that uses 20 indicators to quantify pollution and population vulnerability for each of the 8,000 census tracts. The indicators fall into 2 groups: population characteristics (e.g., rates of asthma, cardiovascular disease, housing burden, unemployment) and pollution burden (e.g., ozone, particular matter, traffic density).[844] In October 2014, CalEPA designated the census tracts with the top 25 percent of CalEnviroScreen scores as disadvantaged communities.[845] The federal EPA has similarly developed an online tool, EJ Screen, that can be used to map pollution impacts and demographic characteristics of different communities.[846] New Jersey does not specifically identify or define EJ communities.

Designing inclusive public processes

A key element of addressing environmental justice issues in state climate action is to design inclusive public processes. Important public engagement practices identified by states in this area include holding public meetings on nights and weekends; providing interpreters; investing in a sustained, broad-based engagement process with transparency, milestones, and reports on progress; developing meeting agendas that provide time for community members to identify issues of importance to them and issue-spot; and developing accessible background materials and presentations.[847] One public process that has been noted as a good model of a sustained public engagement process is South Carolina's engagement with EJ communities on energy issues.[848]

Programs designed to promote equitable benefits of clean energy and climate actions.

California has designed climate and clean energy programs that specifically aim to provide benefits to disadvantaged communities. In 2012 California enacted SB 535[849] which required that a minimum of 25 percent of the total investments from the statewide cap-and-trade program revenues are required to benefit disadvantaged communities; of that, a minimum of 10 percent were required to be located within

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[844] Population characteristics including sensitivity to pollution and socioeconomic factors; pollution burden includes exposure to pollutants and environmental effects indicators. *CalEnviroScreen 3.0: Update to the California Communities Environmental Health Screening Tool*, California Environmental Protection Agency and Office of Environmental Health Hazard Assessment (2017), https://oehha.ca.gov/media/downloads/calenviroscreen/report/ces3report.pdf.

[845] California Environmental Protection Agency, Designation Of Disadvantaged Communities Pursuant To Senate Bill 535 (De León) 14 (2014).

[846] *What is EJSCREEN?*, U.S. Environmental Protection Agency (June 9, 2015), https://www.epa.gov/ejscreen/what-ejscreen.

[847] These public engagement practices were identified through a workshop on equity issues in climate adaptation policy held by the Georgetown Climate Center. Georgetown Climate Center, Opportunities for Equitable Adaptation in Cities: A Workshop Summary Report (2017), http://www.georgetownclimate.org/reports/opportunities-for-equitable-adaptation-in-cities.html.

[848] *Environmental Justice*, South Carolina Department of Health and Environmental Control, http://www.scdhec.gov/environment/environmentaljustice/ (last retrieved August 18, 2017).

[849] S.B. 535, 2011-2012 leg. Session (Ca. 2012).

and provide benefits to those communities.[850] In September 2016, the Legislature passed and the Governor signed AB 1550, which modifies the SB 535 disadvantaged community investment minimums.[851] AB 1550 requires that a minimum of 25 percent of the proceeds be invested in projects that are located within and benefiting individuals living in disadvantaged communities; it requires an additional minimum of 5 percent of funds be invested in projects that benefit low-income households or communities statewide; and that an additional 5 percent be invested in projects that benefit low-income households or communities that are within a 1/2 mile of a disadvantaged community. Administering agencies are in the process of transitioning to full implementation of AB 1550 as part of FY 2017-18 funded programs. In July 2017, California approved two additional laws related to its statewide cap-and-trade program. AB 398[852] authorizes California's cap-and-trade program beyond 2020 and AB 617[853] institutes a program to address emissons and air quality in local communities.[854]

In July 2017, California established the California Climate Investments initiative to manage spending of the proceeds from the state cap-and-trade program pursuant to authorizing laws. CCI will manage spending of proceeds including those in disadvantaged and low-income communities, investment in affordable housing, renewable energy, public transportation, zero-emission vehicles, environmental restoration, sustainable agriculture, and recycling.[855]

Among the programs that California has previously used to direct funds into disadvantaged communities is the low-income weatherization program (LIWP). The program not only requires that 100 percent of received funds benefit disadvantaged communities,[856] but also enables cost-effective energy efficiency (weatherization) measures and solar photovoltaics to help qualifying low-income households reduce energy use and GHG emissions. California also had used a suite of transportation investments designed to benefit low-income residents and disadvantaged communities, including a Clean Vehicle Rebate Project with a level of benefit based on residents' income;[857] a "cash-for-clunkers" program that provides incentives to low-income residents for the replacement of old, inefficient vehicles;858 a public fleets program that provides incentives to local governments in disadvantaged communities to purchase new, clean fleet vehicles;[859] and car sharing and shared mobility pilot project programs.[860]

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[850] Cal. Health & Safety Code § 39711 (West 2014) and Cal. Health & Safety Code § 38565 (West 2013) (It also requires that 10 percent of the funds be expended to projects within disadvantaged communities); *California Climate Investments*, California Climate Investments, http://www.caclimateinvestments.ca.gov/ (last retrieved August 18, 2017).

[851] A.B. 1550, 2016 leg session (Ca. 2016), https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201520160AB1550.

[852] A.B. 398, 2016-2017 leg session (Ca. 2017).

[853] A.B. 617, 2016-2017 leg session (Ca. 2017).

[854] *California Climate Investments: 2017 Draft Funding Guidelines Discussion Document*, California Air Resources Board (2016), https://www.arb.ca.gov/cc/capandtrade/auctionproceeds/2017_draft_funding_guidelines_discussion_doc.pdf.

[855] *Disadvantaged Communities*, California Climate Investments, https://www.cadimateinvestments.ca.gov/disadvantaged-communities/ (last retrieved August 18, 2017).

[856] California Environmental Protection Agency, Environmental Justice Action Plan (2004), http://www.calepa.ca.gov/EnvJustice/Resources (last retrieved Mar. 21, 2016).

[857] *See Clean Vehicle Rebate Project*, California Air Resources Board, https://www.arb.ca.gov/msprog/aqip/cvrp.htm (last Retrieved March 22, 2017).

[858] *See* California Air Resources Board, Making the Cleanest Cars Affordable (2015), https://www.arb.ca.gov/msprog/aqip/ldv_pilots/efmp_plus_up_faq.pdf (last retrieved March 22, 2016).

[859] *Public Fleet Pilot Project*, California Air Resources Board, https://cleanvehiclerebate.org/eng/pfp (last retrieved March 22, 2016).

[860] *Low Carbon Transportation Light-Duty Project Projects that Benefit Disadvantaged Communities*, California Air Resources Board, https://www.arb.ca.gov/msprog/aqip/ldv_pilots.htm (last retrieved March 22, 2016).

