



2019 NEW JERSEY

ENERGY MASTER PLAN PATHWAY TO 2050



ENERGY MASTER PLAN

2019 Energy Master Plan: Pathway to 2050

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SECTION 1

2019 ENERGY MASTER PLAN STRATEGIES AND GOALS

Reduce Energy Consumption and Emissions from the Transportation Sector

1.1 Decarbonize the transportation sector

- 1.1.1 Support the deployment of 330,000 light-duty electric vehicles on the road by 2025, per the State Zero-Emission Vehicle Program Memorandum of Understanding
- 1.1.2 Deploy electric vehicle charging infrastructure throughout the state
- 1.1.3 Encourage electric vehicle adoption through the purchase of electric vehicles and incentives for charging station installation in certain locations
- 1.1.4 Increase consumer and fleet owner awareness and acceptance of electric vehicles
- 1.1.5 Roll over the state's light-duty fleet to electric vehicles
- 1.1.6 Continue to improve NJ TRANSIT's environmental performance
- 1.1.7 Increase clean transportation options in low- and moderate-income and environmental justice communities
- 1.1.8 Partner with industry to develop incentives to electrify the medium- and heavy-duty vehicle fleet with battery or fuel cell technology, and to support R&D that will enable such electrification
- 1.1.9 Explore policies that can accelerate adoption of alternative fuels in the transportation sector

1.2 Improve connections between people, jobs, and services

- 1.2.1 Identify opportunities to strengthen connections between people, jobs, and services
- 1.2.2 Energize the implementation of the Transit Village Initiative and transit-oriented development
- 1.2.3 Relieve congestion and idling throughout New Jersey
- 1.2.4 Establish a sustainable funding source for maintaining the transportation system

1.3 Reduce port and airport emissions

- 1.3.1 Support electrification of diesel-powered transportation and equipment at the ports and airports
- 1.3.2 Support a diesel truck buy-out program
- 1.3.3 Support community solar developments on port property

Accelerate Deployment of Renewable Energy and Distributed Energy Resources

2.1 100% clean power by 2050

- 2.1.1 Meet the 50% Renewable Portfolio Standard by 2030 and explore possible regulatory structures to enable New Jersey to transition to 100% clean energy by 2050

- 2.1.2** Ensure at least 75% of electricity demand is met by carbon-free renewable generation by 2050 and set interim targets
- 2.1.3** Routinely model scenarios and pathways to achieve 100% clean energy generation by 2050 with consideration for least-cost options
- 2.1.4** Explore regulatory authority to achieve 100% clean energy by 2050
- 2.1.5** Update interconnection processes to address increasing distributed energy resources and electric vehicle charging
- 2.1.6** Develop mechanisms to compensate distributed energy resources for their full value stack at the regional and federal level
- 2.1.7** Develop low-cost loans or financing for distributed energy resources
- 2.1.8** Coordinate permitting and siting processes for renewable energy development
- 2.1.9** Begin stakeholder engagement to explore rules to limit carbon dioxide emissions from electric generating units

2.2 Develop 7,500 MW of offshore wind energy generation by 2035

- 2.2.1** Develop offshore wind energy generation
- 2.2.2** Develop the offshore wind supply chain
- 2.2.3** Develop job training programs to support the offshore wind industry
- 2.2.4** Support the offshore wind industry through port infrastructure development and inter-regional collaboration

2.3 Maximize local (on-site or remotely-sited) solar development and distributed energy resources by 2050

- 2.3.1** Continue to grow New Jersey's community solar program
- 2.3.2** Transition to a successor solar incentive program
- 2.3.3** Maximize solar rooftop and community solar development in urban and low- and moderate-income communities using the local workforce
- 2.3.4** Develop programs to increase the deployment of solar thermal technologies
- 2.3.5** Mandate non-wires solutions on state-funded projects, including new construction and rehabilitations
- 2.3.6** Develop mechanisms for achieving 600 MW of energy storage by 2021 and 2,000 MW of energy storage by 2030
- 2.3.7** Maximize the use of source separated organic waste for energy production and encourage anaerobic digestion for electricity production or natural gas pipeline injections

Maximize Energy Efficiency and Conservation and Reduce Peak Demand

3.1 Increase New Jersey's overall energy efficiency

- 3.1.1** Implement the Clean Energy Act requirement that electric and gas utilities reduce consumption by at least 2% and 0.75%, respectively, including the establishment of clear performance indicators and evaluation, measurement, and verification methods
- 3.1.2** Increase awareness of and access to New Jersey's Clean Energy Program and its suite of statewide programs
- 3.1.3** Establish strategic and targeted energy efficiency programs to increase energy reductions and customer engagement
- 3.1.4** Establish a clearinghouse for home energy and health and safety programs targeted to low-income households
- 3.1.5** Adopt equitable clean energy financing mechanisms that enable greater penetration of energy efficiency opportunities for all customers
- 3.1.6** Streamline and increase marketing, education, awareness, and program administration
- 3.1.7** Revise street lighting tariffs as necessary to incentivize mass adoption of energy efficiency initiatives

3.2 Manage and reduce peak demand

- 3.2.1** Support and incentivize new pilots and programs to manage and reduce peak demand
- 3.2.2** Pilot alternative rate design to manage electric vehicle charging and encourage customer-controlled demand flexibility

3.3 Strengthen building and energy codes and appliance standards

- 3.3.1** Advocate for net zero carbon buildings in new construction in the upcoming 2024 International Code Council code change hearings
- 3.3.2** Establish transparent benchmarking and energy labeling
- 3.3.3** Establish mechanisms to increase building efficiency in existing buildings
- 3.3.4** Build state-funded projects and buildings to a high performance standard
- 3.3.5** Improve energy efficiency in, and retrofit state buildings to, a high performance standard
- 3.3.6** Increase compliance of mandated building and energy codes
- 3.3.7** Adopt more stringent appliance standards

Reduce Energy Consumption and Emissions from the Building Sector

4.1 Start the transition for new construction to be net zero carbon

- 4.1.1 Electrify state facilities
- 4.1.2 Partner with private industry to establish electrified building demonstration projects
- 4.1.3 Expand and accelerate the current statewide net zero carbon homes incentive programs for both new construction and existing homes
- 4.1.4 Study and develop mechanisms and regulations to support net zero carbon new construction
- 4.1.5 Develop electric vehicle-ready and demand response-ready building codes for new multi-unit dwellings and commercial construction

4.2 Start the transition to electrify existing oil- and propane-fueled buildings

- 4.2.1 Incentivize transition to electrified heat pumps, hot water heaters, and other appliances
- 4.2.2 Develop a transition plan to a fully electrified building sector

Decarbonize and Modernize New Jersey's Energy System

5.1 Plan for and implement the necessary distribution system upgrades to handle increased electrification and integration of distributed energy resources

- 5.1.1 Require utilities to establish Integrated Distribution Plans to expand and enhance the location and amount of distributed energy resources and electric vehicle charging on the electric distribution system
- 5.1.2 Support bi-directional grid power flow and modernize interconnection standards
- 5.1.3 Assess integration of Volt/Var Control
- 5.1.4 Instruct utilities to propose and adopt non-wires solutions

5.2 Exercise regulatory jurisdiction and increase oversight over transmission upgrades within the state to ensure prudent investment and cost recovery from New Jersey ratepayers

- 5.2.1 Exercise regulatory jurisdiction to review and approve the need for transmission projects
- 5.2.2 Advocate for Return on Equity reform
- 5.2.3 Advocate for federal policy changes to address inter-regional cost allocation issues

5.3 Modify current rate design and ratemaking process to empower customers' energy management, align utility incentives with state goals, and facilitate long-term planning and investment strategies

- 5.3.1 Evaluate a strategic and coordinated rollout of Advanced Metering Infrastructure
- 5.3.2 Develop standards to ensure customers have control of and accessibility to free and standardized energy management data
- 5.3.3 Pilot and implement modified rate design to encourage customer-controlled demand flexibility, manage electric vehicle charging, and support demand response programs
- 5.3.4 Assess existing and modified utility rate structures and consider how to ensure rate structures are aligned with implementation of state energy goals

5.4 Maintain existing gas pipeline system reliability and safety while planning for future reductions in natural gas consumption

- 5.4.1 Develop a planning process to quantify and analytically assess the need for future expansion of the gas system and take appropriate action
- 5.4.2 Instruct gas public utilities to propose and adopt non-pipeline solutions when seeking expansion or upgrade of the distribution system
- 5.4.3 Evaluate and support innovative efforts to decarbonize the state's energy system, and perform a study of regulatory and programmatic mechanisms that support, incentivize, or otherwise bolster the natural gas industry to determine if continued support aligns with state goals
- 5.4.4 Instruct gas utilities to identify and prioritize the replacement of pipelines leaking methane

Support Community Energy Planning and Action with an Emphasis on Encouraging and Supporting Participation by Low- and Moderate-Income and Environmental Justice Communities

6.1 Encourage and support municipalities to establish and enact Community Energy Plans

- 6.1.1 Develop a comprehensive Community Energy Plan program in concert with local community groups to identify energy needs and establish ways to participate in and benefit from the clean energy transition at the local level, prioritizing education and incentives in low-income and environmental justice communities
- 6.1.2 Encourage communities to incorporate land use, zoning, and multimodal transportation plans into their Community Energy Plans
- 6.1.3 Prioritize energy efficiency programs in low- and moderate-income and environmental justice communities

6.2 Support local, clean power generation in low- and moderate-income and environmental justice communities

- 6.2.1 Support community-led development of community solar projects
- 6.2.2 Incentivize maximum installation of rooftop and community solar by the local workforce
- 6.2.3 Develop clean energy workforce opportunities and training programs
- 6.2.4 Target distributed energy resource incentives to support local clean power generation in low- and moderate-income and environmental justice communities

6.3 Prioritize clean transportation options in low- and moderate-income and environmental justice communities

- 6.3.1 Prioritize replacement of fossil-fueled public transportation fleets with electric fleets, with a focus on environmental justice communities
- 6.3.2 Support electrification of diesel-powered transportation and equipment, prioritizing those at or near the ports and airports, and consider a diesel truck buy-out program
- 6.3.3 Build or incentivize electric vehicle charging infrastructure and incentivize the adoption of electric vehicles in low-income communities
- 6.3.4 Develop shared mobility programs, including bike sharing, electric taxis, electric ride-hailing and electric car sharing, neighborhood electric vehicles, and scooters and e-bikes

6.4 Identify barriers that prevent the participation in and benefit from the clean energy economy and create outreach programs that work with communities to overcome those obstacles

- 6.4.1 Provide education and community outreach to low- and moderate-income and environmental justice communities to ensure inclusion in the clean energy future

7.3 Provide innovative financing and low-cost loans to support in-state clean energy projects and technology development

- 7.3.1 Establish a New Jersey Green Bank
- 7.3.2 Develop financial protocols to support New Jersey's clean energy economy and the goals of the Energy Master Plan, such as lowering the cost of capital for renewable energy projects, enabling community solar projects, and supporting energy efficiency projects

7.4 Capitalize on offshore wind economic development opportunities, including establishment of the WIND Institute, to provide the coordination and connection to resources, including workforce training, research and development, and capital investments to make New Jersey the home of the U.S. offshore wind industry

7.5 Establish a Clean Energy New Technology Innovation Center and other state-level facilities and resources to support research, development, and commercialization for promising and emerging clean energy innovations

7.6 Explore establishing a Clean Buildings Hub to develop workforce training, awareness, and education for builders, architects, contractors, engineers, real estate agents, and code enforcers in the most efficient electrification, construction, and retrofit building techniques

Expand the Clean Energy Innovation Economy

7.1 Grow world-class research and development and supply chain clusters for high-growth clean energy sub-sectors

7.2 Establish workforce training programs to ensure New Jersey has the local expertise necessary to support a growing clean energy economy and provide support to those in stagnating industries to refine their skills in line with new needs

- 7.2.1 Develop a workforce needs assessment for the clean energy economy
- 7.2.2 Establish a Clean Energy Job Training program to assist current New Jersey workers to pivot their skills as necessary to meet changing industry needs
- 7.2.3 Establish vocational training to establish a pipeline of well-qualified, modern energy specialists

THIS 2019 EMP OUTLINES A ROADMAP WITH SEVEN MAIN STRATEGIES TO REACH THE GOAL OF 100% CLEAN ENERGY BY 2050

through electrifying the transportation and building sectors, promoting energy efficiency, and meeting more than a doubling of load growth with 94% carbon-free electricity (the remaining 6% can be provided with carbon-neutral electricity).

Successfully implementing the strategies within this EMP will result in a drastic reduction in New Jersey's demand for fossil fuels. Making the building, transportation, and electricity sectors more efficient will also contribute greatly toward meeting the state's goals, as eliminating wasted energy and reducing overall consumption is the most cost-effective and cleanest energy system option.

Importantly, in embracing this climate challenge, New Jersey is also poised to take advantage of a profound opportunity to expand the clean energy innovation economy, support New Jersey families, and create new long-term jobs. The state will also be sensitive to the potential for rising costs, and be aggressive in limiting these costs whenever possible through prioritization and phasing in goals over an appropriate and

reasonable timeframe, as well as through measures including energy efficiency, revised rate design and ratemaking processes, and exercising more regulatory oversight over transmission projects.

This 2019 EMP outlines a roadmap with seven main strategies to reach the goals of 100% clean energy and 80% emissions reductions from 2006 levels by 2050:

STRATEGY 1:

Reduce Energy Consumption and Emissions from the Transportation Sector.

In New Jersey, the transportation sector accounts for 42% of the state's net greenhouse gas (GHG) emissions, making it the largest emissions source in the state. The transportation sector should be almost entirely electrified by 2050, with an early focus on light-duty (passenger) vehicles and short-range medium- and heavy-duty vehicles, particularly in environmental justice communities.

New Jersey will continue to encourage electric vehicle (EV) adoption and deployment of EV charging infrastructure throughout the state, in part motivated by the launch of a tri-agency partnership, the Partnership to Plug In—co-led by NJBPU, NJDEP, and NJEDA—to focus on accelerating aspects of EV deployment. NJ TRANSIT will accelerate deployment of electric buses in urban areas and is establishing a schedule for bus fleet conversion. Further, there will be a concerted effort to explore alternative fuel technologies, reduce vehicle miles traveled, and reduce port emissions through initiatives such as expansion of mass transit and electrification of port and airport vehicles and equipment. Fortunately, these changes will also yield many economy-wide financial and health benefits.

STRATEGY 2:

unit dwellings and commercial construction. The state must also develop a transition plan to a fully electrified building sector, including incentivizing appliances like electrified heat pumps and hot water heaters.

STRATEGY 5:

Decarbonize and Modernize New Jersey's Energy System.

New Jersey must plan for, finance, and implement distribution system upgrades that will be required to handle increased electrification and DER integration.

The utilities will establish Integrated Distribution Plans (IDPs) to allow for the anticipated growth of DER and EV charging on the electric distribution system, and should propose and adopt tariffs and other platforms that encourage non-wires solutions using private sector investment. This also involves modifying current rate design and ratemaking processes to empower customers' energy management and self-generation (especially as EVs are increasingly adopted), align utility incentives with state goals, and facilitate long-term planning and investment strategies. Importantly, NJBPU will exercise its regulatory jurisdiction and increase oversight over transmission upgrades.

Further, as New Jersey takes active steps to decarbonize its energy sector, the gas public utilities must assess existing pipeline capacity and plan for a gradual reduction in system use safely, reliably, and affordably, including through the use of non-pipeline solutions. Finally, the gas public utilities must prioritize the repair or possible replacement of pipelines leaking methane.

