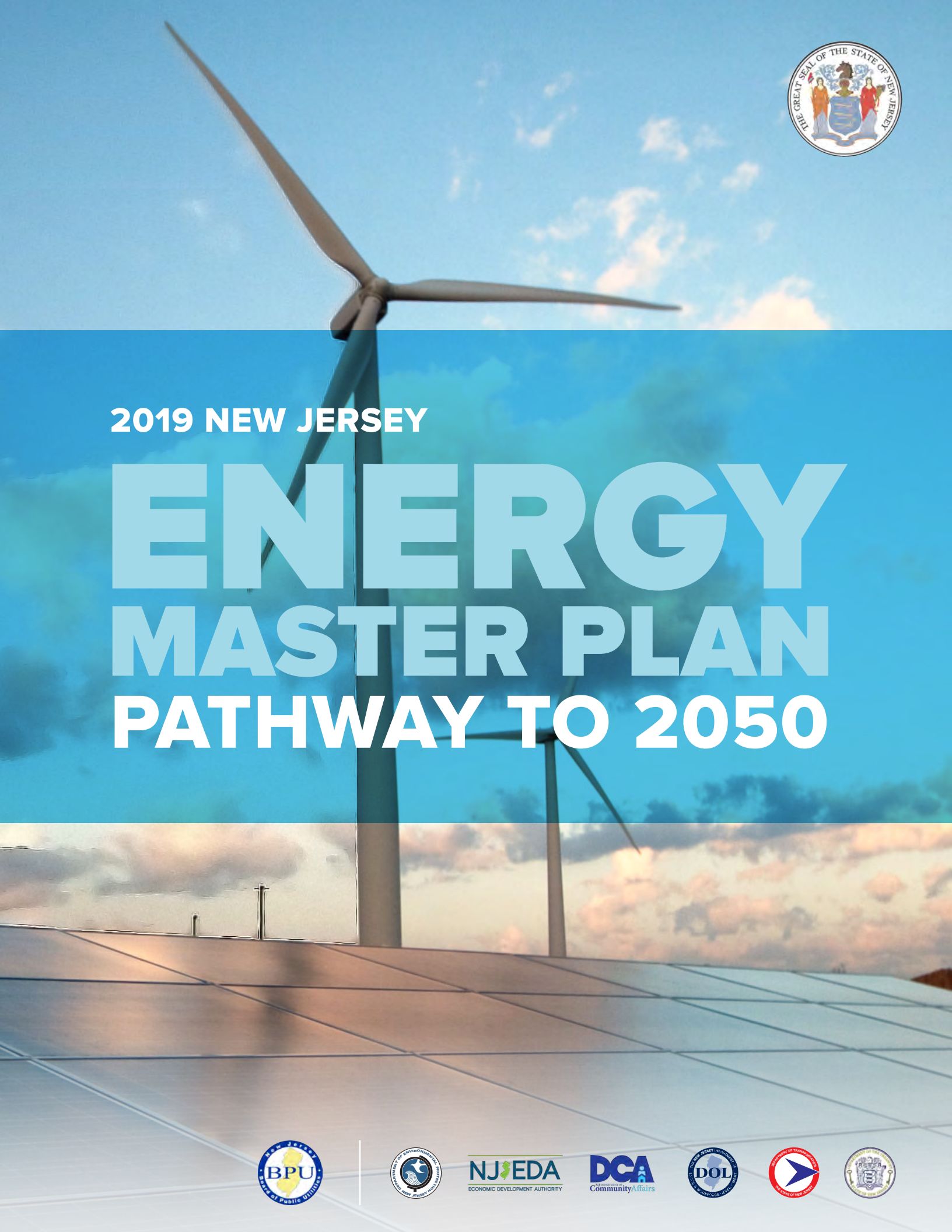

2019 NEW JERSEY

ENERGY MASTER PLAN

PATHWAY TO 2050

ENERGY MASTER PLAN

2019 Energy Master Plan: Pathway to 2050

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

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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

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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

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

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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

SECTION 2

EXECUTIVE SUMMARY

There is near unanimous scientific consensus that the global threat of climate change is grave and that it demands swift local action and focused state leadership. However, there is also evidence that New Jersey's current trajectory and efforts will be insufficient to reach the goals we have established to address climate change, including Governor Phil Murphy's goal of 100% clean energy by 2050 and the Global Warming Response Act (GWRA) goal to reduce state greenhouse gas emissions 80% below 2006 levels by 2050. Despite New Jersey's successes since 2006 in reducing its carbon emissions, this is the state's current reality and its challenge.

In response, New Jersey has developed a new Energy Master Plan (EMP) that encompasses a dramatically broader scope than any previous New Jersey EMP. The 2019 EMP includes rigorous goals and spans multiple sectors and governmental agencies – including the New Jersey Board of Public Utilities (NJBPU), the Department of Environmental Protection (NJDEP), the Department of Transportation (NJDOT), the Department of Community Affairs (NJDCA), the Department of Labor and Workforce Development (NJDOL), the Economic Development Authority (NJEDA), and NJ TRANSIT – while also upholding NJBPU's mission to provide a safe, reliable, resilient and affordable energy system for all New Jersey residents.

The EMP defines "100% clean energy by 2050" to mean 100% carbon-neutral electricity generation[1] and maximum electrification of the transportation and building sectors (the sectors that produce the greatest carbon emissions in the state) to meet or exceed the GWRA emissions reductions by 2050. Energy system modeling conducted for the EMP found that New Jersey can cost-effectively reach its goals of 100% clean energy and reduce its greenhouse gas emissions below the GWRA target largely

[1] Carbon-neutrality means having a net zero carbon footprint by eliminating carbon emissions or balancing carbon emissions with carbon removal.