Programs designed to mitigate potential disparate impacts of climate actions

EJ stakeholders have voiced concerns that greenhouse gas reduction programs that include emission trading may lead to increases of conventional local pollutants—like ozone, nitrogen dioxide, and mercury—in areas that already have a disproportionate share of air pollution. (These areas are referred to as "hot spots" areas where emissions increase under a trading program even when aggregate emissions decrease). For example, environmental justice advocates were concerned about the potential for emissions increases under the Clean Power Plan, which would have allowed states to implement CO_2 emission reduction plans that allowed for emissions trading or averaging.[861] California has sought to address these types of concerns by developing an "adaptive management plan."[862] Under the plan, California uses its existing criteria-pollutant monitoring network to assess whether criteria pollution from units covered by the cap-and-trade program increases in any locations. If increases occur, the Air Resources Board is to analyze whether the increases are due to participation in California's cap-and-trade program, or for other reasons. Should the increases be determined to be caused by the cap-and-trade program, then the agency would develop responses to mitigate the increase through a public process. Additionally, the California Air Resources Board (CARB) is now working with stakeholders to establish rules to implement the provisions of AB 617 signed into law in July 2017 as a complement to the state cap-and-trade program. Under AB 617, CARB is directed to work with local air districts on the development of community-focused air quality monitoring networks including plans to reduce emissions from stationary and mobile sources in in neighborhoods with exisitng air quality burdens. AB 617 also includes provisions that require large industrial facilities in communities with significant existing air quality burdens to upgrade equipment to reduce emissions.[863]

[861] We-Act for Environmental Justice Comments on the Proposed Clean Power Plan (Dec. 1, 2014).

[862] *See Adaptive Management—Localized Air Quality Impacts*, California Air Resources Board, https://www.arb.ca.gov/cc/capandtrade/adaptivemanagement/adaptivemanagement.htm (last retrieved May 2, 2016).

[863] *CARB Approves Cap-and-Trade Improvements*, California Air Resources Board, https://www.arb.ca.gov/newsrel/newsrelease.php?id=945.

V. Analysis of Existing New Jersey Legal Authorities

New Jersey likely has the authority to take significant additional steps on climate change mitigation under existing laws, including setting limits on GHG pollution, rejoining RGGI or another power-sector cap-and-invest program, strengthening its RPS, and establishing an EEPS. While some of the strategies described in the previous chapter would require the passage of legislation to be implemented, this chapter highlights New Jersey's general authority to regulate GHG pollution. It also provides an overview of regulatory options that could likely be implemented under several of New Jersey's existing laws, including:

- The Department of Environmental Protection Act of 1970, the enabling statue for NJDEP;
- The Air Pollution Control Act, granting NJDEP authority to regulate air pollution;
- The Global Warming Response Act, establishing economy-wide GHG limits for 2020 and 2050;
- The Global Warming Solutions Fund Act, authorizing an auction for consumer benefit purposes and participation in RGGI;
- N.J.S.A. 26:2C-8.15 et seq., implementing California Low Emission Vehicle program; and
- The Electric Discount and Energy Competition Act, initiating competition in the power generation portion of the electric industry, requiring the adoption of an RPS, and providing the authority to adopt an EEPS.

This analysis provides a high-level review of these authorities and whether they could authorize additional climate action on the part of New Jersey. It should not be taken as an authoritative legal opinion. Whether or not any specific policy proposal could be implemented under such authority would require a more detailed analysis of the proposal, which is beyond the scope of this analysis. Further, even if a policy could be designed to be implemented through existing authority, there may be benefits to legislation that specifically authorizes the policy. Legislation can help avoid any legal uncertainty or provide more flexibility in policy design to agencies implementing a policy.

V.A. New Jersey's General Authority to Regulate Greenhouse Gas Pollution

New Jersey likely has authority to regulate GHG's under the broad authority of its Environmental Protection Act and Air Pollution Control Act, especially given the state's statutory GHG targets and legislative objectives. This authority is subject to important caveats, including federal preemption, state procedural requirements, and limits on the use of state revenue.

New Jersey's courts have characterized New Jersey's Environmental Protection Act as granting NJDEP a "vast authority … to promulgate regulations for … 'the promotion of environmental protection and the prevention of pollution of the environment of the State.'"[864]

[864] *In re* Adoption of N.J.A.C. 7:15-5.24(b), 420 N.J. Super. 552, 572 (N.J. Super. Ct. App. Div. 2011) (quoting N.J. Stat. Ann. § 13:1D-9). *See also In re* Stormwater Management Rules, 384 N.J. Super. 451 (N.J. Super. Ct. App. Div. 2006) (finding that enabling legislation "accords [NJDEP] broad powers of conservation and ecological control").

Under New Jersey law, courts interpret the authority of an agency based not only on the powers that are expressly granted in statutes, but also based on implied powers that are required to give full effect to the intent of the state legislature in passing the law.[865] Courts may look to the objectives of a law—including declarations and findings—in interpreting the scope of authority that the law grants to a regulating agency.[866] The courts will presume that a regulation is within an agency's authority unless it plainly violates the law.[867]

New Jersey was one of the first states in the nation to adopt a state-wide air pollution control statute,[868] and the Air Pollution Control Act (APCA) grants NJDEP substantial authority to regulate air pollution. It provides the agency the "power to formulate and promulgate, amend and repeal codes and rules and regulations, preventing, controlling, and prohibiting air pollution throughout the state."[869] Courts have found that this provision gives the agency "broad authority to issue health-based regulations."[870] The Environmental Protection Act additionally authorizes the Commissioner of NJDEP to prepare, administer and supervise programs of conservation and environmental protection.[871]

NJDEP has affirmed that "air pollution" as it is defined under the APCA is broad enough to encompass GHGs.[872] In 2005, NJDEP promulgated a regulation that revised existing regulatory definitions to clarify that CO_2—as a GHG—met the definition of an air pollutant under the Act.[873] The agency exempted CO_2 from existing regulatory requirements, but did require that stationary sources report emissions of CO_2

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865 N.J. Guild of Hearing Aid Dispensers v. Long, 75 N.J. 544, 561-62 (N.J. 1978) (The authority possessed by an administrative agency "consists of the powers expressly granted which in turn are attended by those incidental powers which are reasonably necessary or appropriate to effectuate the specific delegation … the grant of authority to an administrative agency is to be liberally construed in order to enable the agency to accomplish its statutory responsibilities and that the courts should readily imply such incidental powers as are necessary to effectuate fully the legislative intent."); DOL v. Pepsi-Cola Co., 170 N.J. 59 (N.J. 2001) (an agency's powers are limited to those expressly granted by statute or those fairly implied as necessary to carry out their assigned function).

866 "To decide whether a particular agency action is authorized, a court 'may look beyond the specific terms of the enabling act to the statutory policy sought to be achieved by examining the entire statute in light of its surroundings and objectives.'" New Jersey Ass'n of School Adm'rs v. Schundler, 211 N.J. 535 (N.J. 2012) (quoting New Jersey Guild of Hearing Aid Dispensers v. Long, 75 N.J. 544 , 562 (N.J. 1978)).