STRATEGY 6:

Support Community Energy Planning and Action with an Emphasis on Encouraging and Supporting Participation by Low- and Moderate-Income and Environmental Justice Communities.

The state has a responsibility to facilitate equal access to and representation within the clean energy economy and all the opportunities and benefits it provides. In addition, many of the state's economic, climate, and energy goals will be strengthened and enhanced with local support and implementation.

New Jersey will support and incentivize local, clean power generation, especially rooftop solar and community solar, and prioritize clean transportation options in low- and moderate-income and environmental justice communities. The state will also encourage municipalities that house predominantly low- and moderate-income populations to establish community energy plans and enact them with state support to develop programs that support affordable and equitable access to renewable energy and energy efficiency. Finally, the state will work with municipalities to establish local workforce opportunities and job training programs.

STRATEGY 7:

Expand the Clean Energy Innovation Economy.

New Jersey will expand upon its existing 52,000 clean energy jobs and invest in developing clean energy knowledge

The Integrated Energy Plan analyzed changes to New Jersey’s economy-wide energy system (including the electricity, transportation, industry, and building sectors) that would allow the state to meet its clean energy targets, its emission reduction targets, and its energy needs while containing costs. Specifically, the Integrated Energy Plan incorporated analyses on electricity generation, transmission, and distribution; transportation across all vehicle classes; and energy demand from residential, commercial and industrial buildings and built a physical model of an energy system that would meet New Jersey’s energy needs across all sectors. Modeling proceeded in three steps. The model:

1. projected New Jersey’s energy service needs through 2050;
2. calculated the gas fuel, liquid fuel, and electricity required using a stock rollover model; and
3. optimized the infrastructure and fuels that would provide this energy while meeting emissions targets at the lowest possible cost.

The modeling made a number of key assumptions. Using input garnered from two workshops and several webinars and conversations with representative stakeholders, the Integrated Energy Plan team defined nine sets of assumptions (i.e., scenarios) and re-ran the model using each assumption set.

The Integrated Energy Plan provides a roadmap that demonstrates how the state can reliably and affordably meet its climate and energy objectives through 2050, which in this report is defined as the Least Cost scenario. The modeling shows that there are additional pathways to achieve the state’s GHG emission reduction goals and energy needs, but those paths are expected to cost more and take more time to

fully implement, delaying the urgent need to reduce harmful emissions as quickly as possible.

Several key findings emerged from the Integrated Energy Plan analysis:

- New Jersey can meet the 2050 Global Warming Response Act requirement and 100% clean energy target by aggressively deploying existing technologies today and adopting new technologies as they become cost-competitive.
- The costs to meet New Jersey’s emissions and energy targets are small compared to total energy system spending and are offset by clean air and climate benefits.
- Existing policies reduce emissions and are a strong start, but are not sufficient to meet 2050 targets. New Jersey must pursue further action to accelerate its energy system transformation.
- A least-cost energy system that meets New Jersey’s emissions and clean energy targets looks quite different from today’s system, including significantly higher levels of renewables deployment, building electrification, and transportation electrification.
- Both in-state investment and regional coordination are needed to meet New Jersey’s needs and emissions targets at least cost.

The Integrated Energy Plan analysis process suggests a set of most prudent actions that will allow the state to maintain options and ultimately meet its climate and energy goals at least cost. The following table summarizes insights and recommendations from the Integrated Energy Plan, categorized according to the first five EMP strategies, which are specific to the energy sector:

EMP Strategy	Integrated Energy Plan Insights and Recommendations
1. Reduce energy consumption and emissions from the transportation sector	• Accelerating the transition to electric vehicles allows the transportation sector, currently the largest source of carbon emissions in New Jersey, to run on clean electricity.
2. Accelerate deployment of renewable energy and distributed energy	

is also a member of the U.S. Climate Alliance, which aims to reduce state emissions to 26-28% below 2005 levels, or roughly 97 MMTs of CO₂e, by 2025. Today, New Jersey emits 97 MMTs of CO₂e, down from 121 MMTs of CO₂e in 2006, and the state has done significant work to realize substantial emission reductions over the years. However, bold action is necessary to ensure that New Jersey reaches the 2050 target limit.

Figure 1 illustrates measured and projected greenhouse gas emissions from 2006 through 2050. New Jersey achieved a number of energy and environmental goals as set forth in the 2008 EMP and the 2009 GWRA Report, resulting in a reduction in emissions from 2006 through 2016, including a 20% reduction in energy use over a “business as usual” scenario, a 5,700 MW reduction in peak energy demand, and a 30% Renewable Portfolio Standard (RPS) by 2025. The 2009 GWRA Report projected greenhouse gas emissions at 154 MMT of CO₂e in 2020 without changes; today, the state is well below the 2020 GWRA standard of 126 million MMT, and these strategies were achieved while reducing overall energy costs.

Figure 1 also shows two projected pathways from 2016 through 2050, including the upper Reference 1 projection assuming “business as usual,” and the lower Reference 2 projection assuming achievement of Governor Murphy’s energy mandates, including the Clean Energy Act, through 2030.

Modeling indicates that in the Reference 1 scenario, New Jersey is not on track to meet its 80x50 targets, but achieving the goals set by the Murphy administration (Reference 2) will be a significant step toward attaining greenhouse gas emissions reductions and successful implementation of these goals is critical. New Jersey has previously achieved greenhouse

FIGURE 1.
New Jersey’s Greenhouse Gas Reduction Targets Including Clean Energy Act Mandates

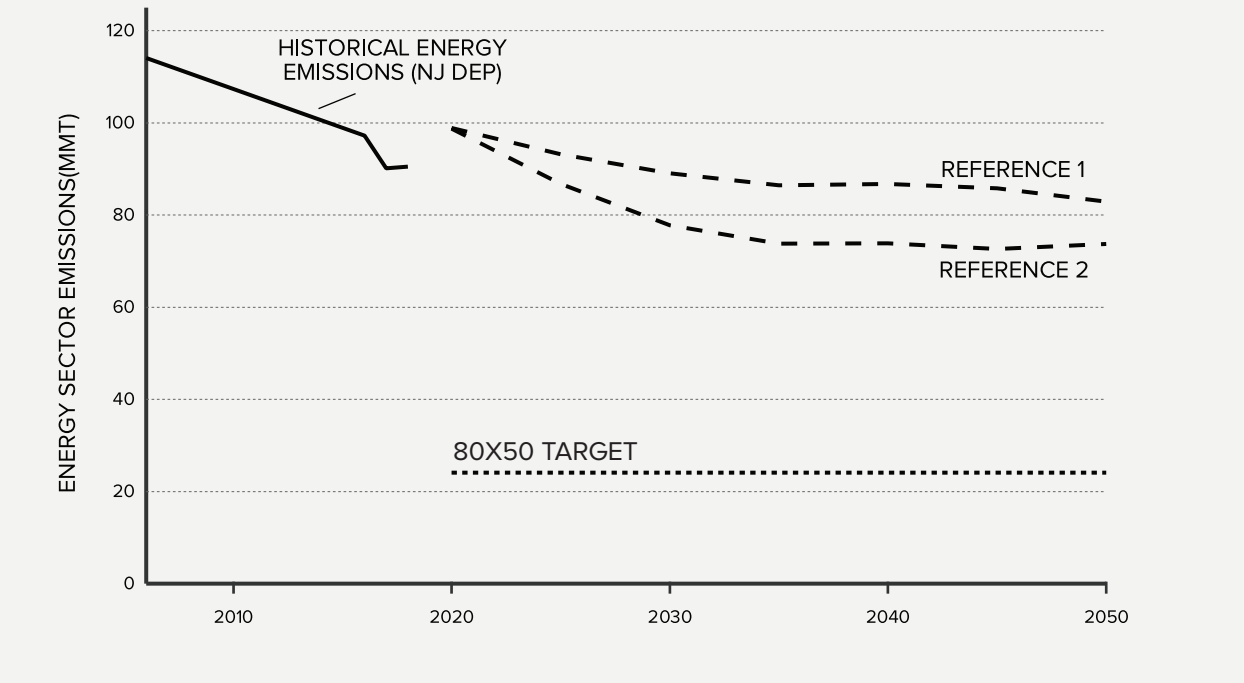


Figure 1: Historical energy sector emissions and emissions projected by the Integrated Energy Plan Reference scenarios as compared to the GWRA “80x50” target. Reference 1 reflects “business as usual” prior to the energy commitments made by the Murphy administration. Reference 2 reflects a “business as usual” pathway assuming achievement of recent energy mandates, including the Clean Energy Act and the State Zero-Emission Vehicle Program Memorandum of Understanding. Note that 2020 emissions are higher than those in 2018 due to economic growth and the retirement of the Oyster Creek nuclear plant.

Achieving the goals set by the Murphy administration will be a significant step toward attaining greenhouse gas emissions reductions and successful implementation of these goals is critical.

gas emissions reduction goals and did so in a cost-effective manner. That said, the pathways to the GWRA 2050 goal cannot simply rely on past actions. In fact, greenhouse gas emissions will rise again if New Jersey does not continue to take aggressive action beyond the 2030 mandates.

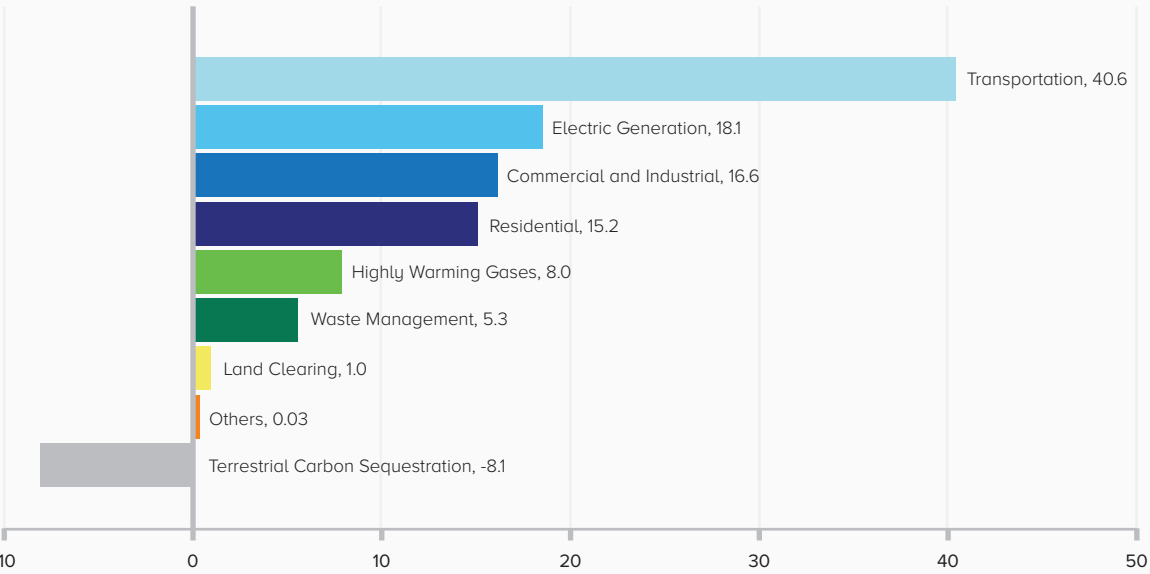
87% of the state’s total greenhouse gas emissions are generated by energy production and consumption (Figure 2). Electricity demand is anticipated to increase, and the state’s highest energy consumption and largest emissions stem from the transportation and building sectors.

FIGURE 2.

Estimated New Jersey Greenhouse Gas Emissions, 2018

(in million metric tons CO₂e)

Total Net Emissions, 97.0 million metric tons CO₂e



Because of this set of factors, New Jersey must look broadly across the entire energy system and engage in a holistic transition to moderate the effects of climate change while continuing to grow the economy and maintain a modern way of life.

This moment demands a comprehensive EMP that will, for the first time, go well beyond electricity generation. New Jersey will pursue the following strategies to grow the innovation economy, develop clean, in-state energy resources, reduce energy demand and reliance on fossil fuels, deliver increased benefits to state residents, and reduce carbon emissions and other air pollutants as it transitions to 100% clean energy and the GWRA 80x50 target:

1. Reduce Energy Consumption and Emissions from the Transportation Sector
2. Accelerate Deployment of Renewable Energy and Distributed Energy Resources

3. Maximize Energy Efficiency and Conservation and Reduce Peak Demand
4. Reduce Energy Consumption and Emissions from the Building Sector
5. Decarbonize and Modernize New Jersey's Energy System
6. Support Community Energy Planning and Action with an Emphasis on Encouraging and Supporting Participation by Low- and Moderate-Income and Environmental Justice Communities
7. Expand the Clean Energy Innovation Economy

The Murphy Administration's Commitment to – and Progress So Far on – Clean Energy

In 2017, Governor Murphy set the trend as the first governor to campaign on 100% clean energy, and he has worked with the Legislature and state agencies to steadily and swiftly advance that promise. The Governor's clean energy agenda is also another way that the administration has put forth policies in a coordinated manner to build infrastructure and train the workforce necessary to realize his vision for the state's innovation economy. Investing in people and communities while advancing clean energy creates good-paying jobs and a diverse ecosystem, and can improve government efficiencies.

One of Governor Murphy's earliest actions was to sign Executive Order No. 7, authorizing the state to rejoin the Regional Greenhouse Gas Initiative (RGGI), which the state left in 2011. NJDEP's final RGGI rules were adopted in June 2019, allowing the state to participate in the RGGI auctions beginning with the first quarterly auction of 2020 (March 2020). Governor Murphy also signed into legislation a bill in February 2018 adding New Jersey as a member of the U.S. Climate Alliance, an alliance of U.S. states committed to advancing the Paris Agreement.

Also during the first weeks of his administration, Governor Murphy signed Executive Order No. 8, directing NJBPU to fully implement New Jersey's Offshore Wind Economic Development Act (OWEDA) – which had been largely neglected under the prior administration – and begin the process of moving the state toward its 2030 goal of 3,500 MW of offshore wind energy generation. In November 2019, Governor Murphy signed Executive Order No. 92, raising this goal to 7,500 MW by 2035.

On April 20, 2018, Governor Murphy signed Executive Order No. 23 authorizing NJDEP as the lead agency in developing guidance for all executive branch departments and agencies for the consideration of

The modeling study identified the most strategic and cost-effective pathway to achieve the 2050 energy and emissions reductions goals and identified the costs and consequences of less optimal pathways.

Since the release of the Draft 2019 EMP in June, NJBPU has collected specific feedback that has informed the final targets and milestones presented in this 2019 Final Energy Master Plan. This was accomplished through a lengthy public comment period—including a separate comment period, workshops, and webinar specifically focused on the Integrated Energy Plan, the modeling of the state’s physical energy system for all fuels and energy usage—as well as eight public meetings and dozens of individual stakeholder meetings.

This final EMP delivers a series of strategies, goals, mechanisms, and agency actions to transition New Jersey’s energy system and put the state on a pathway to a clean energy future. It also incorporates the findings from many of the studies NJBPU has undertaken and establishes implementation details for key initiatives. The EMP is the result of an inter-agency collaboration and stakeholder process to meet the Governor’s stated goal of 100% clean energy by 2050, as set forth in Executive Order No. 28.

A shift of this magnitude has not been seen since the deregulation of the energy system in the 1990s. New Jersey is embarking on a significant transformation in how it generates, distributes, consumes, and conserves energy as it strives to reach 100% clean energy by 2050 and an 80% reduction in greenhouse gas emissions from 2006 levels. Crucial to the success of this transition is a thorough analysis and planning across the state and regional energy system. New Jersey conducted a modeling study for the EMP, the Integrated Energy Plan, which modeled several scenarios reflecting the objectives, strategies, and preferences established in the EMP. The modeling study identified the most strategic and

cost-effective pathway to achieve the 2050 energy and emissions reductions goals and identified the costs and consequences of less optimal pathways.