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.

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STRATEGY 2:

Accelerate Deployment of Renewable Energy and Distributed Energy Resources.

To successfully reduce New Jersey's climate emissions and meet the state's energy needs with clean energy, New Jersey should maximize the development of offshore wind and in-state renewable energy generation (including community solar) and the interconnection of zero-emission distributed energy resources (DER).[2] Governor Murphy recently committed New Jersey to building 7,500 MW of offshore wind by 2035; energy system modeling further supports that New Jersey should optimally build 17,000 MW of solar energy and 2,500 MW of energy storage by 2035, as well as support a moderate amount of investment in clean resources out-of-state.

In addition to the state's ongoing work to enable this clean energy future, the state should also consider a new incentive delivery system to motivate additional carbon-neutral generation using a competitive approach to stimulating competition and investment, such as a Clean Energy Standard; develop low-cost loans or financing for DER; and develop a market-based mechanism to compensate DER for its full value stack at regional and federal levels. These commitments will support the economy and increase local jobs, encourage private sector investment, accelerate clean power production, and improve resiliency.

STRATEGY 3:

Maximize Energy Efficiency and Conservation and Reduce Peak Demand.

New Jersey must strengthen efforts toward promoting energy efficiency and managing and reducing peak load, including clear energy-reduction goal setting and accountability, and must enforce the requirement that electric and gas utilities reduce consumption annually by at least 2% and 0.75%, respectively.

The state must ensure access to increased efficiency for all residents, including through such mechanisms as education and awareness campaigns, streamlining administrative barriers, and adopting equitable clean energy and energy efficiency financing mechanisms. New Jersey will reduce wasted energy through improvements in building thermal envelopes, appliance efficiency, energy benchmarking, equipment controls, strategic energy management, and attention to peak demand reduction. Accordingly, the state must also strengthen building and energy codes and appliance standards.

STRATEGY 4:

Reduce Energy Consumption and Emissions from the Building Sector.

The building sector accounts for a combined 62% of the state's total end-use energy consumption. Given this, the building sector should be largely decarbonized and electrified by 2050 with an early focus on new construction and the electrification of oil- and propane-fueled buildings. New Jersey must electrify its state facilities, partner with private industry to establish electrified building demonstration projects, expand and accelerate the current statewide net zero carbon homes incentive programs for both new construction and existing homes, study and develop mechanisms and regulations to support net zero carbon new construction, and develop EV-ready and demand response-ready building codes for new multi-

[2] Distributed energy resources (DER) are on-site systems, equipment, or processes that are appropriately sized, modular, and decentralized, as compared to larger, centralized power plants, that also include transmission and distribution systems. DER can be either grid-connected or off-grid energy systems located in or near the place where energy is used.

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, services, and products that can be exported to other regions around the country and around the world, thereby driving investments and growing jobs. New Jersey will attract supply chain businesses to create dynamic new clean energy industry clusters and bring cutting-edge clean energy research and development to the state.

New Jersey must support the growth of in-state clean energy industries through workforce training programs, clean energy finance solutions, and investments in innovative research and development programs. This should include a clean energy workforce needs assessment, a clean energy job training program to assist current New Jersey workers to pivot their skills as necessary to meet changing industry needs, and a vocational training program to establish a pipeline of well-qualified, modern energy specialists.

The state will also explore the establishment of a New Jersey Green Bank that would leverage public dollars to grow private sector investment, provide low-cost financing, and develop financial protocols to support New Jersey's clean energy economy and the goals of the EMP, such as lowering the cost of capital for renewables and energy efficiency projects. Finally, New Jersey has capitalized on offshore wind economic development opportunities by proposing the establishment of a WIND Institute, which is charged with developing and implementing a plan to create a regional hub for New Jersey's burgeoning offshore wind industry and build upon the Murphy administration's commitment to making New Jersey a national leader in offshore wind. The state will also take the necessary steps to establish a Clean Energy New Technology Incubator to fund and support research, development, and commercialization for upcoming clean energy technologies, and a Clean Buildings Hub to develop workforce training, awareness, and education for builders, architects, contractors, engineers, real estate, and code enforcers in the most efficient construction and retrofitting building techniques.

Importantly, all of this necessary activity will generate considerable job-creation and economic benefits. This will significantly contribute to the state's clean energy innovation economy while also building out New Jersey's clean energy future.

To develop a quantitative and analytical pathway to achieve the dual goals of 100% clean energy and the GWRA emissions reductions requirements, NJBPU and NJDEP worked together with two contractors, Rocky Mountain Institute (RMI) and Evolved Energy Research (Evolved), to develop an Integrated Energy Plan for New Jersey.