867 An agency's "interpretation of the operative law is entitled to prevail, so long as it is not plainly unreasonable." Waksal v. Director, Div. of Taxation, 215 N.J. 224 (N.J. 2013) (quoting Metromedia, Inc. v. Dir., Div. of Taxation, 97 N.J. 313, 327 (N.J. 1984)). However, "'an administrative agency may not, under the guise of interpretation, extend a statute to give it a greater effect than its language permits,' so 'regulations that flout the statutory language and undermine the intent of the Legislature'" *In re* Amendments and New Regulations at N.J.A.C. 7:27-27.1, 392 N.J. Super. 117, 134 (N.J. Super. Ct. App. Div. 2007) (quoting GE Solid State, Inc. v. Dir., Div. of Taxation, 132 N.J. 298, 306-07, (N.J. 1993)).

868 NJ Environmental Law § 2.11 (2012).

869 N.J. STAT. ANN. § 26:2C-8(a).

870 *In re* Amendments and New Regulations at N.J.A.C. 7:27-27.1, 392 N.J. Super. 117, 134 (N.J. Super. Ct. App. Div. 2007) (quoting Dep't of Health v. Owens-Corning Fiberglas Corp., 100 N.J. Super. 366, 393-94, (N.J. Super. Ct. App. Div. 1968), aff'd o.b., 53 N.J. 248, (N.J. 1969)).

871 N.J. Stat. Ann. § 13:1D-9(f). See also N.J. Stat. Ann. § 13:1B-3(e) (providing Commissioner authority to adopt regulations as may be required by law).

872 The statute defines "air pollution" as "the presence in the outdoor atmosphere of one or more air contaminants in such quantities and duration as are, or tend to be, injurious to human health or welfare, animal or plant life or property, or would unreasonably interfere with the enjoyment of life or property throughout the State and in such territories of the State as shall be affected thereby and excludes all aspects of employer-employee relationship as to health and safety hazards." N.J. Stat. Ann. § 7:27-5.1. An "air contaminant" is defined in turn as "any substance, other than water or distillates of air, present in the atmosphere as solid particles, liquid particles, vapors or gases." N.J. Stat. Ann. § 7:27-8.1.

873 N.J. Stat. Ann. §7:27–1.36 et. seq.

and methane as an air pollutant.[874] In the regulatory action, the agency also indicated that the other five GHGs commonly included in the basket of GHGs were air contaminants for the purposes of the Act.

In the 2007 Global Warming Response Act (GWRA), the state legislature established binding economy-wide GHG limits requiring the state to limit emissions to 1990 levels by 2020 and to 80 percent below 2006 levels by 2050.[875] It also declared that "as a State, there are specific actions that can be taken to attack the problem of global warming" and that it is in the state's interest to establish "a greenhouse gas emissions reduction program" that achieves the GHG limits.[876] The GWRA also directs NJDEP to establish a GHG monitoring and reporting program by January 1, 2009;[877] however, the state never finalized this rule.[878] Finally, the GWRA makes clear that nothing in the statute limits NJDEP's existing authority to regulate GHGs.[879] Through these binding emission limits and related legislative findings, the GWRA clearly establishes reducing GHG emissions to be an objective of the state.

Taken together, the broad grant of authority to regulate air pollution and clear legislative objective to reduce GHG emissions suggest that NJDEP has implicit authority to regulate GHG emissions under the Environmental Protection Act, APCA, and GWRA.[880] Importantly, NJDEP has on at least one other occasion promulgated air pollution regulations under its general authority that were not prompted by federal requirements and were not explicitly authorized in statute, and a New Jersey appellate court upheld this action.

However, there are relevant constraints on NJDEP's air pollution control authority, including federal preemption in certain areas, constraints on revenue, and procedural requirements for certain regulatory options.

Federal law can preempt state law in areas where the federal government is regulating or otherwise occupying the field. For example, federal law explicitly preempts New Jersey from promulgating its own vehicle GHG regulations—the state may only choose between adopting California's regulations (as it has) or accepting federal regulations.[881] In the current federal regulatory environment, states are *not* preempted from setting GHG standards for new or existing stationary sources (e.g., power plants or

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[874] The regulation amended the regulatory code to clarify that carbon dioxide was not a "distillate of air" that would be excluded from the definition of an air contaminant, and therefore, excluded from being an air pollutant. As a result, the regulations clarified that carbon dioxide was an air pollutant. 37 N.J. Reg. 4415(a) (Oct. 15, 2007). *See* N.J. Admin. Code § N.J.A.C. 7:27-21.3 (2017).

[875] N.J. Stat. Ann. § 26:2C-39 to 40 (establishing that the state's GHG emissions "shall" be reduced to meet the 2020 and 2050 limits). For the purposes of these targets, statewide GHG emissions are defined to include in-state GHG emissions and emissions from electricity generated outside the state but consumed in the state.

[876] N.J. Stat. Ann. § 26:2C-38.

[877] N.J. Stat. Ann. § 26:2C-41.

[878] 41 N.J.R. 337(a) (January 20, 2009)

[879] The GWRA called on NJDEP to recommend measures to the legislature and governor that could be used to meet the 2020 and 2050 targets by 2008 and 2010 respectively, and the savings clause made clear that these requirements to provide recommendations did not limit any existing authority to actually limit emissions. N.J. Stat. Ann. § 26:2C-42.

[880] A 2004 NJDEP regulation set first-ever mercury limits on iron and steel smelters without a federal regulatory requirement or express authorization in the statute. Appellate Division of the New Jersey Superior Court found that the NJDEP's broad air pollution control authority sustained these standards. *In re* Amendments and New Regulations at N.J.A.C. 7:27-27.1, 392 N.J. Super. 117, 134 (N.J. Super. Ct. App. Div. 2007).

[881] Clean Air Act § 209(a), 42 U.S.C. 7543(a).

industrial sources), as long state standards are at least as stringent as any federal requirements.[882] States are also *not* preempted from regulating the carbon content of transportation fuels.[883]

As with most states, New Jersey law limits the extent to which regulatory programs can generate revenue without special authorization. The New Jersey Constitution requires special legislative authorization for taxes—that is for measures that seek to generally raise revenues for public purposes. Tax bills must originate in the General Assembly (as opposed to the state Senate),[884] and any resulting revenues must be appropriated in a single annual bill.[885] In contrast, fee legislation does not need to follow this legislative process, but fees are defined to apply to what is necessary to defray the cost of the regulatory process.[886] For example, the APCA sets a specific fee schedule for major sources[887] and requires that the fees be used solely for the administration of the regulatory program.[888] Absent any other legislative authorization, the limit on fees and the process to generate revenue would serve as a barrier to cap-and-invest or cap-and-dividend type approaches, or any other approach that relies on raising revenue beyond what is needed to administer the program. However, the Global Warming Solutions Fund Act (GWSFA) specifically authorizes the use of allowance auctions and the distribution of auction proceeds for investments into clean energy, energy efficiency, restoration of carbon sinks, and mitigation of cost impacts. As described below, this likely authorizes the state to generate revenue for these express purposes.