There is an undeniable uncertainty about how technology will develop over the next thirty years. The Integrated Energy Plan has informed the policies of the EMP such that New Jersey can prioritize and invest in the most prudent strategies that will enable the state to pursue available decarbonization tactics and technologies today, while remaining flexible to pursue alternative paths in line with future developments. Noting this, the Integrated Energy Plan should be refreshed every three years, in conjunction with mandated revisions of the EMP, to ensure New Jersey remains on an optimal, least-cost course to a clean energy future.

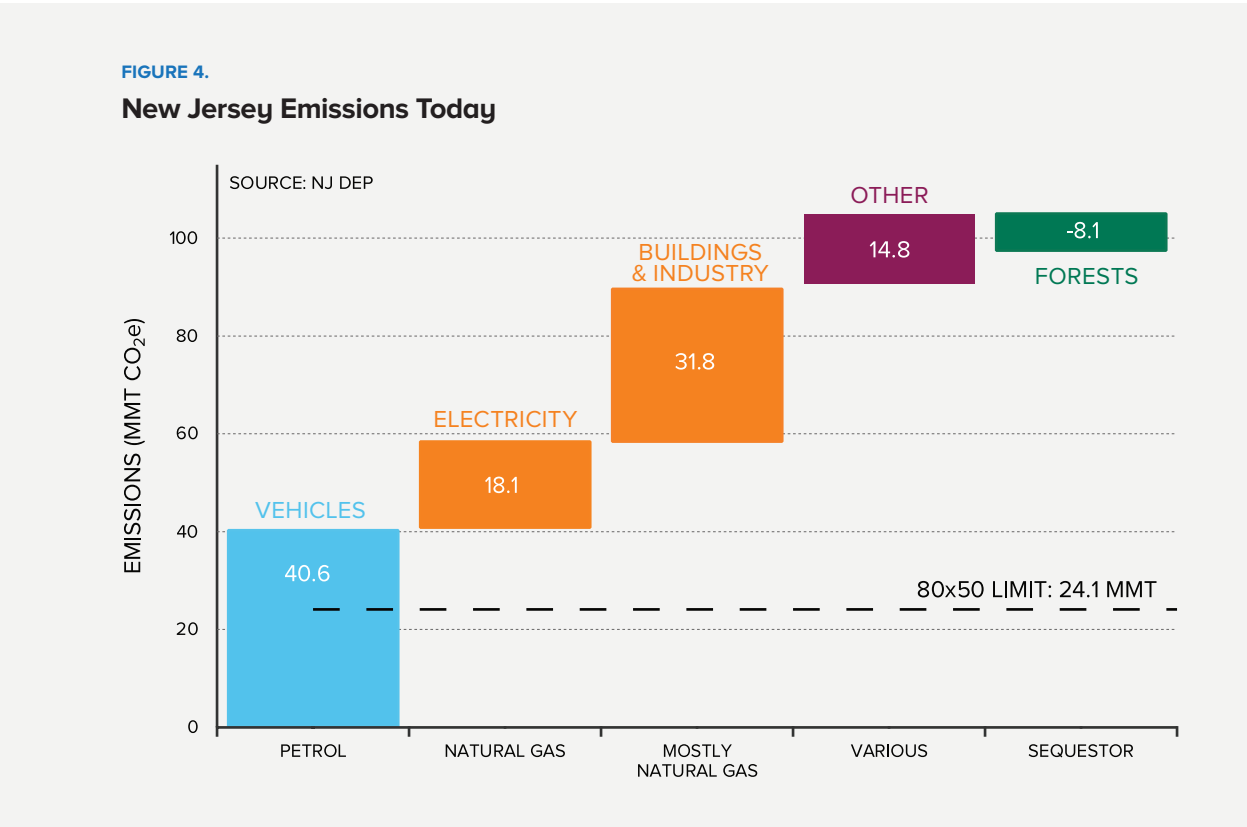
The GWRA Report will incorporate the Governor’s commitment to 100% clean energy by 2050 and the goals and pathways laid out in the EMP for achieving that goal. The GWRA Report will also introduce an evaluation of the state’s emissions in both the energy and other emission-generating sectors. It will make specific recommendations on how to achieve the emissions reduction targets throughout all sectors of the economy, including transportation, housing, agriculture, and consumer products, and will evaluate the economic benefits and costs of implementing these recommendations. This report will be submitted to the Governor and Legislature in June 2020.

In aggregate, these plans cover all aspects of New Jersey’s greenhouse gas emissions and energy system, and will provide guidance, policies, and regulatory and legislative recommendations. The state is keenly aware that as New Jersey, its sister states, and progressive nations around the world are pursuing clean energy systems, the sophistication and cost of developing technologies will continue to evolve rapidly. The EMP and GWRA Report are designed to be living documents to be continually reassessed, remodeled, and reprioritized as early objectives are achieved and newly emerging pathways mature.

New Jersey’s energy system today

New Jersey’s energy system today, like many other states, is reliant on the use of fossil fuels in transportation, buildings, and the electric power sector (Figure 4). The state currently emits approximately 97 million metric tons (MMT) of carbon dioxide (CO₂) each year, compared to the Global Warming Response Act (GWRA) target of 24.1 MMT in 2050, and generates over half of its electricity from carbon-emitting sources, compared to Governor Murphy’s 100% clean energy target by 2050 (Figure 5). The Integrated Energy Plan study was commissioned in part to lay out a roadmap for New Jersey to transition its energy system to reach these goals in an economically beneficial and responsible manner.

Figure 4: New Jersey carbon emissions today largely come from gasoline use in vehicles and natural gas use in buildings and power plants. Source: New Jersey Department of Environmental Protection.



Integrated Energy Plan methodology

In partnership with NJBPU and NJDEP, and with participation from other state agencies, Rocky Mountain Institute (RMI) and Evolved Energy Research (Evolved) designed an approach for the Integrated Energy Plan effort with five key features:

FIGURE 5.
Historical New Jersey Electricity Generation

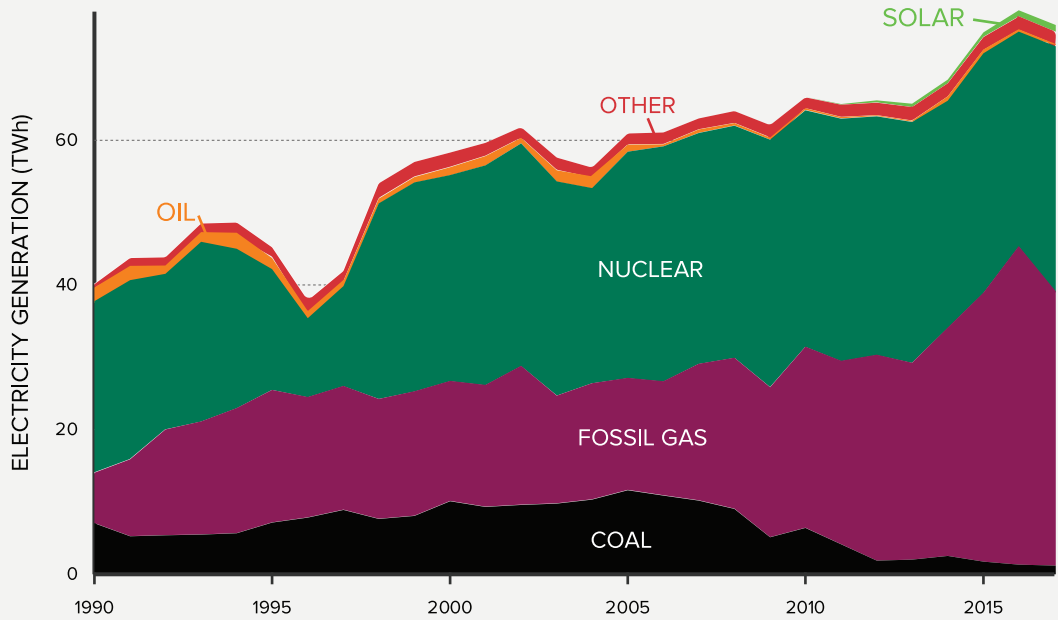
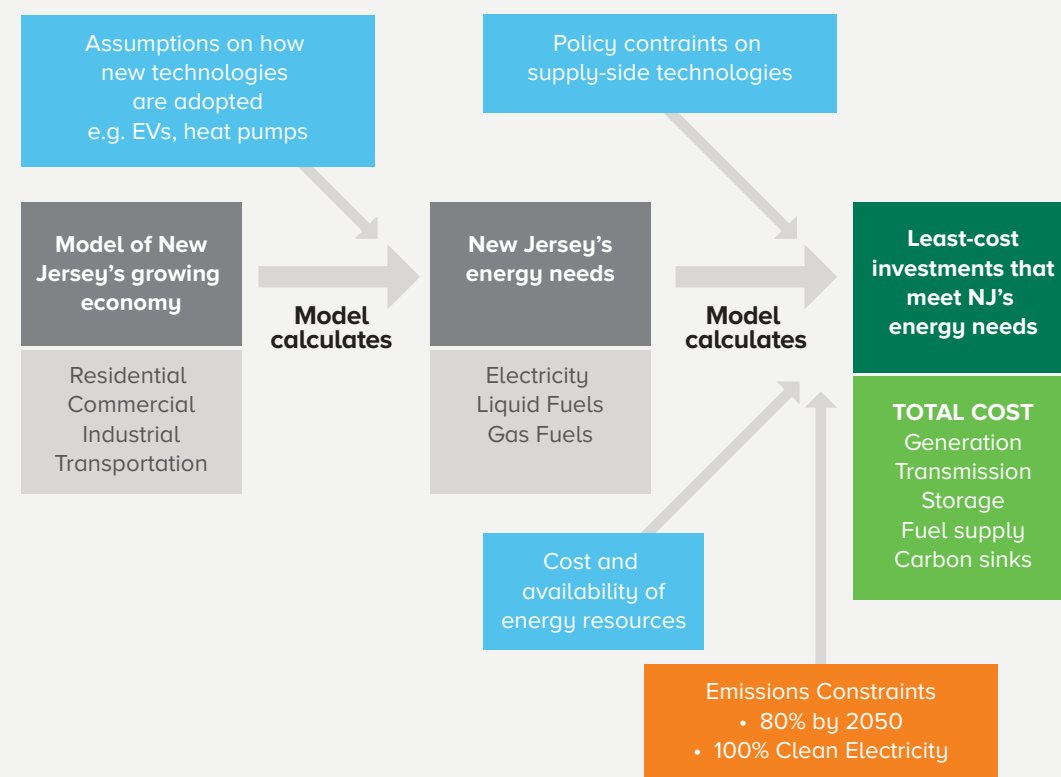


Figure 5: Electricity generation in New Jersey is dominated by natural gas and nuclear power plants, which provide nearly all of the state’s electricity needs. Source: U.S. Energy Information Administration.

- 1. Policy-informed analysis approach:** The Integrated Energy Plan team modeled the impact of all existing policies and targets relevant to New Jersey’s energy system, including the GWRA and Governor Murphy’s Executive Order No. 28 (100% clean energy by 2050), among others.
- 2. Leading-edge, regional-scale, economy-wide energy system modeling:** The Integrated Energy Plan team employed leading analysis tools, validated through previous studies across the U.S. and globally, to comprehensively address the regional, multi-sectoral, and demand side-oriented questions that are critical to enable a low-cost pathway that can meet New Jersey’s energy and climate goals.
- 3. Rigorous, New Jersey-specific data gathering and validation:** The Integrated Energy Plan team utilized the best available data on New Jersey-specific energy systems, energy resource potentials, and costs of known, commercially available technologies to parameterize the modeling tools used for the study.

FIGURE 6.

Integrated Energy Plan Modeling Approach



Importantly, the Integrated Energy Plan analysis uses a physical model – meaning that it optimizes investments that meet New Jersey’s needs at least cost but does not take into account many existing regulatory, market, or electricity rate structures that presently guide investment in and use of the state’s energy system. This approach represents the fundamental system changes necessary to meet long-run climate targets, recognizing that present-day structures can change over time. Because it is a physical model, the analysis does not account for intra-state subsidies such as the Zero Emission Credits (ZECs), Societal Benefit Charges (SBCs), Renewable Energy Certificates (RECs), Investment Tax Credits (ITCs), or other subsidies, because these programs transfer funds from one New Jersey stakeholder to another. This approach simultaneously identifies the most prudent pathways for the physical energy system in

light of an evolving and technologically maturing system, while also informing the regulatory positions necessary to achieve New Jersey’s emissions reduction goals. There are several pathways to reach the 100% clean energy goal; the Integrated Energy Plan identifies the optimal approach based on today’s most cost-effective technologies. For this reason, it will be important for New Jersey to monitor progress toward the 2050 goals and to modify and adjust the pathways to the goals as technology availability and cost change over time.

Equally important to note, the costs shown in the Integrated Energy Plan results are full system costs, and include categories of considerations such as fuel purchases, vehicle purchases, appliance purchases, and the costs to build, operate, and maintain electricity generation resources. The Integrated Energy Plan’s modeled costs include much more than what is contained within ratepayers’ electricity bills, and as such, cannot be characterized or interpreted as ratepayer impacts. In addition, the modeling also does not account for the value of health or environmental benefits associated with meeting clean energy and climate goals.

The model assumes that New Jersey also takes actions to reduce emissions from non-energy sector sources, such as halogenated gases and waste management, and improves its forest management practices to bolster carbon sequestration. NJDEP reports that the net sum of non-energy sector emissions and land-based sequestration is 6.5 MMT in 2018. By implementing aggressive best practices, NJDEP expects that these net emissions can be reduced to 2.8 MMT in 2050. Therefore, the Integrated Energy Plan modeling assumes that non-energy sector emissions decrease to 2.8 MMT through these practices.

The Integrated Energy Plan identifies the optimal, least-cost approach to reach 100% clean energy by 2050 based on today’s most cost-effective technologies.