NEW JERSEY WILL EXPAND UPON ITS EXISTING 52,000 CLEAN ENERGY JOBS

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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 resources	• **Continuing deployment of in-state renewables** and distributed energy resources, above current goals, is consistent with a least-cost path to meeting 2050 targets. • **Coordination with neighboring states and regional markets** can allow New Jersey to complement in-state renewables with low-cost, out-of-state resources. • **Retention, but not near-term expansion, of existing gas and nuclear capacity** can allow New Jersey to preserve reliability and meet clean energy goals.
3. Maximize energy efficiency and conservation and reduce peak demand	• **Continued prioritization of energy efficiency** measures and programs can significantly reduce energy consumption—including through the adoption of electric vehicles and heat pumps—and lower the costs of powering New Jersey's economy with clean energy.
4. Reduce energy consumption and emissions from the building sector	• **Building electrification reduces final energy demand** and allows buildings to efficiently utilize clean electricity for space heat and water heat. • **Electrification programs for new construction** can lay the groundwork for an in-state workforce to retrofit existing buildings.
5. Decarbonize and modernize New Jersey's energy system	• **New Jersey's electricity load doubles by 2050** due to building and vehicle electrification. • **Carefully planned grid modernization** investments can support electrification while containing costs for ratepayers. • **New Jersey's natural gas use declines to less than one fifth of today's levels by 2050**, likely reducing the need for gas distribution system expansion.

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The findings from the Integrated Energy Plan, as well as the many other studies NJBPU has conducted under this administration, have been incorporated into the final EMP.

The EMP is a living document that will guide New Jersey through the next 30 years. Given this, it acknowledges that there are forthcoming technologies that are not yet available or developed, and allows enough flexibility to use today's tools but also incorporate tomorrow's advances. This final 2019 EMP includes strategies and goals to reach 100% clean energy and at least an 80% reduction in greenhouse gas emissions by 2050 while expanding the clean energy innovation economy and supporting Governor Murphy's vision for a "Stronger and Fairer" New Jersey.

Governor Phil Murphy highlights his administration's economic successes over the past year on the one-year anniversary of the release of his economic vision plan at Rowan University on October 1, 2019.

SECTION 3

ENERGY AND CLIMATE CHANGE

"WHEREAS, the international scientific and political communities have widely accepted that human activity is the main driver of global climate change and its corresponding deleterious impacts on our natural environment; and WHEREAS, traditional methods of energy production that rely on the burning of fossil fuels release harmful emissions of carbon dioxide and other greenhouse gases, which in turn contribute to global climate change; and WHEREAS, in order to curtail the serious impacts of global climate change caused by greenhouse gas emissions, New Jersey must shift away from its reliance on fossil fuels as a primary energy source and turn to clean energy sources…

"This 2019 Energy Master Plan (the "2019 Plan") shall provide a comprehensive blueprint for the total conversion of the State's energy production profile to 100% clean energy sources on or before January 1, 2050…"

Governor Phil Murphy, Executive Order No. 28

In October 2018, the Intergovernmental Panel on Climate Change (IPCC) released "A Special Report on Global Warming of 1.5°C," stating that the world must become carbon neutral by 2050 to avoid particularly detrimental consequences of climate change.

2018 was a watershed year for climate change and the corresponding implications for energy policy. In October 2018, the Intergovernmental Panel on Climate Change (IPCC) released "A Special Report on Global Warming of 1.5°C," stating that the world must become carbon neutral by 2050 to avoid particularly detrimental consequences of climate change, and that achieving these goals "would require rapid and far-reaching transitions in energy, land, urban and infrastructure (including transport and buildings), and industrial systems." One month later, the U.S. federal government released Volume II of its "Fourth National Climate Assessment," echoing the IPCC's sentiments.

Further underscoring the urgency of the situation – and the need for innovative and comprehensive energy policy change – was a January 2019 study showing that, after three years of decline, the nation's overall level of greenhouse gas emissions in 2018 increased despite the closing of coal plants. And in November 2019, the U.N. published its "United Nations 2019 Emissions Gap Report" that presents a sobering reality: the world's emissions must fall by 7.6% every year between 2020 and 2030 in order to prevent global temperatures from rising more than 1.5°C, past which scientists say the effects of climate change would be catastrophic. Considering that global emissions have risen 1.5% every year for the last several years, the shift will require a serious and concerted effort from the world's governments to achieve success.

With this dire climate backdrop, under Governor Murphy's direction and led by the New Jersey Board of Public Utilities (NJBPU), New Jersey took a much broader approach to the process of updating its 2019 Energy Master Plan (EMP) than the state has done traditionally. Rather than limiting the scope of the EMP to making projections of energy data, usage, and costs, and calculating related greenhouse gas emissions, this plan sets higher goals and objectives and includes multiple sectors and governmental agencies, striking a pragmatic but ambitious vision of the state's transition to 100% clean energy by 2050.

New Jersey has seen a steady decrease in greenhouse gas emissions, a decline that has indeed been largely due to the closing of coal plants in the state. In 2000, less than 20 years ago, New Jersey had ten coal plants. In May 2019, one of the last three remaining coal-fired power plants officially ceased operations, and the fuel source has been all but eliminated from the state's energy mix. This hard-fought transition from coal to natural gas over the course of the past few decades was made possible through the work of NJBPU and the New Jersey Department of Environmental Protection's (NJDEP) authority under the Federal Clean

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NEW JERSEY HAS ONE OF THE LOWEST CARBON ELECTRICITY GENERATION SECTORS IN THE U.S

Air Act and the New Jersey Air Pollution Control Act. In 2005, NJDEP classified carbon dioxide (CO_2) as an air contaminant, which encouraged the state to look critically at the harmful effects that polluting coal was having on air quality. Further driving the shift away from coal, market economics and the fracking boom drove more of the state's electricity fuel mix to natural gas.

Indeed, from reducing New Jersey's use of coal, to increasing the amount of energy that is now generated in-state, to the amount of solar that is housed here, and beyond, New Jersey's energy landscape has been dramatically transformed over the last 30 years. Today, New Jersey has one of the lowest carbon electricity generation sectors in the U.S. As of 2018, the state's electricity was generated through a combination of natural gas (51.6%) and nuclear (42.5%) power sources, with renewable energy generation approaching 5%. However, with the recent closing of New Jersey's oldest nuclear plant, the state has lost over 600 megawatts (MW) of zero-emission generation capacity.