New Jersey law and executive policy also impose requirements in cases where there are relevant federal regulatory requirements. The New Jersey Administrative Procedure Act requires that each state regulatory action must include a statement of whether any state rule or regulation exceeds the "standards or requirements imposed by federal law."[889] Governor Chris Christie further directed, in an executive order, that state agencies not exceed federal requirements except where required by law or "necessary in order to achieve a New Jersey specific public policy goal" (n.b., executive orders may be unilaterally rescinded or amended by a Governor).[890] These directives could apply if New Jersey regulated GHG emissions from large new sources, including power plants, which are currently subject to federal GHG

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[882] The Clean Air Act expressly permits states to adopt standards for stationary sources. State standards must be at least as strict as federal standards adopted under the Clean Air Act Section 111, which is the authority used by the EPA to promulgate carbon pollution standards for new and existing power plants. Clean Air Act § 116, 42 U.S.C. § 7416.

[883] *See Rocky Mt. Farmers Union v. Corey*, 730 F.3d 1070 (9th Cir. 2013) (finding no federal preemption of California's Low Carbon Fuel Standard).

[884] N.J. Const., Art. IV, Sec. VI, Para. 1.

[885] N.J. Const., Art. VIII, Sec. II, Para. 2; *see* Bugos v. State, 222 N.J. 175 (N.J. 2015) (holding the legislature must provide for appropriations in one law and that the budget created by the appropriations law must be balanced).

[886] A "fee is ordinarily the means of defraying the expense fairly attributable to the regulative process, while the broader sovereign power to tax for revenue to serve a public purpose of a general nature is confined by constitutional limitations, the terms of the grant itself, and the rule of reason and good discretion." BTD-1996 NPC 1 L.L.C. v. 350 Warren L.P., 170 N.J. 90, 97-8 (N.J. 2001) (quoting Bellington v. East Windsor Township, 17 N.J. 558, 564-65 (N.J. 1955)).

[887] N.J. Stat. Ann. § 26:2C-9.5.

[888] N.J. Stat. Ann. § 26:2C-9.6.

[889] N.J. Stat. Ann. § 52:14B-23.

[890] Governor Chris Christie Exec. Order No. 2 (Jan. 20, 2010). Governor Christie's executive order also generally requires the use of cost-benefit analysis.

regulations.[891] For the purposes of the executive order, New Jersey's statutory GHG emission reduction targets could serve as a "public policy goal" justifying regulations more strict than current federal standards—or potentially future federal standards weakened under the current administration.

With these caveats, New Jersey likely has authority to regulate GHG emissions under its general air pollution regulatory authority. The following sections explore New Jersey's existing authority to implement specific policies.

V.B. Authority to Enter into an Emission Budget or Cap-and-Invest Program

As discussed above, the GWRA establishes binding GHG emission limits and declares that it is in the state's interest to establish "a greenhouse gas emissions reduction program" that achieves these limits.[892] The GWSFA—enacted one year later, in 2008—authorizes NJDEP to create and distribute allowances in the service of a "greenhouse gas emission allowance trading program implemented to reduce or prevent emissions of greenhouse gases" that may be exercised "in cooperation and coordination with other states or countries that are participating in regional, national or international carbon dioxide emissions trading programs."[893] It also created a special "Global Warming Solutions Fund" in the treasury to receive funds from allowance auctions.[894] Finally, the legislation directed that money in the fund be annually appropriated for the following purposes:

- 60 percent to the New Jersey Economic Development Authority to support energy efficiency and clean energy projects;
- 20 percent to NJBPU to support demand reduction or cost mitigation programs for low- and moderate-income residents, with a focus on urban areas;
- 10 percent to local governments to plan, develop and implement measures to reduce GHGs; and
- 10 percent to NJDEP to support stewardship and restoration of forests and tidal marshes.[895]

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[891] Large new or modified stationary sources are required to implement Best Available Control Technology (BACT) under the federal Prevention of Significant Deterioration (PSD) program. *See* Utility Air Regulatory Group v. EPA, 134 S. Ct. 2427, 2449 (2014) (upholding most of EPA's regulation of GHG emissions from large new stationary sources under the PSD program such that if a source is otherwise triggering BACT requirements for non-GHGs, it must also implement BACT for GHGs if it emits at least 75,000 tons per year (tpy) of carbon dioxide equivalent (CO_2e).). Large new power plants are required to also meet performance standards under Clean Air Act Section 111. Standards of Performance for Greenhouse Gas Emissions From New, Modified, and Reconstructed Stationary Sources: Electric Utility Generating Units, 80 Fed. Reg. 64,510 (Oct. 23, 2015). Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units, 80 Fed. Reg. 64,662 (Oct. 23, 2015). The Clean Power Plan would require states to set standards on existing power plants that meet minimum federal regulations; however, the U.S. Supreme Court stayed the implementation of this rule. While the D.C. Circuit held oral argument on the final rule on September 27, 2016, the Court requested supplemental briefing by May 15, 2017 on whether to remand or hold the case in abeyance in response to EPA motions related to recent Executive Order. President Donald Trump has directed EPA to review standards for both new and existing power plants and "suspend, revise, or rescind" those regulations if appropriate. Exec. Order No. 13,783, 82 Fed. Reg. 16093, 16095 (Mar. 28, 2017).

[892] N.J. Stat. Ann. § 26:2C-38. It is also important to note that the GWRA does not create an enforceable obligation for NJDEP to implement measures to achieve such limits as the Act obligates NJDEP to prepare a report recommending measures to achieve the limits and determine the state's progress achieving the limits. By comparison, for example, Massachusetts' Global Warming Solutions Act obligates the Massachusetts Department of Environmental Protection to "promulgate regulations establishing a desired level of declining annual aggregate emission limits for sources or categories of sources that emit greenhouse gas emissions." M.G.L.A. 21N § 3(d).

[893] N.J. Stat. Ann. § 26:2C-47(a).

[894] N.J. Stat. Ann. § 26:2C-50.

[895] N.J. Stat. Ann. § 26:2C-51. The Act also authorizes funds to cover the administrative costs of implementing the program for NJDEP (up to 4 percent), NJBPU, (up to 2 percent), and the New Jersey Economic Development Authority (up to 2 percent).

NJDEP relied on this authority—together with its general authority to promulgate air pollution control regulations—to promulgate regulations in 2008 establishing a cap-and-trade program that was part of RGGI.[896]

However, New Jersey subsequently withdrew from RGGI on January 1, 2012.[897] NJDEP also finalized regulations repealing the regulations establishing the cap-and-trade program for participating in RGGI.[898]

The GWRA and GWSFA have not been repealed and remain current law. The authority provided by the GWSFA is not limited by time or any other factor, and therefore, provides authority for New Jersey to rejoin RGGI if it were to finalize new regulations pursuant to these Acts.