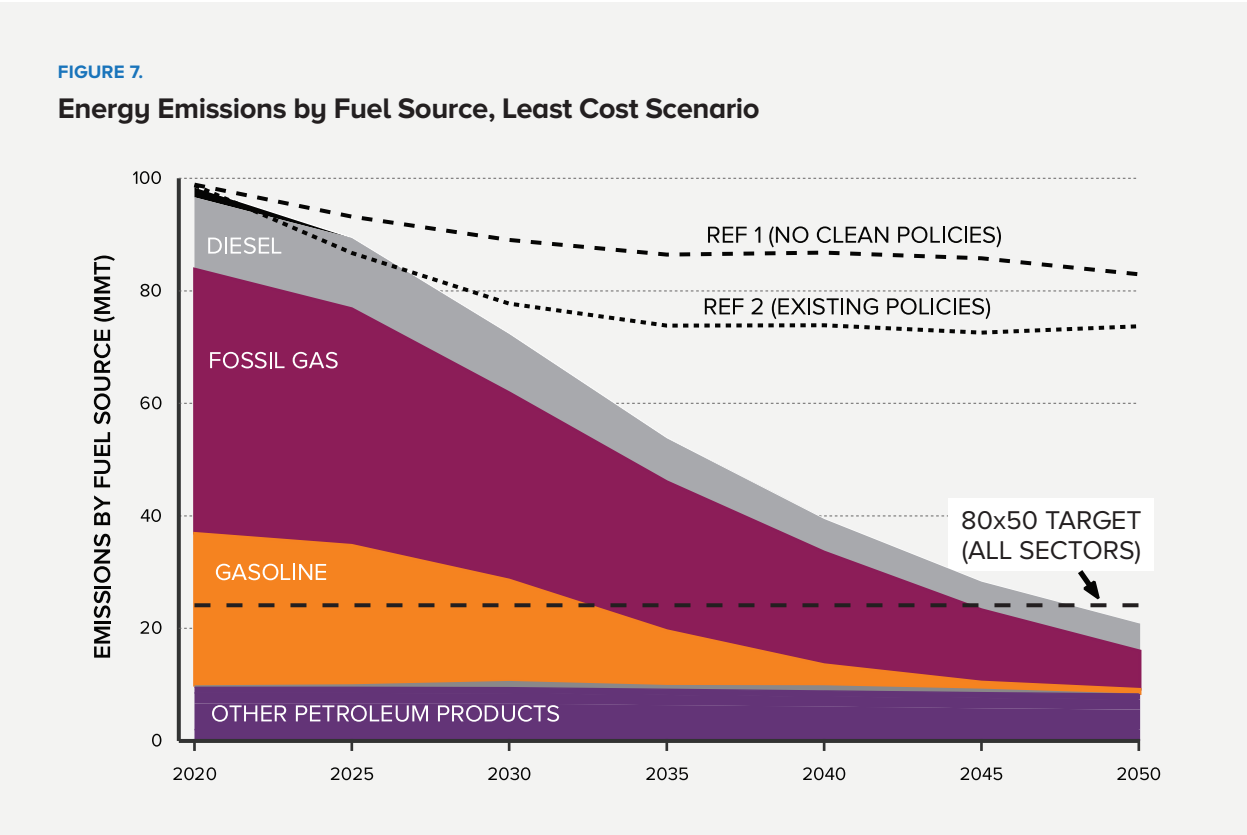
Key Findings

The Integrated Energy Plan modeling produced five key findings:

- 1. New Jersey can meet Global Warming Response Act and 100% clean energy targets by aggressively deploying existing technologies today and adopting new technologies as they become cost-competitive.

In the Least Cost scenario that meets New Jersey’s 2050 targets evaluated within the Integrated Energy Plan, the state can reduce GHG emissions by more than 80% (Figure 7) and provide 100% of its electricity generation needs with carbon-neutral resources, including generating roughly 94% of annual electricity from carbon-free sources (e.g., renewables and nuclear) (Figure 8). The Least Cost scenario relies on the state to scale up deployment of existing technologies,

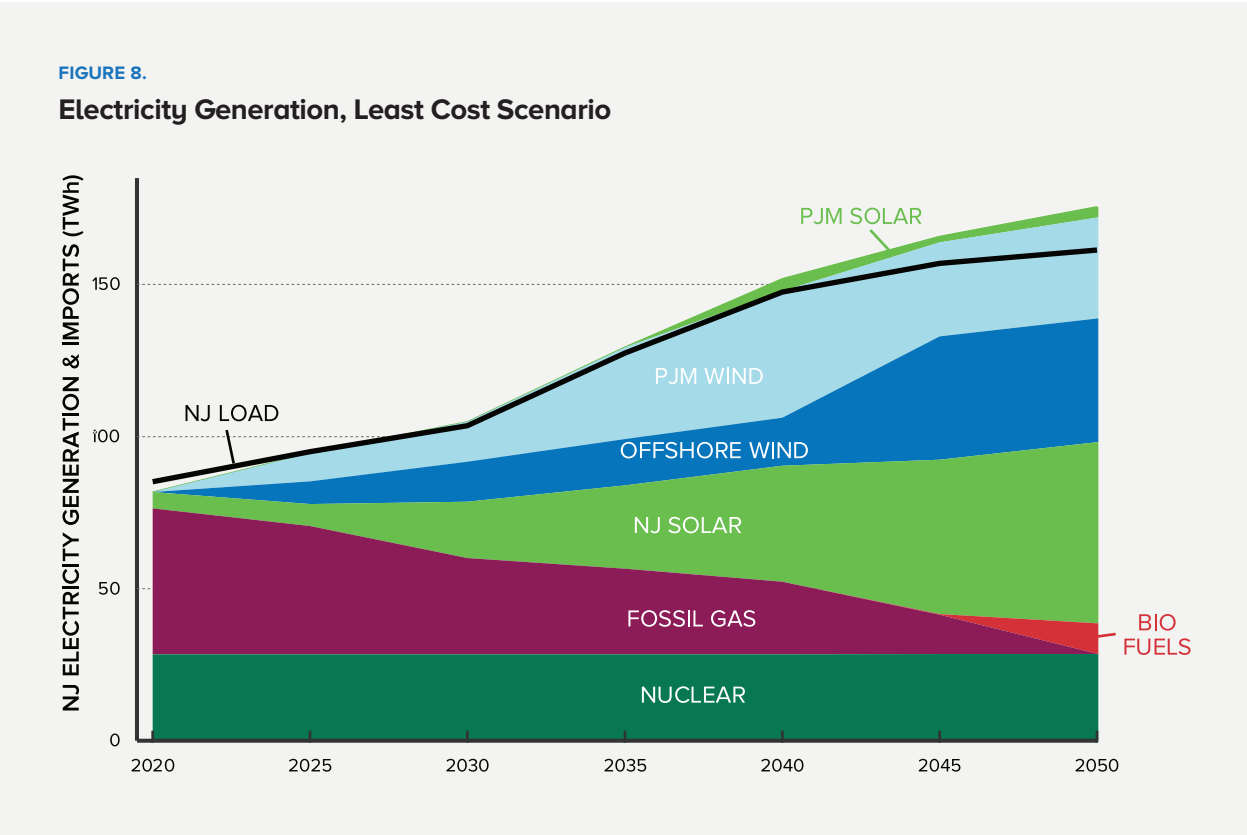
Figure 7: Economy-wide emissions fall to meet 80x50 emissions target.



including energy efficiency technologies, electric vehicles, air-source heat pumps, offshore wind turbines, utility- and rooftop-scale solar photovoltaics (PV), and others. Existing assets, including natural gas and nuclear-fueled power plants in the state, are retained to provide reliable electricity to New Jersey homes and businesses, while an increasing amount of electricity generation comes from in- and out-of-state renewable resources.

By 2050, to meet the requirements of the 100% clean energy target laid out in Executive Order 28, the Least Cost scenario includes a small amount (i.e., approximately 6% of annual electricity) of “clean firm” technology, such as biologically-sourced gas (“biogas”) from energy crops, to provide reliable energy to the system when in- and out-of-state renewable generation is unavailable; this transition from natural gas to biogas or alternative fuels would begin around 2045.

Figure 8: Carbon-neutral electricity grows and transitions to meet 100% clean energy.



Together, the direct health cost and indirect climate change mitigation savings that the state will enjoy through the Least Cost scenario will more than offset the incremental investments needed to meet New Jersey's 2050 targets.

2. Costs to meet targets are small compared to total energy system spending, and they are more than offset by clean air and climate benefits.

The Integrated Energy Plan modeling approach calculated the net cost associated with different pathways that meet New Jersey's 2050 goals relative to the costs of a "business as usual," or reference case, that does not meet the 2050 goals. On average over the period 2020 to 2050, the Least Cost scenario that meets the state's 2050 goals increases energy system spending by only 0.2% of gross state product (GSP) compared to the reference case (Figure 9). In 2050, the annual net cost of the Least Cost pathway for meeting the state's goals is \$2.2 billion (in constant 2018 dollars) more per year than the reference case (Figure 10), rising from \$30.8 billion to \$32.4 billion. This cost increase is not equivalent or directly translatable to ratepayer impacts, because it includes a broader definition of economy-wide energy system spending, including incremental demand-side equipment (e.g., any incremental consumer costs associated with purchasing electric vehicles rather than conventional vehicles) that are not included when calculating ratepayer costs.

Just as the Integrated Energy Plan does not account for incentives and subsidies, the scenario-based Integrated Energy Plan modeling does not account for the value of health or environmental benefits associated with meeting clean energy and climate goals. However, the Integrated Energy Plan team did compare these cost savings against the incremental investments needed in order to meet New

Figure 9: Meeting emissions targets increases the average costs of New Jersey's total annual energy system from 3.5% to 3.7% of GSP.

Jersey's clean energy and emissions reduction targets. In 2016, the American Lung Association analyzed the health costs resulting from exposure to air pollution from passenger vehicles in New Jersey and found that the direct health costs totaled \$3 billion in 2015. The Integrated Energy Plan's Least Cost scenario would avoid these health costs, due to 100% adoption of zero-emissions passenger vehicles by 2050, in addition to significant adoption of zero-emissions medium- and heavy-duty vehicles. These benefits start to accrue long before 2050, as the transition to a cleaner energy sector and transportation sector begins and ramps up over time.

Additional benefits associated with reduced greenhouse gas emissions from other sectors would total \$4 to 6 billion in savings per year in 2050, depending on the assumed value of the social cost of carbon (Figure 10).¹² Together, these direct health cost and indirect climate change mitigation savings more than offset the \$2.2 billion per year incremental investment to meet New Jersey's 2050 targets. Importantly, the health benefits will apply more directly to environmental justice communities and other New Jersey residents who are currently disproportionately burdened by air pollution.

FIGURE 9.
Average Annual Energy Cost, 2020-2050

FIGURE 10.

Benefits and Incremental Costs to New Jersey in the Least Cost Scenario

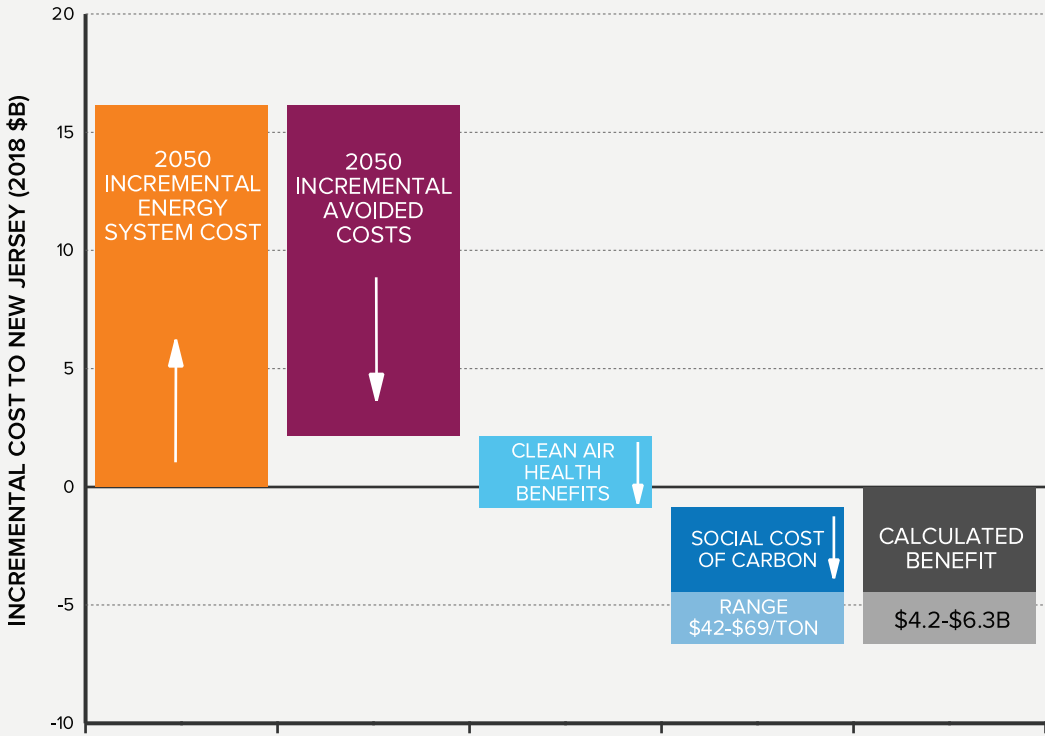


Figure 10. Incremental costs of meeting emissions targets are offset by fossil fuel cost savings and cost savings associated with reduced pollution.

3. Existing policies reduce emissions, but not enough to meet Global Warming Response Act and 100% clean energy targets.

Under existing New Jersey policies, including deployment targets for offshore wind, in-state rooftop solar generation, and energy storage, as well as energy efficiency savings goals, the state's emissions would continue to fall through 2035. Electric vehicle targets (i.e., 330,000 EVs on the road by 2025) also contribute significantly to reducing emissions from gasoline use, while offshore wind and solar deployment reduce generation and associated emissions from New Jersey's fleet of natural gas-fired power plants. Under existing policies, the trajectory of emissions reductions is consistent with a Least Cost pathway to meet 2050 goals through the late 2020s, but then it begins to plateau as the effects of existing policies are fully realized. In that scenario, the state's energy emissions would remain

flat from 2035 through 2050. This means that New Jersey will need to implement additional policies or other actions to build upon the progress made by existing policies and to continue reducing emissions at a pace necessary to reach the state's 2050 goals.

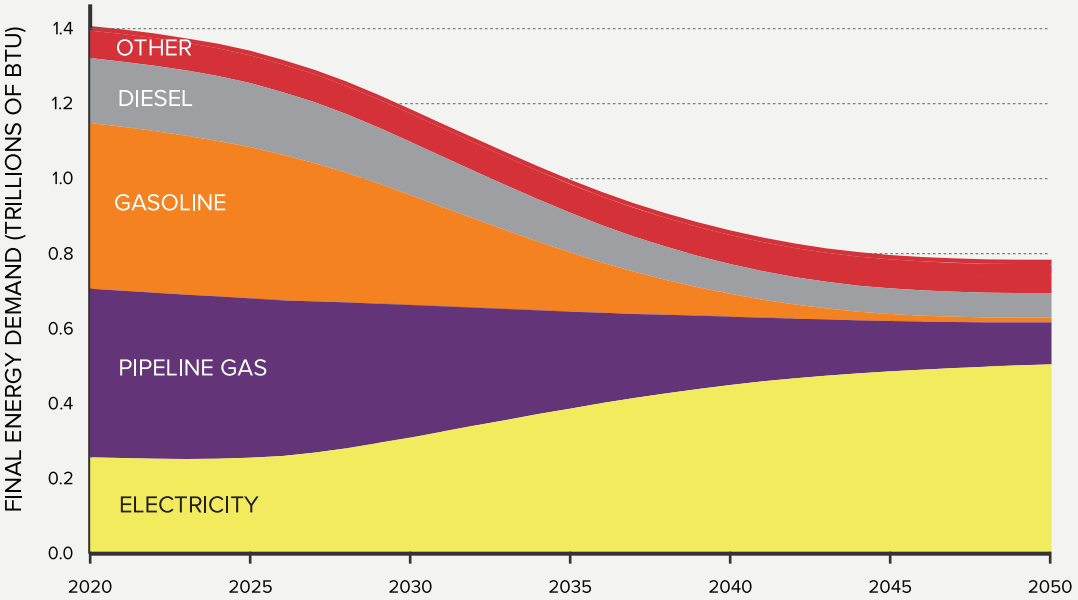
4. A least-cost energy system that meets New Jersey's emissions and clean energy targets looks quite different from today's system, including significantly higher levels of renewables deployment, building electrification, and transportation electrification.

The Integrated Energy Plan revealed that a least-cost energy system in New Jersey that meets the state's 2050 goals is likely to consist of a set of energy resources that are comprised of and operated very differently than what is used today. In particular, the Least Cost scenario includes electrification of 90% of thermal loads in buildings (i.e., water heating, space heating) by 2050, as well as electrification of the vast majority of vehicles. Electrification of these end-uses has the effect of more than doubling demand for electricity compared to 2020 levels, but at the same time reducing final energy demand because heat pumps and electric motors are far more efficient than

Figure 11. Building electrification and EV adoption reduce final energy demand for fossil fuels while increasing demand for electricity.