Per the Global Warming Response Act of 2007 (GWRA), New Jersey is obligated to reduce its greenhouse gas emissions to 24.1 million metric tons (MMTs) of carbon dioxide equivalent (CO_2e) by 2050 (80x50).[3] New Jersey

[3] NJDEP is in the process of updating its greenhouse gas emissions inventory to account for increasingly sophisticated modeling and measuring techniques. The Global Warming Response Act emissions reductions may therefore shift slightly as the inventory is completed. NJDEP will confirm or modify all emissions measurements and targets in the upcoming Global Warming Response Act Report.

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 CO_2e, by 2025. Today, New Jersey emits 97 MMTs of CO_2e, down from 121 MMTs of CO_2e 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 CO_2e 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 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.

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.

FIGURE 1.

New Jersey's Greenhouse Gas Reduction Targets Including Clean Energy Act Mandates

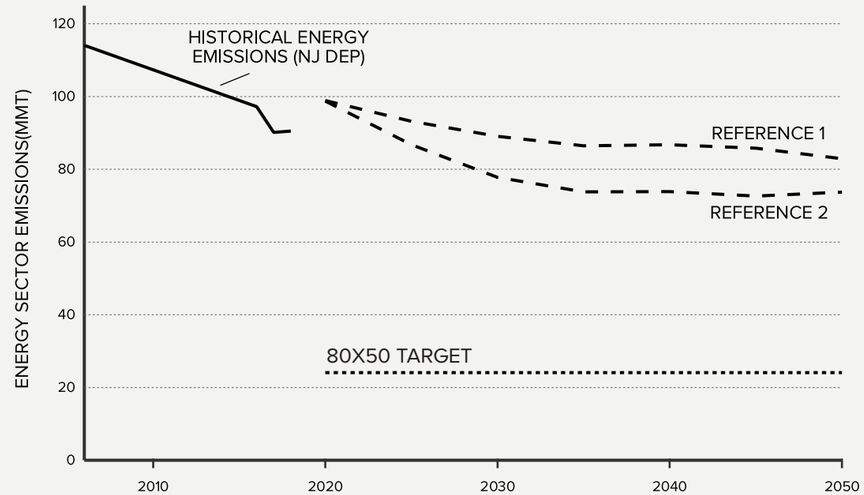

Figure 1: Historical energy sector emissions and emissions projected by the Integrated Energy Plan Reference scenarios as compared to the GWRA "80x50" target. Reference 1 reflects "business as usual" prior to the energy commitments made by the Murphy administration. Reference 2 reflects a "business as 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.

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.

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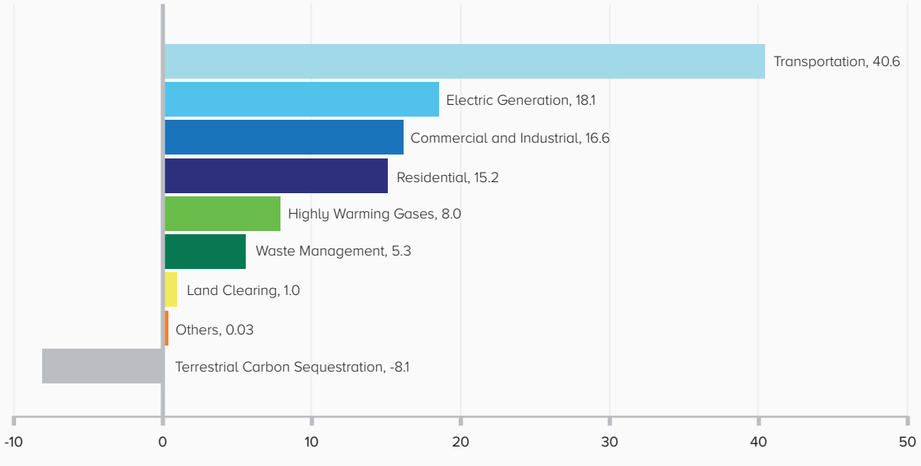
FIGURE 2.

Estimated New Jersey Greenhouse Gas Emissions, 2018

(in million metric tons CO_2e)

Total Net Emissions, 97.0 million metric tons CO_2e



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

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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

environmental justice in implementing their statutory and regulatory responsibilities. NJDEP-led stakeholder discussions to develop a strategic funding plan to effectively reduce greenhouse gas emissions with the RGGI auction proceeds concluded in December 2019, and will focus on communities that have been disproportionately impacted by pollution.

On May 23, 2018, Governor Murphy signed Executive Order No. 28, directing the development of an updated Energy Master Plan for the state to achieve 100% clean energy by 2050. That same day, Governor Murphy signed into law the Clean Energy Act of 2018 (P.L. 2018, c.17). The Act was the fulfillment of a campaign promise, developed in close coordination with the Legislature, administration, and interested stakeholders, for New Jersey to undertake a massive overhaul of its energy system while growing the economy, building sustainable infrastructure, creating strong, local jobs, reducing carbon emissions, and improving the environment, air quality, and public health. In addition to seizing a once-in-a-generation opportunity to establish the state as a landmark clean energy leader and innovator in a newly-emerging and rapidly-changing industry, the law was also the first step in a massive change as to how New Jersey generates, distributes, consumes, and conserves energy.