The GWSFA and GWRA—together with New Jersey's general air pollution control authority—likely also provide authority for New Jersey to finalize new regulations that implement its own stand-alone program, or join another multi-jurisdiction program. Although the legislative finding of the GWSFA specifically mentions that it is in the public interest of the state to participate in RGGI,[899] the operative provisions of the law that authorize setting up an allowance program are broad. For example, the language does not specify that the authority may only be used to join RGGI. On the contrary, NJDEP "may exercise this authority in cooperation and coordination with other states or countries that are participating in regional, national or international carbon dioxide emissions trading programs with the same or similar purpose,"[900] suggesting that participation in other multi-jurisdiction trading programs would also be authorized. A court also found in an earlier case that the prior implementing regulations were written broadly enough to create a stand-alone cap-and-trade program.[901] Although this was a non-binding, unpublished opinion, the reasoning used by the court suggests that New Jersey also has authority to create a stand-alone program.[902]

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[896] 40 N.J. Reg 3792(a) (July 7, 2008).

[897] N.J. Dept of Envt'l Conservation, Notice of Withdrawal of Agreement to the RGGI Memorandum of Understanding (2011), https://www.rggi.org/docs/Documents/NJ-Statement_112911.pdf.

[898] 47 N.J.R. 1937(a) (repealing the CO_2 Budget Trading Program rules at N.J.A.C. 7:27).

[899] The relevant language specifies that it is in the public interest to authorize "the Commissioner of Environmental Protection and the President of the Board of Public Utilities … [to] participat[e] with other states in the formation and activity of a separate legal entity established for the purpose of furthering the Regional Greenhouse Gas Initiative." N.J. Stat. Ann. § 26:2C-45.

[900] *Id.*

[901] *See In re* Regional Greenhouse Gas Initiative, No. A-4878-11T4, 6 (N.J. Super. Ct. App. Div., 2014) (unpublished). Following New Jersey's withdrawal from RGGI, this case involved a question of whether the language of the regulations implementing New Jersey's participation in RGGI through the authority provided to NJ DEP in GWSFA was sufficiently broad that it required action by NJ DEP absent New Jersey's participation in a regional trading program, such as a stand-alone cap program. *Id.* The New Jersey Superior Court's Appellate Division held that the regulations were sufficiently broad to require action by NJ DEP absent a regional trading program, indicating that the Court believed that the authorizing statute was at least sufficiently broad to support regulations to implement New Jersey participation in RGGI or a stand-alone cap program. As an unpublished opinion, this opinion is not binding precedent. Lower courts often choose not to publish decisions for a variety of reasons, including to reduce workload, for example because a case presents a well-settled issue of law. New Jersey court rules state that an unpublished case "may not constitute precedent or be binding on any court." New Jersey Rules of Court. 1:36-3, Unpublished Opinions.

[902] Under the Rules Governing the Courts of the State of New Jersey, Rule 1:36 states that unpublished opinions do not constitute precedent and are not binding upon any court; however, the reasoning is helpful to consider in evaluating NJDEP's authority under the statute.

The statutory language also does not limit a program to the power sector,[903] given that the state's emission reduction targets are economy-wide—the regulations could authorize a program that covers other sectors. Further, while the language in the GWSFA specifies "carbon dioxide emissions trading programs" potentially limiting covered emissions only carbon dioxide as covered in RGGI, the GWSFA also refers to greenhouse gases generally. For example, the GWSFA includes a finding that "efforts to reduce greenhouse gas emissions in New Jersey must include complementary programs to reduce greenhouse gas emissions from electricity generated outside of the State but consumed in New Jersey, and that one measure that may be most effective in doing so is the adoption of a greenhouse gas emissions portfolio standard."[904] The Act also requires "[w]ithin three months after the enactment of federal law providing for implementation of a national emissions allowance trading program, the Commissioner of Environmental Protection shall render an interim decision as to whether the national program is substantially comparable to the greenhouse gas emissions allowance trading program in which the State is participating at that time" suggesting that the state could participate in a GHG trading program other than RGGI and one that covers all greenhouse gases and not just carbon dioxide.[905]

In short, the GWSFA and GWRA would likely authorize either a stand-alone trading program or a participation in a multi-sector trading program that is not RGGI, and the Acts likely also authorize a trading program that covers sectors beyond the power sector and CO_2. However, if New Jersey used this authority to rejoin RGGI, join another program, or implement a stand-alone program in the state, it would need to invest auction proceeds as required by GWSFA, as those provisions remain in effect.

V.C. Other Potential Regulations under Air Pollution Control Authority

New Jersey could potentially use NJDEP's existing air pollution control authority to establish other types of GHG emission limitations beyond a cap-and-trade program. For example, these could include:

- GHG emission limits for individual sources of emissions, similar to the approach adopted by Washington State. It should be noted that Governor Jay Inslee first sought to implement a cap-and-trade program, and pursued this regulatory approach under the state's existing authority when the legislature failed to pass legislation that would have been needed to implement a cap-and-trade program.[906]
- CO_2 emissions performance standards for power plants or other stationary facilities. California, New York, Oregon, and Washington all have implemented state emission performance standards for new power plants.[907]

[903] *See* N.J. Stat. Ann. § 26:2C-47.

[904] N.J. Stat. Ann. § 26:2C-45.

[905] N.J. STAT. ANN. § 26:2C-54.

[906] Washington Clean Air Rule, Chapter 173-442 WAC; Press Release of Office of Governor Jay Inslee, Inslee directing Ecology to develop regulatory cap on carbon emissions, July 28, 2015 (noting that the regulatory approach "is not the comprehensive approach we could have had with legislative action").

[907] *See* Cal. Pub. Util. Code §§ 8340-41 (2013) (West, Westlaw through Ch. 2 of 2016 Reg.Sess. and Ch. 1 of 2015-2016 2nd Ex.Sess); *see also* OR. SB 101 (2000); N.Y. Comp. Codes R. & Regs. tit. 6 Part 251 (2013)) (West, Westlaw through amendments included in the New York State Register, XXXVIII, Issue 9 dated March 2, 2016.); Wash. Rev. Code tit. 80, ch. 80.80 (2013) (West, Westlaw through all laws from the 2015 Regular and Special Sessions and Laws 2016, chs. 1 and 2, Wash. SB 6001 (2007)).

- Methane standards for new and existing natural gas transmission or distribution infrastructure, including leak detection and repair programs,[908] emission limitations, a mandatory equipment replacement schedule, and the use of emission control devices, processes, or technology based on NJDEP's existing authority.
- Emissions standards for other highly warming gases.