FIGURE 11.

Final Energy Demand Least Cost Scenario



as possible. The state will accomplish these goals through electrification and other decarbonization strategies in the transportation sector, by reducing reliance on passenger vehicles—particularly single passenger—and by increasing the use of mass transportation.

GOAL 1.1: DECARBONIZE THE TRANSPORTATION SECTOR

- 1.1.1 Support the deployment of 330,000 light-duty electric vehicles on the road by 2025, per the State Zero-Emission Vehicle Programs Memorandum of Understanding**
- 1.1.2 Deploy electric vehicle charging infrastructure throughout the state**
- 1.1.3 Encourage electric vehicle adoption through the purchase of electric vehicles and incentives for charging station installation in certain locations**
- 1.1.4 Increase consumer and fleet owner awareness and acceptance of electric vehicles**
- 1.1.5 Roll over the state’s light-duty fleet to electric vehicles**
- 1.1.6 Continue to improve NJ TRANSIT’s environmental performance**
- 1.1.7 Increase clean transportation options in low- and moderate-income and environmental justice communities**
- 1.1.8 Partner with industry to develop incentives to electrify the medium- and heavy-duty vehicle fleet with battery or fuel cell technology and to support R&D that will enable such electrification**
- 1.1.9 Explore policies that can accelerate adoption of alternative fuels in the transportation sector**

To reach New Jersey’s mandated goal of 80% emission reductions by 2050 relative to 2006 levels (80x50), New Jersey will decarbonize most of its transportation sector, primarily through electrification. Battery electric vehicles are the most common electric vehicles (EVs) today, but the technology for fuel cells, which use hydrogen to produce electricity instead of a battery, is also gaining traction in the U.S. marketplace, with particular applicability in the non-road sector. As discussed earlier in Section 4: 100% Clean Energy by 2050, electrifying the transportation sector will have several major benefits:

- Electrified transportation is considerably more efficient than conventional transportation, particularly if properly planned with managed charging through an Integrated Distribution Plan (see Goal 5.1.1).** Light-duty (passenger car) EVs are three to five times more efficient per mile traveled than their gas-fueled counterparts. Transitioning from conventional to battery or fuel cell (hydrogen) EVs will reduce New Jersey’s overall energy consumption.

Transportation and the Integrated Energy Plan

Integrated Energy Plan Approach

The Integrated Energy Plan focused on estimating the cross-sector impacts of vehicle electrification in the context of meeting New Jersey’s 2050 targets. In the Least Cost scenario, the Integrated Energy Plan assumed rapid electric vehicle (EV) adoption, with all new light-duty vehicle (i.e., passenger cars) sales comprised of EVs by 2035. Given an assumed 15-year vehicle life, this leads to a fully electric fleet in 2050. Medium- and heavy-duty

Electrification of the transportation sector is one of the most cost effective ways of meeting New Jersey’s 80x50 carbon emissions reduction target.

- **Electrified transportation is less polluting than conventional transportation.** As discussed above, electrified transportation produces fewer greenhouse gas emissions or other air pollutant emissions, including carbon monoxide, nitrogen oxides, particulate matter, black carbon, and hydrocarbons, than are released at the tailpipe of gasoline and diesel-fueled vehicles. Because New Jersey’s electricity generation sector heavily relies on nuclear energy and will increasingly utilize renewable energy, electrifying transportation will provide net emission and air pollution benefits.
- **Electrified transportation can provide grid benefits such as better utilizing the distribution grid, shaving peak load, and providing power back to the grid.** With managed charging, battery EVs can charge when there is excess capacity or reduced demand, better utilizing the distribution grid during off-peak times. Further, as Vehicle-To-Grid technology matures, electrified vehicles on the grid can provide mobile battery storage and load balancing power, which will further reduce or shift energy demand to avoid increased capacity costs.

Electrification of the transportation sector is one of the most cost effective ways of meeting New Jersey’s 80x50 carbon emissions reduction target. According to the Integrated Energy Plan modeling, significantly electrifying the transportation sector results in billions of dollars in savings when compared to a scenario in which transportation electrification was greatly reduced. While there is a short-term increase in costs as the state rolls out new electric cars and associated infrastructure, those costs are more than recouped later, and the initial stages of the effort yield many economy-wide financial benefits, all of which point to building a thriving innovation-based economy in the state, including:

- Creating jobs in construction, the trades, planning, and engineering to provide, wire, and install EV infrastructure and to modernize, upgrade, and maintain the distribution grid and all its connected components;
- Reducing medical visits and time off from work or school due to fewer pulmonary and respiratory illnesses associated with pollution;
- Protecting consumers from wide swings in the cost of gasoline and diesel; and
- Potentially reducing the overall cost of electricity for all customers through more efficient utilization of the grid and by using EVs as “virtual power plants” that can offset the need for other electric grid investments.

Detailed modeling for the Integrated Energy Plan suggests that to reduce greenhouse gas emissions in accordance with the Global Warming Response Act at the least cost, all new passenger vehicle sales should be electric by 2035, and 75% of medium-duty vehicles and 50% of heavy-duty vehicles should be electrified by 2050. Such modeling does not take into account possible future market transformations, such as the proliferation of hydrogen fuel cell or other alternative fuels, which may be impactful, particularly for medium- and heavy-duty vehicles and off-road mobile sources. The state should encourage aggressively pursuing today’s available decarbonization technologies, including battery electric, hybrid, and fuel cell.

As an additional interim goal, the state—largely through its bi-state partnership at the Port Authority of New York New Jersey (Port Authority)—should also encourage the transition to plug-in hybrid heavy-duty vehicles, since the technology to electrify these larger vehicles is less commercially mature than it is for light-duty vehicles. The state may also explore policies that encourage cleaner liquid fuels for heavy-duty and specialized equipment for which commercially

drive consumer adoption of EVs. The state is pursuing “cash-on-the-hood” incentives to purchasers of EVs. Such incentives bring the cost of EVs in line with the costs of a petroleum-fueled vehicle – particularly after the lower operations and maintenance, fuel, and other costs of owning an EV are taken into consideration. In order to ensure that all residents benefit from the transition to EVs – regardless of income – many states have adopted a tiered incentive system that provides larger incentives for low- and moderate-income families. Many also provide a proportional incentive for used EVs, which likewise brings the cost of EV ownership within reach of more New Jersey residents. The state should consider establishing similar mechanisms, which are likely critical to meeting the state’s targets, along with significantly expanded access to EV infrastructure and rate reform, both of which are discussed below.

Goal 1.1.1: Support the deployment of 330,000 light-duty electric vehicles on the road by 2025, per the State Zero-Emission Vehicle Programs Memorandum of Understanding.

Governor Murphy signed the State Zero-Emission Vehicle Programs Memorandum of Understanding (ZEV MOU) in 2018.^{xi} As part of the Multi-State ZEV Task Force, which includes nine states in the Northeast, the Mid-Atlantic, and the West Coast, New Jersey is supporting deployment of 330,000 zero emission vehicles in the state by 2025; the collective target for all ZEV Task Force states is 3.3 million by 2025. The ZEV MOU defines ZEVs to include battery-electric vehicles, plug-in hybrid electric vehicles, and hydrogen fuel cell electric vehicles.^{xii} The task force will collaborate on infrastructure development, incentivizing EV adoptions, transitioning municipal fleets, and dealership and consumer education and outreach.

Previously, New Jersey enacted the Clean Car Program in 2004, which adopted California’s Zero-Emission Vehicle Program and applies to vehicles from Model Year 2009 and newer.^{xiii} Due to program design that allowed car manufacturers to sell New Jersey’s allotment of clean cars to California, the Clean Car Program was largely symbolic until 2017. Today, New Jersey is one of ten states in the U.S. mandating that an increasing percentage of zero-emission or plug-in hybrid vehicles be produced and delivered for sale in New Jersey.

Goal 1.1.2: Deploy electric vehicle charging infrastructure throughout the state.

In order to meet New Jersey’s ambitious goal to put 330,000 ZEVs on the road by 2025, the state needs to create a comprehensive “EV Ecosystem” that provides consumers with easy access to charging infrastructure for

Among the largest barriers to mass adoption of passenger EVs are range anxiety, the high upfront capital costs of EVs compared to their gas-powered counterparts, limited model choices, outdated electricity rate structures, and the lack of consumer and dealer awareness.

EVs, as well as e-scooters and e-bikes, where they live, work, and recreate, in partnership with New Jersey’s employers, property owners, electric public utilities, consumers, and investors. New Jersey must establish the entire state as “range safe” by substantially increasing publicly accessible electric charging infrastructure. That means a rapid expansion of the number of locations to charge vehicles, as well as the quality of the charging

In implementing these policies, New Jersey should adopt a “shared responsibility” model for EV infrastructure that promotes appropriate roles for both the utility and for private investors.

To support its electrification efforts, New Jersey will need to revamp electricity rate structures to better support charging in the places where our residents live and work. For example, the demand charge rate structure used by most of New Jersey’s utilities can make it prohibitively expensive to install high capacity charging stations, particularly in multi-family dwellings or at small-to-medium size commercial businesses. Possible solutions include either eliminating demand charges for EV chargers or providing a “demand charge holiday” for electric customers installing new high-capacity charging stations that are made available to the public.

New Jersey is committed to leveraging a combination of funds from the Volkswagen Settlement Fund, the NJ Clean Energy Program, utility programs, public-private partnerships, and other sources of funding to build out initial charging infrastructure. The Murphy administration in June 2019 announced the New Jersey Partnership to Plug-In, a statewide partnership, co-led by NJDEP, NJBPU, and NJEDA, to build out the necessary infrastructure to support EV ownership to improve air quality and reduce greenhouse gas emissions. NJDEP has thus far earmarked \$27.5 million from the Volkswagen Environmental Mitigation Trust for charging infrastructure technology via the “It Pay\$ to Plug-In” program, as well as for electric heavy-duty garbage trucks, school buses, port-related vehicles, and electric transit buses for use in the City of Camden.

NJDEP is also mindful of the developments in fuel cell technology and hydrogen fueling infrastructure and is particularly interested in the potential for hydrogen to be produced using sustainable, less resource intensive methods.

Additional agencies, including NJDCA, NJMVC, and NJDOT, will further support the Partnership to Plug-In. As an example, NJDCA will:

- (1) produce model municipal zoning ordinances to (a) require EV charging infrastructure in new or redeveloped parking areas for residential and non-residential development (including allowing EV parking to count toward minimum parking requirements); (b) permit EV charging infrastructure as an accessory use in select or all zoning districts; and (c) restrict the use of those designated parking spaces for EVs only;
- (2) encourage municipalities to update zoning ordinances, Master Plans, and Redevelopment Plans to include EV charging infrastructure, and to apply for state grants to install EV charging infrastructure in public parking lots and parking garages;

(3) draft model permitting guidelines for municipalities regarding when construction permits and inspections are required and regarding ways to expedite the permitting process; and

(4) update building codes as permitted to encourage or require appropriately sized electric conduits and wiring (i.e., EV readiness) for EV charging infrastructure in new construction, major renovations and—to support the adoption of EVs among residents of apartments, townhouses, and condominiums—when electric infrastructure upgrades occur in multi-unit dwellings.

NJDEP will support NJDCA by developing a set of best practices for local approval of EV charging stations with the goal of streamlining and standardizing the process. NJDEP will also partner with NJDCA to

NJBPU should work with both the utilities and operators of electric vehicles (with school bus operators being a prime candidate) to pilot the Vehicle-to-Grid technologies that hold promise as a source of grid services that can help make the total net cost of EV ownership more economical.

implement innovative EV-specific rates that encourage charging at times of the day that minimize the stress on the grid, as well as to modify the utilities’ demand charges for EVs to avoid significantly impacting commercial and industrial electricity bills. In addition, NJBPU should work with both the utilities and operators of electric vehicles (with school bus operators being a prime candidate) to pilot the Vehicle-to-Grid technologies that hold promise as a source of grid services that can help make the total net cost of EV ownership more economical.

In keeping with New Jersey’s commitment to the State Zero-Emission Vehicle Programs MOU, the Partnership to Plug-In will collaborate with utilities, industry, public and private fleets, non-profit and community organizations, investors, and other energy providers to establish an implementation roadmap for the strategic mapping underway by NJDEP to install charging infrastructure in strategic and critical locations. This will include assessing the distribution of Level 2 and DC Fast Charging stations and identifying a clear role for regulated utilities and the private sector in building out the infrastructure. As discussed above, this shared responsibility model ensures that utility providers and other stakeholders can offer a significant opportunity for widespread charging deployment across multiple transportation modes and sectors (i.e., residential, multifamily, workplace, fleets, and public DC fast charging), using both rate-based and non-rate-based solutions, and resulting in diminished consumer “range anxiety” and increased EV adoption rates.

The state can further encourage adoption of these technologies by asking both regional Metropolitan Planning organizations and Transportation Management Associations to incorporate alternative fuel and EV charging planning activities into their short-term work programs and long-term plans. In planning for EV infrastructure, the Partnership to Plug-In should consider the integration of Mobility on Demand services, which have the potential to decrease personal vehicle ownership and increase the use of shared EVs. Finally, as charging infrastructure becomes more built out, NJBPU must use its regulatory authority to ensure that EV drivers are paying just and reasonable rates for charging services. In doing so, NJBPU should work to ensure that infrastructure is accessible to all ratepayers and that non-ratepayer dollars are utilized whenever possible. The state will lead by example by installing EV chargers at state parking lots and garages, state parks, and other locations under its jurisdiction.

Goal 1.1.3: Encourage electric vehicle adoption through the purchase of electric vehicles and incentives for charging station installation in certain locations.

In an effort to bolster EV adoption and market maturation, New Jersey supports reducing the upfront cost of EVs through incentives for charging station installation and EV purchases and leases. NJBPU’s Clean Fleet EV Incentive Program helps local governments throughout New Jersey in their efforts to electrify transportation. This program provides grants to local government authorities for the purchase of up to two electric vehicles and one Level 2 charging station for their fleets. Priority will be given to low- and moderate-income communities and to those local governments purchasing their first EVs and committing to public access at their charging stations.

As noted above, through the Partnership to Plug-In, NJDEP will continue the It Pay\$ to Plug-In program to subsidize the cost of installing electric charging infrastructure, and NJBPU will develop incentives for the purchase and lease of EVs. While strategically mapping preferred locations for charging stations, the Partnership will also establish carve-outs for incentives for charging stations and EV purchases and leases in low- and moderate-income and environmental justice communities to prioritize improved affordability and air pollution reduction

New Jersey,² NJDEP will expand opportunities to inform consumers and car dealers about the benefits of driving EVs, including information on cost comparisons with conventional vehicles, information and guidance regarding state and federal financial incentives, and support for experiential test drives, commonly referred to as “Ride and Drive” events. NJDEP will continue to collaborate on PlugStar, a new dealer certification program, conduct between five and ten Ride and Drives per year, improve content on its Drive Green New Jersey website, and continue its partnership with state and regional car dealer associations to explore successful sales techniques.

Goal 1.1.5: Roll over the state’s light-duty fleet to electric vehicles.