On May 23, 2018, Governor Murphy signed Executive Order No. 28, directing the development of an updated Energy Master Plan for the state to achieve 100% clean energy by 2050.

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The Clean Energy Act commitments include:

- Increasing the state's Renewable Portfolio Standard to 50% by 2030
- Generating 3,500 MW of offshore wind by 2030[4]
- Installing 2,000 MW of energy storage by 2030
- Increasing energy efficiency standards by at least 2% in the electric sector and at least 0.75% in the natural gas sector by 2024
- Transitioning to a new solar incentive program
- Developing a community solar program that allows more state residents to benefit from solar energy, especially low- and moderate-income (LMI) families[5]

Implementation of the Murphy Administration's Clean Energy Commitments

The state has made significant headway in the last year to advance the Clean Energy Act requirements, in addition to other clean energy and emissions-reduction objectives. For example, the law increased the state's solar power goal to 5.1% of generation within an accelerated deadline of energy year (EY) 2021 and with cost caps of 9% through EY 2021 and 7% thereafter to protect ratepayers. In November 2019, New Jersey's solar industry surpassed 119,000 solar projects completed across the state. NJBPU is currently conducting a study and stakeholder meetings to determine how best to transition the existing Solar Renewable Energy Certificate (SREC) program into a sustainable system by 2021, and has already adopted the rules and regulations necessary for the closure of the existing program.

To further develop the solar industry and enable more equitable access to the clean energy economy, NJBPU also launched an innovative three-year Community Solar Energy Pilot Program with an ambitious 40% carve-out for projects that serve at least 51% low- and moderate-income customers, one of the highest goals in the nation and the first-of-its-kind in New Jersey. The Community Solar Energy Pilot Program, the first year of which received more than 250 applications, 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, enabling ratepayers who previously could not access solar energy to participate in the clean energy economy.

[4] Executive Order No. 92, signed on November 19, 2019, increases this goal to 7,500 MW by 2035.

[5] "Low-income household" means a household with adjusted gross income at or below 200% of the federal poverty level. "Moderate-income household" means a household with a total gross annual household income in excess of 50%, but less than 80% of the median income, as determined by annual HUD income limits.

In September 2018, NJBPU opened the nation's largest single-state solicitation to date for 1,100 MW of offshore wind, and in December 2018, only six months after the Clean Energy Act was signed into law, NJBPU approved rules for the Offshore Wind Renewable Energy Certificates (ORECs) funding mechanism. Three offshore wind project developers submitted bids and in June 2019, NJBPU announced that Ørsted's record-breaking 1,100 MW Ocean Wind project was the winner. NJBPU is developing an Offshore Wind Strategic Plan that will provide a roadmap to achieving the 7,500 MW goal, as well as any solicitations beyond this target (see Appendix B). The Strategic Plan will provide guidance on the supply chain, infrastructure and workforce development; environmental and fisheries concerns; ports development; offshore wind integration and pricing; and energy costs. Governor Murphy has asked NJBPU to open additional solicitations in 2020 and 2022.

NJBPU IS DEVELOPING A ROADMAP TO 7,500 MW OF OFFSHORE WIND

New Jersey has also, for the first time, set ambitious targets of 600 MW of energy storage by 2021 and 2,000 MW by 2030. As more renewable energy sources are connected to the grid, energy storage will support the variable nature of their generation. NJBPU has conducted an Energy Storage Analysis and a stakeholder engagement process to gather ideas about strategically increasing energy storage and distributed energy resources (DER).[6] Following issuance of the report summarizing these findings, NJBPU is preparing to establish a process and mechanisms to achieve the state's energy storage goals.

For the first time, NJBPU is establishing plans for regulated utilities to achieve minimum energy savings of 2% of electric use and 0.75% of natural gas use, an increase of three to four times the current targets. NJBPU established an Energy Efficiency Advisory Group in August 2019 and is engaged in a stakeholder process to inform the transition of New Jersey's energy efficiency programs and adopt the energy efficiency resource standards mandated by the Clean Energy Act. Energy efficiency targets are vital to reducing costs for ratepayers and to reducing overall energy consumption. NJBPU contracted an Energy Efficiency Market Potential Study that was completed in May 2019 and identified:

- the best, most cost-effective targets for electricity usage reduction and natural gas usage reduction;
- the potential for peak demand reduction by the customers of each electric and gas public utility;
- qualitative performance indicators, incentives, and penalties; and
- timeframes for regulated utilities to achieve the reductions.

Finally, although the state is taking steps to accelerate the electrification of transportation systems, New Jersey needs more aggressive strategies to increase electric vehicle (EV) adoption. New Jersey ranked second among states in the northeast for EV sales in 2018,[iii] but only 1.5% of new vehicles sold in New Jersey are electric, compared to 2.1% nationwide, and the state ranks 39th in publicly-available charging stations (Fast-Charging and Level 2 Ports) per capita.[iv]

In the past year and a half, the administration has made significant progress on EV adoption in the state. In April 2018, Governor Murphy added New Jersey as a signatory to the State Zero-Emission Vehicles Program Memorandum of Understanding (ZEV MOU), committing the state to support the deployment of 330,000 zero emission vehicles by 2025. Most recently in June 2019, the administration announced the Partnership to Plug-In, a statewide partnership to support the growth of EVs, including through the use of vehicle rebates. Further, the state has disbursed or ear-marked a collective $27.5 million of New Jersey's settlement with the federal Volkswagen lawsuit to be spent on electric buses in the City of Camden, heavy-duty electric vehicles in urban areas, and on EV charging stations throughout the state.