V.D. California Car Standards

In 2004, the New Jersey Legislature passed legislation requiring NJDEP to adopt California's Low Emission Vehicle (ZEV) program and authorizing the agency to promulgate regulations necessary under the program.[909] The federal Clean Air Act (CAA) allows California to set vehicle emission standards more stringent than the federal standard and, under Section 177 of the CAA, other states can adopt California's standards.[910] NJDEP originally adopted California's Low Emission Vehicle program in 2006.[911] The standards set GHG and criteria pollution standards for passenger cars[912] and also require that zero emission vehicles make up an increasing portion of manufacturer new vehicle sales. Since the regulation incorporates California's standards by reference,[913] changes made by California are incorporated into New Jersey's regulatory requirements without any action by New Jersey.

V.E. Authorities to Promote Clean Energy and Energy Efficiency

As noted in Section II.D. above, the NJBPU regulates natural gas, electricity, water, telecommunications, and cable television services of the state with the responsibility of ensuring safe, adequate, and proper utility services at reasonable rates to customers in New Jersey.[914] EDECA established a framework for the NJBPU to implement a competitive market for electric generation and gas by separating the cost of generating and supplying the power from the cost of delivering it.[915] Through this authority, the NJBPU implements programs to promote a market-based, competitive environment for the production and delivery of natural gas and electricity.[916] In providing safe and adequate service, the NJBPU has the authority to require any public utility to provide service in a manner that preserves the "quality of the environment" and "prevent[s] the pollution of the waters, land and air" in New Jersey.[917] The NJBPU could use this authority to incorporate consideration of GHG emissions. One potential way of doing so

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[908] N.J. Stat. Ann. § 26:2C-8(a); *see also* N.J. Admin. Code § 7:27-16.18(c)-(d) and 26 N.J. Reg 2600(a) (June 20, 1994) (regulation, adopted through N.J. Stat. Ann. § 26:2C-8, requiring the use of leak detection and repair programs at natural gas processing plants to reduce VOC emissions; methane is a component of VOC).

[909] N.J. Stat. Ann. § 26:2C-8.15 et seq.

[910] 42 USC § 7507(1) (2016).

[911] N.J. Admin. Code § ***7:27-29.1 et seq. (2016); 38*** N.J. Reg. ***497(b) (Jan. 17, 2006).***

[912] Beginning with model year 2012, California's standards have been harmonized with federal GHG standards for passenger vehicles.

[913] See ***38*** N.J. Reg. ***497(b) (Jan. 17, 2006).***

[914] N.J.S.A. 48:2-13.

[915] N.J. Stat. Ann. §§ 48:3-49 et sq.

[916] N.J.S.A. 48:2-21.24.

[917] N.J.S.A. 48:2-23. *See also*, In re New Jersey Bd. of Public Utilities, 200 N.J.Super. 544, 558 (1985) recognizing that Legislature intended to vest the BPU with the "powers necessary to ensure that disposal operators subject to its jurisdiction have the economic capacity to effectuate the environmental mandates of the DEP."

would be to use the social cost of carbon as a means to evaluate the climate implications of policy choices affecting electricity and the associated emissions. Several states, including for example Minnesota,[918] already use the social cost of carbon in their states' energy-related evaluations. (See discussion in Section IV.C.3).

At the same time, the NJBPU is also directed to deliver reasonable rates and must balance the environmental benefits with costs to customers. For example, the Offshore Wind Economic Development Act enacted in 2010 requires projects submitted to the NJBPU to include a "cost-benefit" analysis.[919] The Act requires the Board to determine if the projects "demonstrates positive economic and environmental net benefits to the State."[920] In the 2011 Energy Master Plan, the state explains that "the cost-benefit test is intended to ensure that any subsidies in the form of ORECs that are ultimately borne by ratepayers are at least offset by the aggregated net benefits to New Jersey residents and businesses."[921] Thus, while the NJBPU may explore using the social cost of carbon or other means to consider the environmental benefits of a policy, the Board is also required to balance those benefits with any impacts to rates for customers.

In addition to the general authority of the NJBPU, the EDECA and subsequent amendments provide authority to the NJBPU to establish a societal benefits charge (SBC) to allow electric utilities to recover some or all of the costs associated with energy efficiency and renewable energy programs.[922] EDECA also directs the NJBPU to initiate a comprehensive resource analysis ("CRA") of energy programs to determine the appropriate level of funding for energy efficiency and Class I RE programs (now called New Jersey's Clean Energy Program or NJCEP) that provide environmental benefits in addition to those provided by standard offer or similar programs, in effect as of February 9, 1999.[923] Most recently, the NJCEP is developing a strategic plan to serve as a framework for the design and implementation of programs beginning in fiscal year 2018 (July 1, 2017 to June 30, 2018). Through this process the NJCEP has sought feedback from participants and stakeholders on how the program can most effectively achieve its objectives.[924]

Additionally, the NJBPU must require electric power suppliers to disclose their fuel mix and emissions of CO_2 as well as SO_2, NOx, and other pollutants the Board determines to pose an environmental or health hazard.[925] EDECA also authorizes the Board to establish an emission portfolio standard for electric suppliers as well as to establish and strengthen an RPS, net metering standards, and an energy efficiency portfolio standard.[926] Thus, in addition to potential regulatory action by NJDEP previously discussed and the opportunities to consider carbon emissions highlighted above, the EDECA provides the NJBPU with

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[918] Ben Norris et al,, Clean Power Research, Minnesota Value Of Solar: Methodology (2014), available at http://mn.gov/commerce-stat/pdfs/vos-methodology.pdf.

[919] N.J.S.A. 48:3-87,1(a).

[920] N.J.S.A. 48:3-87.1(b); N.J.A.C. 14:8-6.5

[921] 2011 New Jersey Energy Master Plan (Dec. 2011) available at: http://www.nj.gov/emp/docs/pdf/2011_Final_Energy_Master_Plan.pdf.

[922] N.J.S.A. 48:3-60(a)(3).

[923] *Id.*; *See In the Matter of New Jersey Clean Energy Program,* Docket No. EX99050347 (Jan. 22, 2003).

[924] *See, e.g.,* NJBPU, NJCEP Strategic Planning Stakeholder Focus Groups (Jan. 26, 2017), http://www.njcleanenergy.com/files/file/NJCEP%20Strategic%20Plan%20Slides%2001-26-17.pptx.

[925] N.J.S.A. 48:3-87a.

[926] N.J.S.A. 48:3-87(c)-(g).

potential regulatory authorities to address climate change by further promoting clean energy and energy efficiency.