In mid-2019, the New Jersey Department of the Treasury awarded a new contract for passenger vehicles that included battery electric, plug-in hybrid, and hybrid vehicles. This, combined with the August 2018 award of a contract which includes a hybrid minivan offering, will enable state and local government agencies to purchase light-duty EVs. The state will transition its light-duty fleet to electric as vehicles reach the end of their useful lives, with the transition to hybrid, plug-in hybrid, and full EVs beginning in the fiscal year following the award of a state contract for EV charging infrastructure. In moving toward these goals, Treasury should apply a “best available technology” approach keeping in mind the use cases, duty cycles, mileage demands, and technology availability for each particular application. Wherever otherwise appropriate, new purchases of state vehicles should be fully electric. Treasury will work with the state agencies to inventory the current state fleet and develop a fleet transition plan to begin and complete the transition, including the purchasing of EVs and the installation of charging infrastructure. The inventory and fleet transition plan may include data such as total mileage per vehicle, average daily mileage per vehicle, vehicle function, and assessment of daily charging requirements to meet operational demands.

In addition to purchasing EVs for the state fleet, the state should conduct an assessment of on-site charging infrastructure needs. Adding EVs to the state fleet will also require additional staff expertise in order to maintain those vehicles and related equipment.

Goal 1.1.6: Continue to improve NJ TRANSIT’s environmental performance.

Buses, trains, and vans can move more passengers using less fuel, therefore generating fewer emissions and criteria air pollutants than private

vehicles use; in technical terms, on average NJ TRANSIT bus operations emit 52% fewer emissions per passenger-mile than single occupied vehicles. As the nation’s largest statewide transportation system providing more than 944,000 weekday trips, NJ TRANSIT plays an important role in achieving critical state goals, including reducing miles traveled in private vehicles and facilitating compact development patterns. NJ TRANSIT’s role in reducing emissions, air pollutants, and energy consumption can be even more significant and can lead to greater benefits as the number of riders increase.

A critical determinant of NJ TRANSIT’s net impact on greenhouse gas emissions and air pollutants is the passenger load on individual transit services. Ridership on vehicles must be high enough that more emissions are displaced from private travel than are emitted from a transit vehicle. NJ TRANSIT estimates that its ridership benefits result in a total reduction of more than one billion vehicle miles traveled per year, and the land-use benefits of transit-oriented smart growth result in a further reduction of more than 16 billion vehicle miles traveled annually. Relevant state agencies will work with NJ TRANSIT to ensure that transportation service is provided in a manner that maximizes ridership and if needed, redesign

and where buses should recharge within routes and performing a budgetary analysis for electric bus and charging infrastructure purchasing and installation. NJ TRANSIT has undertaken a process to develop a strategy to begin transitioning their bus fleet to electric power, with a focus on procurement, infrastructure, workforce training, and maintenance. The agency is also in the process of developing a broader strategic plan, expected to be completed by the first quarter of 2020, which will inform procurement and investment planning to decarbonize the fleet.

NJ TRANSIT is receiving funding for the purchase and deployment of eight electric buses in Camden and for facility upgrades at its Camden bus garage, in an electric bus early deployment program using Volkswagen Settlement Funds as well as additional federal funds. The agency is continuing to pursue competitive federal grant opportunities to acquire more electric buses and infrastructure. Further, it is prioritizing additional electric bus early deployment programs in other urban and environmental justice communities in order to reduce local air pollutants in those communities while it incorporates electric buses into fleet operations and management.

NJ TRANSIT is continuing to monitor the rapid improvements in electric bus technology, establishing long-term plans to continually adopt new electric buses as older buses retire, and continuing to replace old diesel-engine buses with cleaner diesel engines while other decarbonized technologies mature. Currently, NJ TRANSIT owns and maintains over 3,000 buses; 147 are fueled with compressed natural gas (CNG), 37 are diesel hybrids, and the balance are diesel vehicles. NJ TRANSIT buses are typically procured with both state and federal funds and purchased over rolling six-year procurements. Federally procured buses are required to remain in service for 12 years. Through its forthcoming strategic plan and electric bus early deployment program, NJ TRANSIT will determine how to integrate electric bus and charging infrastructure purchases into its procurement cycle.

NJ TRANSIT has also steadily taken steps to reduce emissions in its locomotive fleets by ensuring they meet or exceed all EPA emissions regulations. The agency has implemented operational procedures to put diesel powered trains on wayside electric power when possible, and to install engine start-stop systems to reduce idling. In the past eight years, it also purchased 35 ALP-45A Dual Power Locomotives, which can switch from diesel power to electric power whenever catenary (overhead, wire-based) power is available, and which emit fewer emissions. NJ TRANSIT is in the process of purchasing 17 additional ALP-45A Dual Power Locomotives to replace older GP-40 type locomotives, which will continue to modernize

The state must make significant concerted efforts to prioritize providing clean energy and clean air to low- and moderate-income and environmental justice communities through a suite of clean transportation options.

locomotives in the fleet with a vehicle that improves both the versatility and the reliability of the rail fleet while further reducing the locomotives' emissions when operating in diesel mode by meeting EPA Tier IV emission regulations. Each GP40 locomotive replaced reduces NO_x emissions by nearly 47 tons annually. NJ TRANSIT will work to electrify its rail operations where feasible as well as investigate if new battery technologies for rail vehicles can be introduced on shorter-haul lines.

Goal 1.1.7: Increase clean transportation options in low- and moderate-income and environmental justice communities.

The state must make significant concerted efforts to prioritize providing clean energy and clean air

Goal 1.1.8: Partner with industry to develop incentives to electrify the medium- and heavy-duty vehicle fleet with battery or fuel cell technology, and to support R&D that will enable such electrification.

While much media attention is spent on the growing EV market for passenger vehicles, diesel-fueled medium and heavy-duty vehicles, such as trucks and buses, add significantly to local air pollution; electrifying these larger vehicles will be critical for meeting New Jersey’s emissions goals and reducing air pollution, especially in urban areas, ports, and airports. Medium- and heavy-duty vehicle battery technology is in a more nascent stage of market development than passenger vehicle battery technology for several technical, economic, and infrastructural reasons. Chief among these issues is that batteries are most efficient for physically lighter loads; heavy trucks carrying heavy cargo cannot travel far on a single charge. Further, EV infrastructure isn’t yet widely available to the public, and not all trucks can return to their bases each night to charge. However, several vehicle manufacturers and commercial companies are rolling out or piloting new technologies for applications in which EVs make sense, such as school buses and refuse trucks that can return to charge after their runs or medium-duty urban delivery services.

State agencies will work with industry leaders and manufacturers to establish which kinds of vehicles (e.g., buses, refuse trucks, delivery trucks, drayage trucks, jitneys, etc.) should be incentivized as “first adopters” to further drive development and enable the technologies and efficiencies established in the early generations of vehicles to inform future vehicle manufacturing. NJEDA is finalizing a Request for Information aimed at commercial fleet owners, supply chain companies, and other related parties (e.g., truck leasing/financing), and will offer electric truck purchase incentives beginning in the second half of 2020.

When this nascent market is more fully developed, the state will establish transition goals to EVs for the medium- and heavy-duty fleet. Further, the state will work with local industry to create incentives to encourage EV adoption for local delivery to reduce the emissions around warehouses and ports (see Goal 1.3). The strategy adopted should take account of opportunities that may exist for New Jersey to participate in the development of the supply chain for these vehicles by bringing relevant assembly and manufacturing jobs to the state. Finally, the state will also work with school district-owned and commercially-owned school bus fleet operators to incentivize and encourage EV adoption as a means to upgrade fleets and reduce operating costs. Those may include, as an example, incentives for Boards of Education that prioritize contracting with bus companies that utilize EVs.

New Jersey should also consider truck and bus rebate or grant programs to reduce the incremental up-front cost of purchasing EVs over their conventional counterparts, or explore a state-wide procurement mechanism wherein the batteries in medium- and heavy-duty EVs are leased, thereby reducing the up-front cost of one comparable to a new diesel vehicle, and allowing the reduced operating costs (e.g., for fuel and maintenance) to cover the battery lease payments over time. In addition, agencies such as NJEDA should work with private lenders and trucking industry participants to develop longer term loan products that can enable the lower projected operating costs for EV trucks and buses to more effectively provide for the payback of the high upfront investment in electric versions of vehicles. The state could also help facilitate financing for bulk purchases to drive down capital procurement costs. New Jersey will work with transportation network companies, as discussed earlier, to advance the deployment of public charging infrastructure along busy transportation corridors and within urban areas and to ensure private sector support for an electric fleet transition.

The state should continue working with the Transportation and Climate Initiative (TCI) to evaluate the feasibility of a regional low carbon transportation policy for fuels.

fuel within Port Authority’s fleet and at its facilities, in the second quarter of 2019, the agency signed a cooperation agreement with Neste, the largest biofuel producer in the world.

While Port Authority is aggressively reducing its greenhouse gas emissions, its business lines such as aviation, trucking, and shipping are decarbonizing much more slowly than the overall New Jersey economy. The power sector and light-duty transportation sectors are natural areas of focus for near-term state-wide decarbonization efforts, but to accelerate the process of reducing emissions from aviation, shipping, and heavy-duty transportation, the state should explore additional measures.

The state should continue working with the Transportation and Climate Initiative (TCI) to evaluate the feasibility of a regional low carbon transportation policy for fuels. After several stakeholder sessions, TCI released a draft framework for public input in October 2019 for a potential low carbon transportation policy. This was followed by the release of a draft Memorandum of Understanding and associated projections of economic, environmental, and health benefits on December 17, 2019. NJDOT and NJDEP will continue to actively engage in these discussions, consistent with direction from the Governor’s Office.

In addition, NJDOT is currently exploring several options to make its fleet cleaner. NJDOT, along with NJDEP, currently has a Congestion Mitigation and Air Quality-funded project in place to replace or retrofit pre-2007 diesel powered construction vehicles. NJDOT will initiate a study to strategically upgrade its gas-powered fleet to electric.

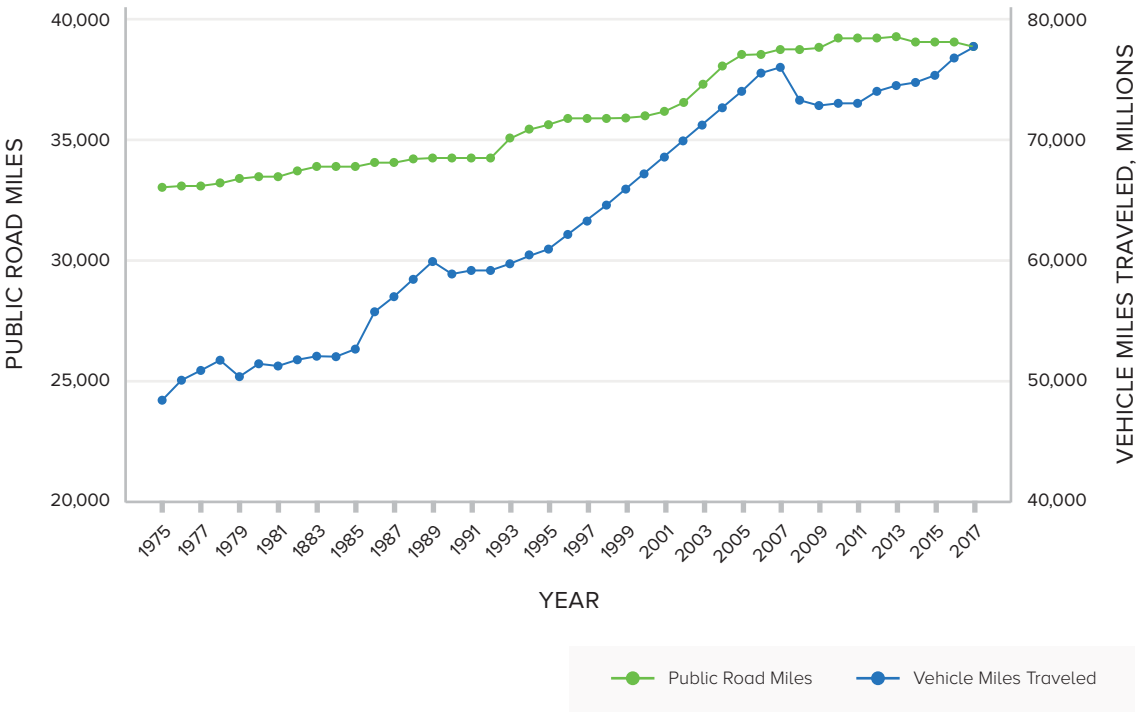
Finally, the state should support ongoing efforts by regional port authorities to identify mechanisms for private operators to procure cleaner equipment and establish a transportation R&D and clean tech transfer forum for private enterprise, government, and academia.

GOAL 1.2: IMPROVE CONNECTIONS BETWEEN PEOPLE, JOBS, AND SERVICES

- 1.2.1 Identify opportunities to strengthen connections between people, jobs, and services
- 1.2.2 Energize the implementation of the Transit Village Initiative and transit-oriented development
- 1.2.3 Relieve congestion and idling throughout New Jersey
- 1.2.4 Establish a sustainable funding source for maintaining the transportation system

The efficiency and fuel type of vehicles are key variables affecting the amount of energy consumed and emissions produced by the transportation sector, but the overall amount of vehicle travel cannot be overlooked. While it is well understood that there are negative system-level impacts of increased vehicle travel, particularly when the vehicles have internal combustion engines, state interventions are only effective when they are grounded in actions that agencies control, and when they support household and business needs for safe, efficient, and cost-effective travel.

FIGURE 13.
New Jersey Public Road Miles and Estimated Vehicle Miles Traveled (1975-2017)^{xvi}



The primary metric to assess vehicle travel is to measure vehicle miles traveled (VMT), where one vehicle traveling one mile equals one VMT. In New Jersey, the number of VMT has increased in recent decades. In 1984, the earliest year in which we have data, annual VMT in New Jersey was roughly 52.2 billion. VMT temporarily peaked in 2007 at 76 billion miles traveled, dipped slightly during the recession, and resumed climbing in 2010. As of 2017, New Jersey drivers traveled a record 77.5 billion vehicle miles.^{xvii} At the same time, miles of road increased from 33,879 miles in 1984 to 38,896 miles in 2017 (Figure 13).

According to the 2017 American Community Survey, New Jersey has one of the longest average commute times, at 32.1 minutes. Additionally, 14.6% of New Jersey commuters face particularly long commutes of over 60 minutes. Of the state’s commuters, 71% drive to work alone, while 8% car-pool and 12% use mass transit. The remaining 9% either walk (3%), work from home (4.5%), or travel by other means (2%).^{xviii}

As policies or strategies to reduce VMT are developed, it is important to consider the factors influencing them. As the state’s population has increased over the years, so have VMT. Growth of VMT also tracks closely with the health of the economy. VMT increases as employment expands, and people take more trips as the economy gets stronger. Conversely, as the economy slows, the rate of VMT growth declines, and can even turn negative, as happened in the recession of 2007 to 2010. Further, the level of VMT is an outcome of residential and business location decisions, as well as personal travel choices. While the state cannot reduce VMT directly, it can develop programs and strategies that encourage people to make travel choices that are both rational and sustainable, as well as encourage smart growth and redevelopment opportunities.

As the debate on how to manage vehicle travel continues, it is important to remember that the purpose of transportation is not travel for its own sake, but to connect people with jobs, school, and other services and destinations. Encouraging the design of streets and roads to shorten trips, minimize the need to drive, support safe bicycling and walking, and improving access to transit allows people to access what they need while reducing the stress of driving, improving air quality, and positively impacting their health.

Goal 1.2.1: Identify opportunities to strengthen connections between people, jobs, and services.

The state can take steps now to continue to reduce the overall transportation energy footprint and strengthen connections between people and efficient transportation options long before a critical mass of vehicle electrification takes hold. The state should consider holistically how New Jersey can encourage sustainable travel choices that will improve system effectiveness and access.