[6] Distributed Energy Resources (DER) are on-site systems, equipment, or processes that are appropriately sized, modular, and decentralized, as compared to larger, centralized power plants, that also include transmission and distribution systems. DER can be either grid-connected or off-grid energy systems located in or near the place where energy is used.

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Governor Murphy's ambitious energy and climate leadership comes at a time when the global energy system is facing substantial disruptors to traditional business models. Periods of transition are also opportunities for innovation and growth. The state is set to capitalize on this energy transition, and has emerged as a leader in the state-led clean energy revolution. Through mechanisms such as the Department of Labor and Workforce Development's (NJDOL) many existing and developing apprenticeship, training, and industry partnership programs, and the Economic Development Authority's (NJEDA) initiatives to provide green financing and support dynamic new clean energy industry clusters, the state is poised to create and grow full-time, permanent jobs in the clean energy market, to support pioneering clean energy start-ups and small businesses, to invest in research and development in the state's higher education institutions and tech hubs, to develop new energy supply chains, and to train and educate tomorrow's clean energy workforce.

As New Jersey embarks on this bold transition to a clean energy economy, it must remain sensitive to, identify, and pursue least-cost pathways to achieving these goals and ensuring they are inclusive and beneficial to all New Jersey residents. The state must be cognizant of potentially rising costs and be aggressive in limiting these costs wherever possible. In strategically phasing in goals over an appropriate and reasonable timeframe, and pursuing measures and policy mechanisms to reduce aggregate energy consumption, the state will have the opportunity to manage and control these costs.

The Energy Master Plan and the Global Warming Response Act Report

Since 1977, the State of New Jersey has been statutorily required to develop and regularly update an Energy Master Plan to set forth a strategic vision for the production, distribution, consumption, and conservation of energy in the state. New Jersey's energy policy, under the authority of NJBPU, reflects the full scope of New Jersey's current energy system and its future.

Separately, New Jersey, under the purview of NJDEP, is statutorily required to produce the Global Warming Response Act (GWRA) Report. This report will establish how the state can reduce its emissions to 24.1 MMT of CO_2e by 2050, which is 80% of New Jersey's emissions relative to 2006 levels, otherwise known as "80x50."

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New Jersey Governor Phil Murphy signs an executive order directing the New Jersey Board of Public Utilities to fully implement the Offshore Wind Economic Development Act (OWEDA) at the ACUA Wastewater Treatment Facility in Atlantic City New Jersey on Wednesday January 31st, 2018.

The goals of the EMP and GWRA Report are inextricably linked. NJBPU and NJDEP have partnered to develop a unified plan to transition New Jersey to a 100% clean energy economy. The agencies are working together and leading other state agencies and authorities in collaborating on each of the phases of this transition:

- Phase 1: 2019 Draft Energy Master Plan (June 2019)
- Phase 2: 2019 Final Energy Master Plan (January 2020)
- Phase 3: Global Warming Response Act Plan (June 2020)

The 2019 EMP marks the first report in our state's history to holistically consider the complete energy system in New Jersey, including electricity generation, transportation, and buildings, along with their associated greenhouse gas emissions. The 2019 Draft Energy Master Plan, released in June 2019, put forth preferred objectives, strategies, and supporting policies to achieve 100% clean energy by 2050. It defined, for the first time, the concept of 100% clean energy and provided an overview of the seven core strategies on which New Jersey will focus to achieve 100% clean energy by 2050.

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.

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SECTION 4

100% CLEAN ENERGY BY 2050

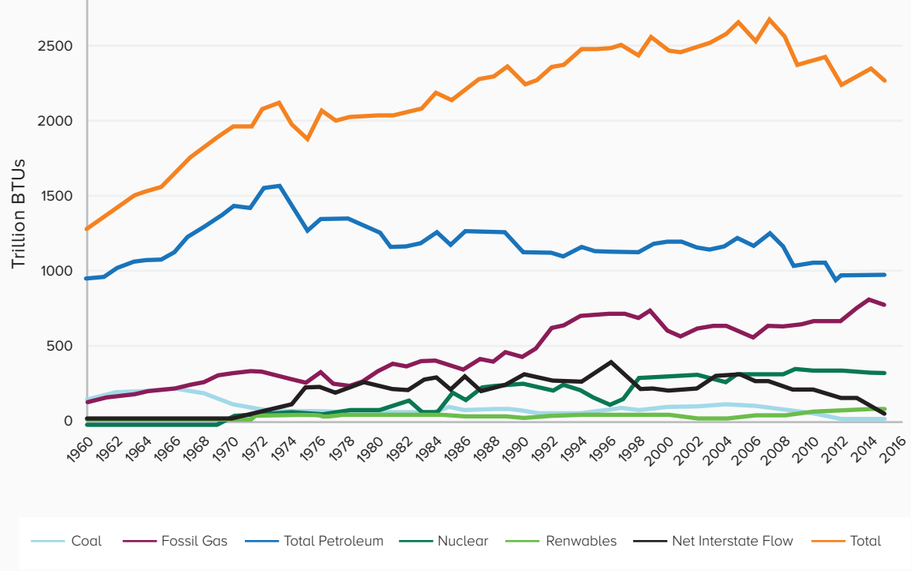
The 2019 EMP defines "100% Clean Energy by 2050" to mean 100% carbon-neutral electricity generation and maximum transition to electrification of the transportation and building sectors by 2050, with the goal of meeting or exceeding the 80x50 GWRA requirements.