V.E.1 Energy Planning

In 1977, the New Jersey Legislature enacted New Jersey's Energy Master Plan Statute in response to the energy crisis of the 1970s.[927] Under the statute, the Energy Master Plan Committee[928] must develop a 10-year "master plan" (with updates every three years) for the "production, distribution, and conservation of energy" in New Jersey. In general, the NJBPU is the lead agency implementing the measures consistent with the plan, including coordinating with other state agencies, the industry and other stakeholders; reporting on progress to the Governor; and working with the legislature to develop or refine programs consistent with the Plan.[929] The 2015 Energy Master Plan Update is the latest release by the Committee, which updated the 2011 Energy Master Plan.

Additionally, the legislature further refined the role of the Committee and requirements for the Master Plan in the GWRA. For example, NJDEP must coordinate the required evaluation of greenhouse gas reduction policies and measures with the Energy Master Plan Committee.[930] The GWRA also required that the Master Plan include a list of "recommended policies and measures to reduce the emission of greenhouse gases from the production, processing, distribution, transmission, storage, or use of energy that will contribute to achieving the 2020 limit."[931]

V.E.2 Authority to Strengthen the State's Renewable Portfolio Standard

The EDECA requires NJBPU to adopt a renewable portfolio standard (RPS),[932] and subsequent legislation requires the BPU to create requirements that a portion of electricity sold in the state must be supplied by solar energy, wind, or other approved renewable energy sources.[933] EDECA also requires that NJBPU "periodically consider increasing the renewable energy portfolio standards" beyond the statutorily-mandated minimum percentages through consultation with NJDEP, electric public utilities, affected members of the solar energy industry, and other stakeholders.[934] In considering possibly increasing the RPS, NJBPU considers several factors, including but not limited to, reductions in air pollution, GHG emissions, peak demand, and cost to electricity consumers and increases in renewable energy development, manufacturing, investment and job creation opportunities in the state.[935] NJBPU has used

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[927] N.J.S.A. 52:27F-14.

[928] The Energy Master Plan Committee is comprised of the heads of the following departments or their designees: comprised of the heads or designees from the departments of: Commerce, Energy and Economic Development, Community Affairs, Environmental Protection, Health, Human Services, Transportation, and Treasury.

[929] *See, e.g.,* State of New Jersey, New Jersey Energy Master Plan at 13 (Dec. 2011), http://www.nj.gov/emp/docs/pdf/2011_Final_Energy_Master_Plan.pdf.

[930] N.J.S.A. 26:2C-42(a).

[931] N.J.S.A. 26:2C-42(d).

[932] N.J. Stat. Ann. §§ 48:3-87(d)(1)(2).

[933] N.J. Stat. Ann. §§ 48:3-87(d)(3).

[934] *Id.* § 48:3-87(o).

[935] *Id.* §§ 48:3-87(o)(1)-(3).

this authority in the past to strengthen the state's RPS, including in 2005 when it strengthened the core RPS requirement to 20.38 percent by 2021 (later legislation changed this to a 20.38 percent RPS with a 4.1 percent solar carve out).[936] The BPU can use this authority to again strengthen the RPS in the future.

V.E.3 Authority to Adopt an Energy Efficiency Portfolio Standard

EDECA, as amended by the GWSFA, also provides NJBPU the discretionary authority to implement an energy efficiency portfolio standard (EEPS) to reduce electricity or gas usage in the state. NJBPU "may adopt" an electric and/or a gas EEPS requiring each electric or gas public utility to implement energy efficiency measures that reduce electricity or natural gas usage in New Jersey to a level that is 20 percent below the amount of electricity that would be used in the absence of an EEPS target by 2020.[937] NJBPU has not implemented an EEPS, although it has considered petitions to implement an electric and gas portfolio standard, most recently in 2014. NJBPU declined to adopt a portfolio standard at that time, citing its objective to "to phase out reliance on ratepayer-funded subsidies and phase in a market-driven model" and explaining that implementing a standard without "due consideration of all related issues" would not reach that objective.[938] Given that the language of the statute authorizes an EEPS target through 2020, it is not clear whether the BPU could authorize an EEPS target beyond 2020 without additional authority. Nevertheless, the NJBPU could use its authority to adopt an EEPS for electricity or gas in the future.

V.E.4 Authority to Implement Decoupling

The GWSFA amendments to EDECA specifically contemplate the use of "incentives or rate mechanisms that decouple utility revenue from sales of electricity and gas" as one of the possible ways that gas or electric utilities can be compensated for investments into energy efficiency and renewable energy programs.[939] Such decoupling mechanisms would need to be approved by the board through a ratemaking procedure and would be subject to other ratemaking constraints. Additional analysis would be required to understand how broad the board's authority is to implement decoupling, and what constraints would apply.

V.E.5 Authority to Regulate Methane Leaks from the Natural Gas Supply Chain

EDECA and the NJBPU enabling statute also provide NJBPU broad authority to adopt regulations related to the safety, reliability, and the cost of distributing natural gas in New Jersey.[940] Thus, in addition to the potential methane regulations that NJDEP can implement discussed above, NJBPU can likely use its existing authority to place a cap on the maximum allowable rate of lost and unaccounted for (LAUF) gas each local distribution company (LDC) or utility can emit. It can also prevent LDCs or utilities from recovering costs in excess of the allowable rate because it comes under the regulatory purview of NJBPU

[936] *See* N.J. Admin. Code § 14:8-2.3; ***38*** N.J. Reg. 2176(a) (May 15, 2006).

[937] N.J. Stat. Ann. §§ 48:3-87(g)-(h).

[938] 46 N.J. Reg. 1656(d) (July 7, 2014).

[939] N.J. Stat. Ann § 48:3-98.1(b).

[940] N.J. Stat. Ann. § 48:2-13(d); *id.* 48:3-55.

in affecting the rate paid by customers and improving the safety and reliably of the distribution infrastructure.[941] EDECA also instructs NJBPU to adopt "standards for the inspection, maintenance, repair, and replacement of the distribution equipment and facilities of electric public utilities."[942] This regulatory mandate can be employed to establish timelines for the repair of non-hazardous leaks in New Jersey.

[941] *See* 52 Pa. Code § 59.111 (2016) (Pennsylvania's LAUF cap adopted through 66 Pa. Cons. Stat. §§ 501, 504, 523, 1301, 1501, 1504 (2016).
[942] N.J. Stat. Ann. § 48:3-96.

VI. Discussion

New Jersey has already met its 2020 limit of returning to 1990 levels of emissions. This is due in part to significant reductions from the power sector, where a shift from coal to natural gas generation and an increase in renewables has cut emissions 42 percent since 2005. New Jersey's largest sector of emissions is the transportation sector, however, and transportation-sector emissions have increased 27.5 percent since 1990. This long-term increase is due largely to the continued rise in vehicle miles traveled, as the vehicles themselves are becoming more fuel-efficient. These two sectors account for approximately two-thirds of New Jersey's emissions—the next largest categories for emissions are from direct fossil fuel use in the residential, industrial, and commercial sectors, mainly for heating.