Providing increased or additional service and routes on NJ TRANSIT and implementing measures to make public transit more attractive will reduce VMT. A range of additional options are also available, including encouraging Complete Streets,³ “smart growth,” and redevelopment opportunities that support more transit use, bicycling, and walking; expanded carpool and vanpool programs; and encouraging micro-mobility options like electric bikes, scooters, and skateboards. In addition, some municipalities could assess the elimination of minimum parking requirements in targeted

by trains. The agency will also explore more opportunities for cross-modal transportation.

Further, NJ TRANSIT will explore how the placement of EV charging stations and EV car shares at Park and Rides might encourage additional transit use, and should similarly encourage local municipalities, where applicable, to look at how EV car shares, mobility on demand, e-bikes, e-scooters, and bike parking options can impact first and last mile decisions about transit use.⁴ Additionally, NJ TRANSIT should explore whether there are opportunities to grow transit use by implementing these new options and whether there are incentives that can be implemented to encourage current parking pass holders to use alternative means to travel to transit to reduce congestion and VMT.

Port Authority is similarly enhancing the PATH system capacity by establishing nine-car rail service on heavily utilized lines. Additional railcars will increase peak period capacity by approximately 19%, or 7,500 passengers per hour. Planning has also begun for extension of PATH service to Newark Liberty International Airport, which will also improve regional mass transit options and reduce vehicle miles traveled and congestion on local roadways.

The state should ensure that other types of clean transit and micro-mobility are co-located with mass-transit hubs like NJ TRANSIT and PATH stations and bus depots, including bike, scooter, or car shares. Municipalities and state agencies and authorities will work with developers and property owners to provide significant and easily accessible sheltered bike parking and bike repair terminals along train stations and Park and Rides and consider installing bike or scooter-sharing services.

With the advent of ride-hailing services (e.g., Lyft, Uber), bike and scooter-sharing services, transit-oriented development, and nascent development of connected and autonomous vehicles, the state should consider the many variables affecting traditional means of transportation and how they will impact the transportation system. NJ TRANSIT and state agencies, Port Authority, local municipalities, and stakeholders must work together to reduce dependence on vehicles.

Connecting people to transit and getting more cars off the road will require more investment in Complete Streets. NJDCA can assist munici-

palities in adapting municipal land use law to further encourage walkable and bikeable communities and extending bike and scooter sharing, jitney services, and community EVs in community and commercial areas to decrease the need for personal vehicles. NJDOT, which implements New Jersey's Complete Streets policy, will likewise continue to ensure that state roadways, wherever possible, are safe for multimodal transportation and will work with municipalities to increase the number of towns and counties that adopt and implement Complete Streets policies and checklists, possibly with additional grants and incentives.

NJDOT offers training to counties and municipalities to develop and implement their own Complete Streets policies, which enable local governments to ensure that all streets are designed and operated to enable safe access and mobility for all users. The Complete Streets policy and checklists assist officials in evaluating transportation projects, major site plans, and redevelopment efforts, to ensure that adequate consideration of bicycle, pedestrian, and transit needs are incorporated into the planning, design, construction, and maintenance of projects. NJDOT's recently published *Complete and Green Streets for All: Model Complete Streets Policy and Guide* will serve as a resource for local governments to adopt in whole or in part.

As New Jersey considers emerging technologies, the state can also explore and pilot shared, connected, and autonomous vehicle deployment in select communities and settings (e.g., dense downtown

Transit-oriented development decreases reliance on vehicles, increases quality of life, and revitalizes downtown municipal centers by creating attractive, vibrant, pedestrian-friendly neighborhoods.

Goal 1.2.2: Energize the implementation of the Transit Village Initiative and transit-oriented development.

NJDOT and NJ TRANSIT lead a multi-agency Smart Growth program called the Transit Village Initiative, founded in 1999, in which municipalities are incentivized to redevelop or revitalize their downtowns into dense, mixed-use development communities within a half-mile of transit centers using transit-oriented development design standards. Such development decreases reliance on vehicles, increases quality of life, and revitalizes downtown municipal centers by creating attractive, vibrant, pedestrian-friendly neighborhoods where people can live, shop, work, and play without relying solely on automobiles. In addition to community revitalization, the Transit Village Initiative seeks to reduce traffic congestion and improve air quality by increasing transit ridership. Studies have shown that adding residential housing options within walking distance of a transit facility – typically a one-half mile radius – increases transit ridership more than any other type of development. Therefore, one of the goals of the initiative is to bring more housing, businesses, and people into the neighborhoods around transit stations. In the last 20 years, 33 municipalities have been designated as Transit Villages.

Municipalities voluntarily seek the Transit Village designation – it is not a state mandate. In doing so, municipalities commit up front to growing housing, populations, and jobs as well as adopting zoning around transit to support compact, mixed-use development. After becoming designated Transit Villages, the community and developers who invest in transit-oriented development in designated districts are eligible for a variety of state-funded programs (e.g., loans, grants) that support transit-oriented development. For example, NJDOT administers a state-funded \$1 million annual grant program, which is only open to designated Transit Villages. Moving forward, NJDOT will seek to spur interest in the Transit Village Initiative among New Jersey communities through enhanced NJDOT web and social media presence and providing material at events; to continue to support municipalities looking to obtain the designation; to continue to administer an effective DOT grant program, subject to annual budget appropriations; and to provide information and resources to prospective municipalities on the benefits of becoming a designated Transit Village. In addition, state agencies such as NJDOT, NJ TRANSIT, and NJDCA will look for opportunities to encourage more interest in and action supporting transit-oriented development in partnership with communities.

Planning around Transit Hubs – multi-use development co-located with or near transit stops – should also incorporate EV options and encourage bike and pedestrian commuting. NJBPU and NJDEP should look for

opportunities to partner with NJEDA on its Transit Hub program, which Governor Murphy recently announced. These opportunities could include providing parking spots for EV car share users so that they can run errands nearby before heading home, which can reduce VMT, congestion, and parking concerns. Other opportunities to reduce commuters’ reliance on personal vehicles include but are not limited to: providing sheltered bike parking; ensuring that transit stops are pedestrian-friendly and have safe sidewalks; and establishing clear signage and adequate lighting at the transit stop and on the roads leading up to it. Partnering with providers of EV Mobility on Demand to provide commuters with flexible options can help reduce reliance on personal vehicles by allowing commuters to walk to transit in the morning but call for an EV ride home in the rain.

Goal 1.3.1: Support electrification of diesel-powered transportation and equipment at the ports and airports.

Port Authority has committed to electrifying 100% of its airport shuttle bus fleet, and earlier in 2018 it placed six electric buses into service at Newark Airport; these were the first electric buses used in the state. The Port Authority will have a fully electrified airport shuttle fleet by mid-2020. The Port Authority also committed to electrifying 50% of its light-duty vehicles by 2025, and has procured over 150 battery EVs and installed associated charging infrastructure. The agency has nearly 120 EV charging ports installed to support fleet and public vehicles across its facilities. Port Authority has also begun a dialogue with NJ TRANSIT to share lessons learned as a first mover on vehicle electrification in New Jersey.

Port Authority is also working with its tenants and partners to electrify airside and portside equipment. The agency is currently working with United Airlines to support a project at Newark Airport to electrify baggage tugs and belt loaders using Volkswagen Settlement funds, and is planning further collaboration with its airline partners to pursue additional ground support equipment electrification projects.

At marine terminals, SJPC's newest crane, the Kocks multi-purpose crane, is its first fully electric crane, and it produces no emissions. Port Authority is similarly working with its terminal operators to demonstrate alternative-fueled equipment. Port Authority anticipates beginning a pilot of electric cargo-handling equipment in 2020 at the Elizabeth-Port Authority Marine Terminal in partnership with Maher Terminals. This equipment would be the first-of-its-kind in operation at a U.S. port.

Recently, Port Authority opened the GCT Bayonne Express Rail Port Jersey facility, which culminates a \$600 million Port Authority capital investment program dating back to the 1990s that established direct rail access to on-dock and near-dock intermodal rail services at all its major marine terminals. The facilities were designed to reduce the port's historically heavy reliance on trucks to transport cargo that arrives at the port via ship to its final destination, and each rail lift is expected to eliminate 1.5 truck trips on regional roadways.

In October 2018, the Port Authority Board reauthorized the agency's Clean Vessel Incentive Program (CVI). Vessels participating in CVI may receive financial incentives for slow steaming and making voluntary engine, fuel, and technology enhancements that exceed regulatory standards. As of the first quarter of 2019, 73% of the containerships calling on the Port of New York and New Jersey participated in CVI.

Goal 1.3.2: Support a diesel truck buy-out program.

Port Authority implements several important initiatives under its Clean Air Strategy to improve air quality and lower greenhouse gas emissions. In early 2019, the U.S. EPA awarded Port Authority a \$2 million grant to revive its Truck Replacement Program, which pays up to \$25,000 to replace aging drayage trucks with trucks made in Engine Model Year 2013 or newer. Port Authority has also allocated millions of dollars from its own budget to support this program.

Since its inception in 2009, the Truck Replacement Program has put over 700 cleaner trucks on the roads. Clean

STRATEGY 1

Reduce Energy Consumption and Emissions from the Transportation Sector

Goal	Description	Commitments & Timeline	Baseline	Agencies
Support the deployment of 330,000 ZEVs by 2025	In June 2019, Governor Murphy established the Partnership to Plug-In, a tri-agency partnership between NJDEP, NJEDA, and NJBPU, to develop a road-map and strategy to increase the number of electric vehicles in New Jersey.	NJBPU will develop a \$30 million incentive program to purchase EVs for rollout in 2020. NJDEP will increase its EV education and awareness campaign in 2020. NJMVC will develop a mechanism to distinguish EVs from conventional vehicles during registration in 2020. NJDEP will track EV purchases and leases to inform charging infrastructure placement and assess where grid upgrades are necessary to support increased demand.	23,000 EVs as of June 2019	NJDEP, NJBPU, NJEDA, NJMVC, NJDOT
Ensure sufficient EV charging infrastructure to address equitable access and consumer confidence (“range anxiety”)	The Partnership to Plug-In will use Volkswagen and possibly RGGI funding to support charging infrastructure build-out. Thus far, \$3.2 million has been committed from Volkswagen funds to install 729 charging plugs.	NJDEP is developing strategic mapping for charging infrastructure, to be completed in the first half of 2020. NJDCA will produce model municipal zoning ordinances and model permitting guidelines in early 2020. NJDCA will continue to encourage municipalities to include EV charging infrastructure planning in their planning documents and to apply for grants for installation.	275 publicly-accessible fast charging ports at 80 locations and 647 Level 2 ports at 293 locations as of December 2019.	NJDEP, NJEDA, NJBPU, NJDOT, NJMVC, NJDCA

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STRATEGY 1

Reduce Energy Consumption and Emissions from the Transportation Sector

Goal	Description	Commitments & Timeline	Baseline	Agencies
Ensure sufficient EV charging infrastructure to address equitable access and consumer confidence (“range anxiety”) <i>Continued</i>		NJDOT will encourage the use of the LOGOS program for the use of the EV providers and to make the public aware of EV charging locations along designated freeways and interstate highways. NJDEP and NJDCA will develop best practices for streamlining local approvals beginning in 2020. NJBPU will establish an ownership model for charging infrastructure in the context of utility filings by the end of 2020. NJ TRANSIT will incorporate planning for installation of EV charging upon renewal of lease and/or facility upgrades at each potential location.		

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STRATEGY 1

Reduce Energy Consumption and Emissions from the Transportation Sector

Goal	Description	Commitments & Timeline	Baseline	Agencies
Lead by example and roll over the state passenger vehicle fleet <i>Continued</i>		Treasury will maintain a conversion target of 15% of the remaining fleet with suitable EV/hybrids, every other fiscal year, with full conversion, as appropriate, by Year 10. Treasury will prioritize for replacement early model vehicles with high mileage that have EV or hybrid equivalents. Cargo and passenger vans will be included in the stock EV roll-over when available.		
Continue improving NJ TRANSIT performance	NJ TRANSIT will increase battery electric bus pilot projects in urban areas, establish a plan to convert the full bus fleet, and incorporate electric locomotives.	NJ TRANSIT's battery electric bus pilot project in Camden will commence in 2020. NJ TRANSIT will introduce a battery electric train prototype by 2025. NJ TRANSIT will review and enhance advertising and/or incentives for reduced fares on forecasted poor air quality days to encourage mass transit use beginning in mid-2020.	NJ TRANSIT does not have any electric buses in service as of 2019, but was awarded \$8 million in VW funds in 2019 for the purchase and operation of 8 electric transit buses in Camden.	NJ TRANSIT

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STRATEGY 1

Reduce Energy Consumption and Emissions from the Transportation Sector

Goal	Description	Commitments & Timeline	Baseline	Agencies
Increase clean transportation options in environmental justice and low- and moderate-income communities	New Jersey state agencies will work with communities to increase multi-modal transportation options and accelerate opportunities for EV purchase, lease, or car sharing.	NJBPU has received a \$100,000 grant from the U.S. DOE to develop a program to create an actionable plan for underserved communities throughout New Jersey to access clean transportation in the form of Plug-In Electric Vehicles (PEVs). The grant is being used to retain Rowan University to conduct stakeholder outreach, study the various methods for providing access to PEVs to underserved areas, develop sustainable funding mechanisms, and create the plan. NJDEP will fund e-mobility projects in environmental justice areas using Volkswagen and other funding sources. NJDCA and NJDOT will work with advocates and consultants to target Complete Streets workshops in environmental justice and low- and moderate-income communities. NJDOT will work with advocates and consultants to target Local Bicycle and Pedestrian Planning Assistance in environmental justice and low- and moderate-income communities.	\$8 million in VW funds	

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STRATEGY 1

Reduce Energy Consumption and Emissions from the Transportation Sector

Goal	Description	Commitments & Timeline	Baseline	Agencies
Increase clean transportation options in environmental justice and low- and moderate-income communities <i>Continued</i>		NJ TRANSIT is performing a detailed study regarding necessary facility upgrades at four existing bus garages that serve routes in urban areas to determine the feasibility of charging e-buses. The study will be completed in April 2020 and will inform additional efforts at remaining bus garages. The Camden e-bus pilot will commence in 2020.		
Reduce port emissions through electrification of equipment and a diesel truck buy-out program	PANYNJ and other relevant state agencies will introduce mechanisms to transition port and airport sources of mobile and non-mobile emissions to electric resources.	New Jersey will provide incentive funding from Volkswagen (Round 2 in first half 2020; Round 3 in second half 2020); and possibly from RGGI (1st auction in March 2020). Starting in 2020 and contingent upon regulatory approval, PANYNJ and PSE&G will partner on an electrification roadmap for PANYNJ-owned property, owned vehicles, and equipment. Starting in 2021, PANYNJ will establish a cargo handling equipment inventory and/or registration system to support phase out of older equipment.	\$16.2 million in Volkswagen settlement funds has been allocated from the 1st solicitation as of October 2019.	NJEDA, NJBPU, PANYNJ, NJMVC, NJDEP

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STRATEGY 1

Reduce Energy Consumption and Emissions from the Transportation Sector

Goal	Description	Commitments & Timeline	Baseline	Agencies
Reduce port emissions through electrification of equipment and a diesel truck buy-out program <i>Continued</i>		Starting in 2020, PANYNJ will collaborate on development of a new regional strategy to improve air quality, in partnership with stakeholders. NJDEP will work with NESCAUM to develop a multi-state zero-emission medium- and heavy-duty vehicle MOU by Spring 2020 in accordance with Statement of Intent released December 12, 2019. NJEDA will pursue public private partnerships and innovative financing to develop the market for medium- and heavy-duty and non-road equipment electrification, beginning in the second half of 2020. NJDEP will apply for USDOT Congestion Mitigation and Air Quality (CMAQ) grants and USEPA Diesel Emission Reduction Act (DERA) grants as solicitations are issued.		