New Jersey's total energy system is a combination of electricity generation and consumption, transportation fuel, and building use, including heating, appliances, and industrial use. In an effort to achieve 100% clean energy by 2050 and the 80x50 greenhouse gas emissions reductions in the most cost-effective and beneficially economic way, the state must consider the entirety of New Jersey's energy demand, starting with aggregate demand of primary energy.[7]

New Jersey consumed a total of 2,219 trillion British Thermal Units (BTUs) of primary energy in 2016. Of that total primary energy, 43.6%, or roughly 968 trillion BTUs, was sourced from petroleum, primarily in the form of transportation fuel, and 35.8%, or 795 trillion BTUs, was sourced from natural gas, primarily used for building heat and electricity generation (Figure 3).

FIGURE 3.

New Jersey Primary Energy Consumption (Trillion BTUs) (1960-2016)



[7] According to the U.S. EIA, "primary energy" is energy in the form that it is first accounted for in a statistical energy balance, before any transformation to secondary or tertiary forms of energy. For example, coal can be converted to synthetic gas, which can be converted to electricity; in this example, coal is primary energy, synthetic gas is secondary energy, and electricity is tertiary energy.

Further, New Jersey generated about 77 million MWh (262.73 trillion BTUs) of electricity in 2016, including about 30 million MWh (102.36 trillion BTUs) from nuclear power and 44 million MWh (150.13 trillion BTUs) from natural gas, which was enough to meet the state's current electricity demand.[8]

Reducing carbon from the electricity resources serving New Jersey's load, incentivizing deployment of renewable generation and zero-emission distributed energy resources (DER), upgrading the grid to handle large, variable electricity loads, and decreasing energy demand and peak load through efficiency measures and conservation are vital actions the state can initiate immediately.

The state's highest energy consumption and largest emissions come from the transportation and building sectors. Therefore, any meaningful transition of the state's energy system to reduce energy consumption and emissions must also encompass decarbonization – primarily through electrification – of the transportation and building sectors, which have not been significantly addressed in previous state EMPs.

[8] Energy reporting in the EMP is predominantly described on a calendar year (CY) basis. For some energy reporting, including the BGS and the RPS it is reported on an energy year (EY) basis. The EY for the NJ RPS is June 1 to May 31 of the following year.

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Electrified transportation and buildings support the state's emissions-reductions goals because:

- **They can be powered with renewable energy.** A clean electric grid powering clean transportation and buildings is naturally synergistic, reducing emissions and improving air quality from all three energy sectors. Though New Jersey must continue to ramp up its renewable energy industry, powering vehicles and buildings utilizing the state's current electricity generation system is far cleaner and more efficient than powering them with natural gas or petroleum.
- **They reduce overall energy consumption.** Electric vehicles (EVs) and electric heating systems and appliances are more efficient per unit of energy than their conventional counterparts, such as gasoline or diesel-fueled vehicles and natural gas or oil heating systems.
- **They support the benefits of a modern, flexible, and connected grid.** Electrified resources are responsive to load shifting, demand response, and other energy efficiency measures that are necessary to shave peak energy demand, reduce energy consumption, and better utilize the distribution grid.
- **They improve air quality.** Air pollutants will be covered with more depth in the GWRA Report, but the EMP must acknowledge the substantial economic and public health benefits, particularly among the communities most burdened by pollutants, of improved air quality resulting from emission- and pollutant-free transportation, buildings, and electricity.

Notably, electrification of traditionally fossil fuel-dominated sectors will result in two significant shifts: the substantial increase in electricity demand over time, and a corresponding decrease in natural gas and petroleum consumption over the same period. Specifically, the EMP's modeling study found that, in the Least Cost scenario, New Jersey's electricity demand would more than double, and demand for natural gas would decrease by 75% by 2050.[9]

The Integrated Energy Plan forecasted the growth of electricity demand to 2050 considering several variables, such as the rate of adoption of EVs and electric heat pumps; the success of energy efficiency programs; and the effect of new rate structures to incentivize energy reductions and managed electricity use. The modeling also equips the state with information necessary to evaluate the necessity or financial prudency of future gas infrastructure projects in light of a substantial decrease in demand of natural gas within the next three decades.

[9] The Integrated Energy Plan found that demand for fossil natural gas falls by 85% in the Least Cost case. However, because the electricity system utilizes some biogas in the 2040s, the gaseous fuel use delivered by the gas transmission system falls by 75%.

Electrification of the building and transportation sectors will increase the electricity load on the grid, while also significantly decreasing overall energy usage. There are ways to manage this rate of increased electric demand through 2050 and defer the need for additional electricity generation, distribution, and transmission system upgrades. Indeed, reducing wasted energy is the most cost-effective and cleanest energy system option. These methods can include, but are not limited to:

- Robust energy efficiency programs;
- Redesigned rate structures to more efficiently manage the distribution systems;
- Improved management of zero-emission DER through distribution service operations (DSO);
- Managed EV charging and demand response programs;
- Stronger energy efficiency appliance standards and building and energy codes;
- Improved thermal insulation; and
- Reduction of vehicle miles traveled.

Conversely, poorly managed, rapid electrification of the transportation and building sectors could inadvertently trigger increased peak load at great cost to ratepayers and to the state's emissions reduction goals.

For these reasons, the rapid deployment of renewable energy generation and further development and installation of electric and thermal energy storage systems (Strategy 2), coupled with proper planning via Integrated Distribution Plans (IDP) (Strategy 5) and the programs and objectives listed above to reduce and manage load, will be critical factors in reaching 100% clean energy by 2050.