New Jersey has already taken some important steps toward addressing climate change. In addition to setting 2020 and 2050 limits, the state has promulgated regulations requiring large stationary sources to report CO_2 and methane emissions, and clarifying that CO_2 is an air pollutant that may be regulated under its Air Pollution Control Act, adopted California's GHG and ZEV standards for vehicles, established and then strengthened an RPS, authorized an offshore wind target, established a net metering program, adopted an energy master plan, and participates in the Transportation and Climate Initiative. The state was also a founding member of RGGI, but withdrew from the program in 2012.

In the United States, states have historically been leaders in developing and implementing climate and clean energy policies, and states have developed policy models for reducing emissions in every sector, as well as comprehensive policies for the entire economy. New Jersey may want to consider a variety of these policies in order to put itself on track to meet its 2050 limits. New Jersey may also be able to implement some of these policies through existing legal authorities. The reader should remember that this report is not an authoritative legal opinion; however, based on the review of existing authorities noted within this report, New Jersey may have latitude to advance some or many of the policy options discussed below.

Below are a set of suggested categories that may serve as a framework to guide consideration of the many policy options presented in this report. Note that **examples** from those policy options are cited to demonstrate how policy options can coincide with the categories; the authors are not making recommendations nor advocating for any particular policy option or suite of options.

1. Mid-term and long-term economy-wide planning.

Examples:

- Set an interim GHG emissions limit (e.g. 2030);
- Update the 2009 Global Warming Response Recommendations Plan[943] to meet a new statewide interim limit and long-range (2050) statewide limits;

[943] New Jersey Department of Environmental Protection. 2009. Meeting New Jersey's 2020 Greenhouse Gas Limit: New Jersey's Global Warming Response Act Recommendations Report. http://www.nj.gov/dep/aqes/docs/njgrwa_final_report_and_appendices_dec2009.pdf (last visited July 21, 2017).

- Establish a system for monitoring emissions and reporting on progress, such as the economy-wide emissions reporting provisions included in the Global Warming Response Act.

2. New statutory initiatives.

Examples:

- Economy-wide carbon pricing, such as legislation under consideration in Massachusetts that would return portions of the revenue to households and invest in actions that reduce greenhouse gas emissions and increase communities' preparedness for a changing climate;
- Constitutional dedication of revenues from the Societal Benefit Charge to efforts that reduce energy use, and/or greenhouse gas emissions,including in sectors such as energy, transportation, and natural resource stewardship;
- Explore the need for statutory decoupling provisions or determine other mechanisms necessary to remove the pressure on utilities to sell as much energy as possible by eliminating the relationship between revenues and sales volume to incentivize efficiency and conservation measures by utilities.
- Expanded authority to establish a binding economy-wide GHG enforceable emissions limit under which state policies, performance standards, and other programs operate.

3. Standard setting with opportunities for innovation and economic development.

Examples:

- Increase the state Renewable Portfolio Standard;
- Rulemaking pursuant to the Offshore Wind Economic Development Act to establish Offshore Wind Renewable Energy Credits;
- Establishment of an energy efficiency portfolio standard;
- Maximize use of existing authorities to address Highly Warming Gases in industrial, energy and refrigeration operations and monitor and address sources of Black Carbon;
- Align and enforce the state's current building codes with energy efficiency and demand response best practices as well as EV readiness (enforce code compliance, green building codes, energy benchmarking, point of sale disclosure, update change of occupancy requirement).

4. Multi-state approaches.

Examples:

- Join the ZEV memorandum of understanding with the other nine ZEV states and increasing incentives for ZEV purchase and use;
- Rejoin RGGI;
- Participate in the Transportation and Climate Initiative's ongoing consideration of multi-state market-based efforts to reduce greenhouse gas emissions in the transportation sector.

5. Climate change considerations in rulemaking and planning.

Examples:

- Establish a metric for monetizing the social cost of carbon and applying that metric in state rulemaking;
- Consider climate change impacts in statewide planning efforts (e.g., State Development and Redevelopment Plan, the Water Supply Master Plan, the Long-Range Transportation Plan, the Comprehensive Statewide Freight Plan, and the Energy Master Plan) for attaining any new interim and the 2050 limits;
- Consider climate change impacts, the social cost of carbon and contributions to attaining any new interim and the 2050 limits in major investments of public monies, including infrastructure and economic development investments, development and redevelopment of state facilities, and Executive Order 215 Reviews;
- Consider climate change impacts, attainment of any new interim and the 2050 limits, and a social cost of carbon metric in review of filings at the Board of Public Utilities.
- Establish a program that could require or incentivize Metropolitan Planning Organizations to meet state or regional GHG emissions limits;
- Establish leak detection and replacement requirements for natural gas compressor stations and prioritize replacement of distribution pipelines.

6. Equity for populations especially vulnerable to climate change, including socially vulnerable populations and communities that are disproportionately burdened by environmental pollution.

Examples:

- Establish a more formal environmental justice policy and create programs that target benefits to environmental justice communities;
- Identify populations that are especially vulnerable to a changing climate and ensure that climate change mitigation programs, including but not limited to public investment in strategies to reduce greenhouse gas emissions and the establishment of regulatory standards, specifically address the needs of those socially vulnerable populations;
- Establish monitoring programs to ensure that state climate policies contribute to reductions of emissions in communities already disproportionately burdened by pollution.

VII. Conclusion

Meeting the challenge of climate change will require dramatic reductions of emissions by mid-century, as recognized by 195 countries in the Paris Agreement. New Jersey's 2050 limit of reducing emissions 80 percent below 2006 levels by 2050 is consistent with the 2050 targets of other leading states and generally consistent with the Paris Agreement's standard of limiting global warming to well below two degrees Celsius. Achieving these reductions will require approximately 75 percent emission reductions from 2012 levels (the most recent year for which data are available).

The Paris Agreement encourages countries to develop pathways to deep decarbonization, and in recent years the United States, other governments, and independent analysts have conducted such studies. The deep decarbonization analysis conducted by the United States emphasizes three broad categories of action that will also apply to New Jersey: (1) transitioning to a low carbon energy system by cutting energy waste, decarbonizing the electricity system and shifting other energy uses to clean electricity or other low carbon fuels; (2) sequestering carbon through forests, soils, and CO_2 removal technologies; and (3) reducing non-CO_2 emissions that contribute to global warming. New Jersey has certain unique emissions reduction opportunities, including the potential to generate energy from off-shore wind and to implement smart growth, transit, and shared mobility strategies. Another valuable opportunity for New Jersey is its location within the Mid-Atlantic and Northeast where there is considerable multi-state activity in addressing climate emissions (such as the Transportation and Climate Initiative and RGGI) which magnifies an individual state's impact on moving private markets to reduce GHG emissions.

New Jersey has an opportunity to build upon existing programs and authorities and incorporate thinking from current and emerging policies under development by other states to achieve the deep decarbonization necessary to reach a 75 percent reduction of its current GHG emissions necessary to meet its statutory limits for 2050.