STRATEGY 2

Primary
Goals:

2.1
100% clean
power by 2050

2.2
Develop 7,500
MW of offshore
wind energy
by 2035

2.3
Maximize solar
development
and distributed
energy
resources by
2050

Accelerate Deployment of
Renewable Energy and Distributed
Energy Resources

New Jersey has committed to reaching 100% clean energy by 2050. In addition to clean energy targets for offshore wind and storage, the state should establish additional targets for in-state and out-of-state renewable generation, distributed energy resources, and other carbon-neutral supply-side resources. New Jersey must reach these accelerated clean energy goals in a manner that supports the economy, increases local jobs, encourages private sector investment, and improves resiliency – all while maximizing affordability.

New Jersey’s transition to a clean energy future requires the substantial growth of carbon-free generation resources sufficient to meet not only today’s electricity needs, but also the increased load growth that accompanies end-use electrification of the state’s homes and transportation sector. The goal is to meet New Jersey’s hour-by-hour energy usage with renewable generation, nuclear, storage and other carbon-free technologies whenever possible, while using carbon-neutral generation as a backup power source in times of low-renewable output; this will ensure that New Jersey successfully achieves its joint reliability and environmental goals at the least cost.

New Jersey is part of the largest competitive energy market in the world, operated by PJM Interconnection LLC (PJM),⁵ which presents opportunities to decarbonize the electric sector in an affordable manner. For example, PJM’s large geographic scope will enable New Jersey to sell power into neighboring states when in-state solar, nuclear, or offshore wind resources provide more power than the state needs for its consumption. Likewise, the integrated PJM grid will allow New Jersey to import affordable electricity generated

5 New Jersey electric public utilities are among the founding members of PJM, the Regional Transmission Organization (RTO) that operates the whole-sale power markets and controls the transmission of electricity in New Jersey, the District of Columbia, and parts or all of twelve other states, which stretch as far south as North Carolina and as far west as Illinois. PJM also coordinates the flow of electricity produced between New Jersey and New York, which has a separate regional power system.

FIGURE 14.
Total New Jersey Electric Generation by Source with Percent
Total Generation Imported Power⁶

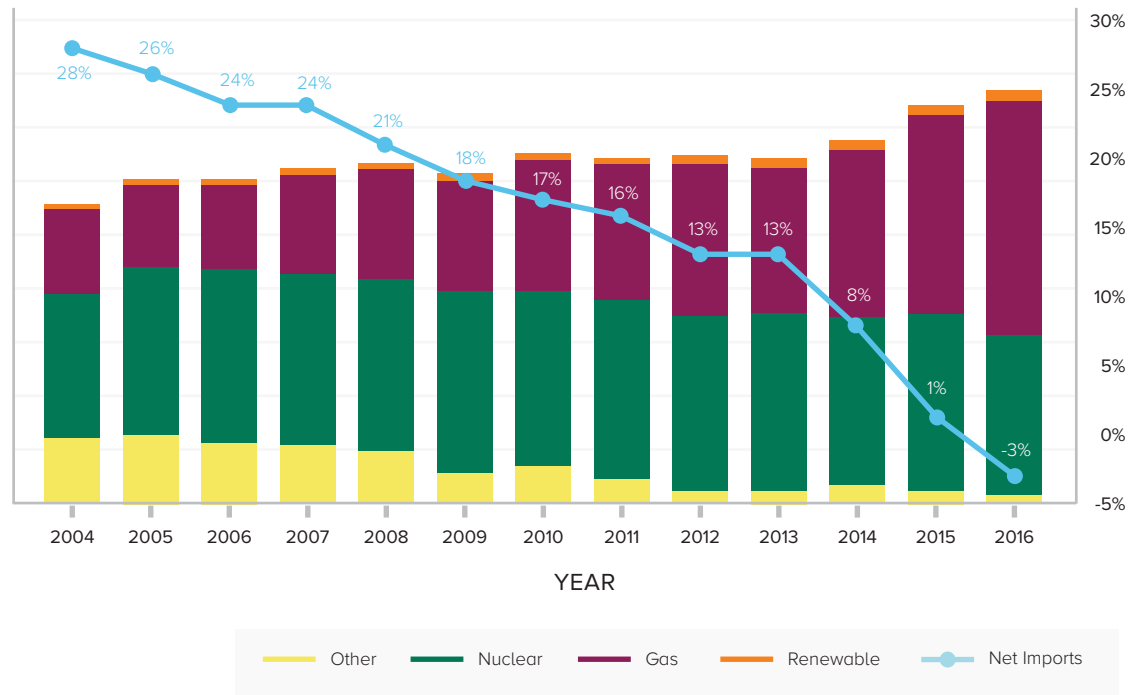


FIGURE 15.
Electric Power Sector CO₂ Emissions by Fuel Source (1980-2016)⁷

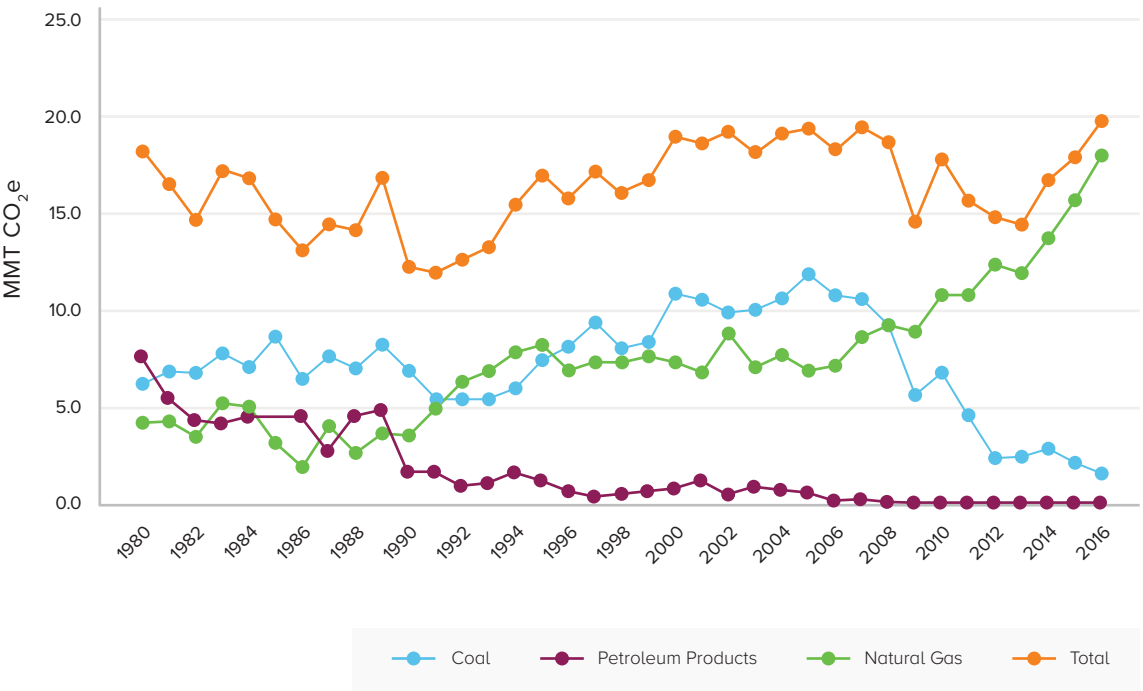
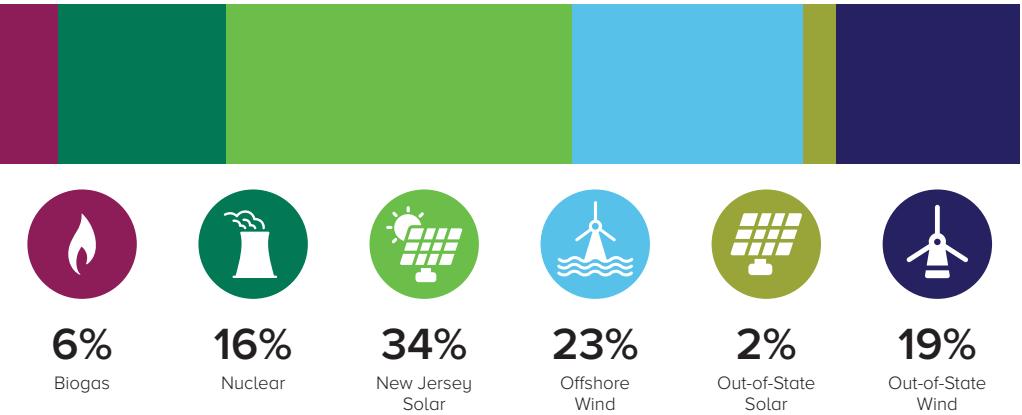


FIGURE 16.

Supply Sources to Meet New Jersey's 100% Clean Energy Requirement in 2050



solar electric generation. However, more will be needed for New Jersey to realize a 100% clean energy economy; ensuring that appropriate regulatory pathways are available will strengthen the ability to achieve renewable energy goals.

New Jersey must shift from a predominantly fossil fuel-based electricity system to a system predominantly based on carbon-free resources. Modeling from the Integrated Energy Plan showed that on a least-cost pathway, New Jersey could supply 94% of its electricity from in- and out-of-state carbon-free resources, and meet the remaining 6% with “clean firm” generating resources,¹¹ which today would include biogas co-fired in existing natural gas fired generators, but may include other non-fossil fuel-based technologies in the future (see Figure 16).

Pursuant to the Clean Energy Act of 2018, New Jersey’s RPS will increase to 50% by 2030, but the state must also meet a 100% clean energy by 2050 target, as mandated by Executive Order No. 28. Further, New Jersey is now administering a growing RPS, which is specific to renewable energy, and Zero Emission Credits (ZEC), which are specific to nuclear energy. While New Jersey must continue to aggressively pursue a decarbonized electricity sector, ratepayers may be better served with a new clean ener-

gy market mechanism that would enable competition among zero-emission generating resources in all-inclusive and technology-neutral manner. Such a zero-emission, clean energy market, such as a Clean Energy Standard (CES), would increase over time to 100% by 2050 and encourage competition among all eligible generating resources, both inside and outside the state. Establishing a new regulatory structure, such as a CES, would not preclude the state from incorporating additional targets or incentives in favor of preferred state policies—such as supporting small-scale, geographically local, or nascent technologies—but would open the market to greater competition by valuing the decarbonization goal, rather than favoring specific technologies. NJBPU should open a proceeding to explore how to enable the state to adapt the electricity sector to achieve 100% clean energy by 2050, such as implementation of a CES or similar mechanism, potentially including a requirement that its jurisdictional utilities procure clean energy. Supporting legislation would likely reduce costs and encourage

collectively have commitments or goals reaching 24 GW of offshore wind by 2035. On the west coast, the federal Bureau of Ocean Energy Management (BOEM) published a Call for Information and Nominations (Call) to obtain nominations from companies interested in commercial wind energy leases within the proposed development areas off central and northern California. BOEM also issued a Call to gauge the offshore wind industry’s interest in acquiring commercial wind leases in two areas off the Hawaiian island of Oahu.

Goal 2.2.1: Develop offshore wind energy generation.

On November 19, 2019, Governor Murphy signed Executive Order No. 92, which changed the state’s initial 3,500 MW goal set in Executive Order No. 8 to 7,500 MW by 2035. Analysis of the Integrated Energy Plan modeling in the Least Cost scenario suggests that New Jersey should build 10.6 GW of offshore wind by 2050. Notably, the model selected 10.6 GW of offshore wind over the next 30 years based solely on the cost benefits of the physical infrastructure and delivery of electricity; it did not account for the additional economic or health benefits accrued from creating jobs, driving innovation, or improving air quality due to expediting the interconnection of clean energy.

NJBPU will develop a consistent and transparent solicitation schedule through 2035 that supports a steady, long-term Mid-Atlantic project pipeline. This procurement approach will enable long-term industry investment in core infrastructure and manufacturing facilities. In addition, NJBPU will determine how much of New Jersey’s energy demand should be met with offshore wind electricity generation through 2050 (see Goal 2.1.2).

According to the U.S. DOE, total wind production, including onshore and offshore, exceeded 82 GW of capacity nationally in 2016. The majority of that energy is currently onshore wind, for which New Jersey does not have a strong market. However, Block Island Wind Farm off the coast of Rhode Island became the country’s first commissioned offshore wind farm in 2016, adding 30 MW of capacity. New Jersey and other states along the East Coast are taking action to capitalize on this capacity.

Pursuant to Executive Order No. 8, NJBPU opened a solicitation for its first 1,100 MW of offshore wind in the fall of 2018, the first step toward achieving New Jersey’s increased goal of 7,500 MW by 2035. On June 21, 2019 NJBPU announced the winner of New Jersey’s first offshore wind solicitation: Ørsted’s Ocean Wind Project. At the time of the award, this 1,100 MW solicitation was the largest single-state procurement of offshore wind electricity generation capacity in the U.S. Since the OREC award, Ørsted has also committed to using 12 MW turbines on the project, replacing the 8 MW turbines originally proposed, which will reduce its physical foot-

TABLE 2
East Coast Offshore Wind Goals (as of November 2019)

State (North to South)	Offshore Wind Goal	Offshore Wind Financing Awards
Massachusetts	1,600 MW	800 MW (Vineyard Wind LLC) 80

commenced a solicitation process that will lead to the installation of solar PV at state-owned facilities; the current solicitation lists 13 potential sites,²⁴ and there are more than 40 sites under consideration. Notably, the local solar industry also provides roughly 6,400 New Jersey jobs.^{xxxvi} New Jersey remains committed to supporting sustainable growth of solar in the state.

Solar is expected to make up the bulk of New Jersey’s in-state Class I renewable power generation in the immediate future. As discussed previously, offshore wind holds great promise for New Jersey and could become the state’s largest renewable energy resource; New Jersey’s initial offshore wind energy generation is expected to be operational by 2024. New Jersey’s existing Class I biopower resources largely include landfill gas-to-energy plants and wastewater treatment plant biogas-to-energy plants; waste-to-energy plants (resource recovery facilities) are classified as a Class II REC and are limited to 2.5% of retail electricity sales. In particular, the conversion of biogas to electricity at wastewater treatment plants or food waste processing facilities offers additional promise for increased renewable electricity generation.

Goal 2.3.1: Continue to grow New Jersey’s community solar program.

In 2019, NJBPU launched a three-year Community Solar Energy Pilot Program, which will enable customers to participate in a solar energy project that may be remotely located from their property, and receive a credit on their utility bill. The Pilot Program sets an ambitious 40% carve-out for projects that allocate at least 51% of the project’s capacity to LMI customers.

Community solar is a major step towards ensuring equity and fairness of New Jersey’s energy policies across all income levels and geographic regions of the state. It enables those who can’t benefit from rooftop solar, such as those who rent, live in multi-unit dwellings, have property unsuitable for solar, or lack access to capital, to participate in the clean energy economy, previously only accessible to those who could install solar energy generation on their own property.

The Community Solar Energy Pilot Program was designed as a competitive application process; the criteria were designed to further the state’s policy objectives for community solar development, including preferred siting, low- and moderate-income resident inclusion, and savings for participating customers.

FIGURE 18.
New Jersey Solar Installations as of 08/31/19