The Integrated Energy Plan analysis has enabled NJBPU to quantify on a net present value the costs and benefits of transitioning New Jersey's energy system against the status quo, including rising consumption, rising fuel costs, and increasing consequences of climate change impacting public health, infrastructure, and the overall economy. Accordingly, the EMP incorporated these findings into the strategy development, goals, and implementation mechanisms necessary to establish a roadmap to a clean energy future.

SECTION 5

INTEGRATED ENERGY PLAN: INTRODUCTION, APPROACH, AND KEY FINDINGS

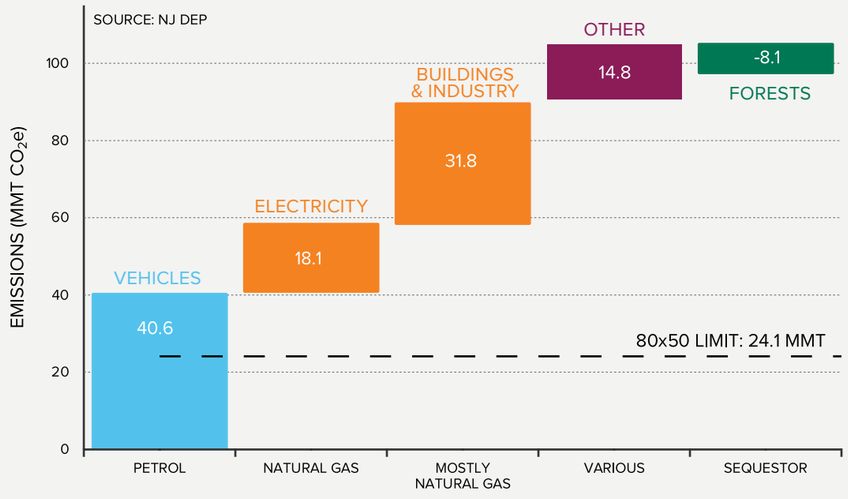
New Jersey's energy system today

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.

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 (CO_2) 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 Emissions Today



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

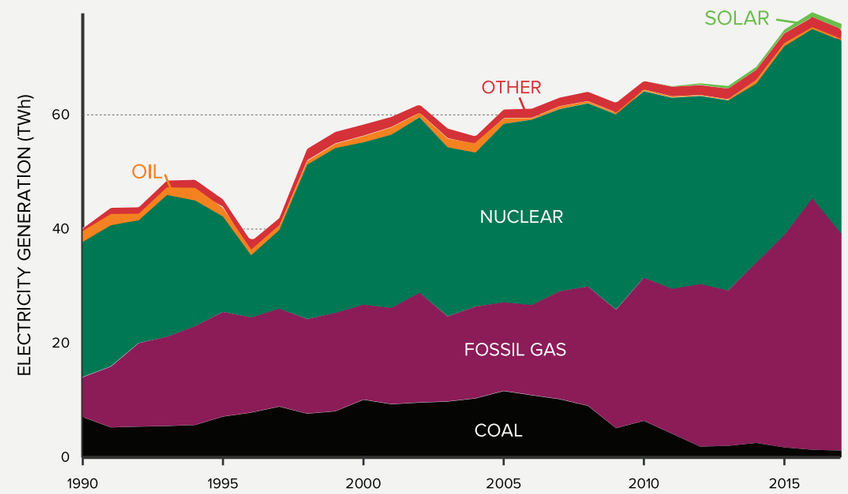


Figure 5: Electricity generation in New Jersey is dominated by natural gas and nuclear power plants, which provide nearly all of the state's electricity needs. Source: U.S. Energy Information Administration.

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.

4. **Scenario-based analysis:** To understand the impacts of variable factors and choices in policy priorities, the Integrated Energy Plan team analyzed nine different scenarios for the evolution of New Jersey's energy economy from 2020 through 2050.

5. **Stakeholder input and participation:** The Integrated Energy Plan team engaged extensively with stakeholder groups (including utilities, labor unions, environmental advocates, environmental justice communities, technology companies, and others) through multiple focus groups, webinars, data requests, and other means to inform data inputs and modeling scenarios used in the Integrated Energy Plan analysis.

The model tested how different demand- and supply-side options and policy priorities might affect the costs and feasibility of reaching the 2050 goals.

The Integrated Energy Plan addressed three high-level questions, listed below, through a combination of research, scenario-based energy system modeling, and stakeholder engagement:

1. *What is the current state of New Jersey's energy system?* The Integrated Energy Plan team, working with state agencies and other stakeholders, defined a base-case representation of the state's energy economy in 2020.

2. *What resource mixes and pathways meet 2050 emissions goals?* The Integrated Energy Plan team, with input from state agencies and other stakeholders, defined scenarios to test how different demand- and supply-side options and policy priorities might affect the costs and feasibility of reaching the 2050 goals.

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3. *What strategies are common to least-cost pathways?* The Integrated Energy Plan team, in partnership with state agencies and stakeholders at a workshop held in October 2019, explored the implications of pathway analyses and other modeling results for setting near- and long-term policy priorities.

Modeling approach

Integrated Energy Plan modeling proceeded in three steps (see Figure 6):

1. **Define the energy services required by New Jersey's growing economy.** In the first modeling step, the Integrated Energy Plan team defined the energy services New Jersey will need through 2050, using Annual Energy Outlook projections for population and economic growth. The model included all major energy end uses in the transportation, residential, commercial, and industrial sectors. The model did not assume any significant changes to the level of demand for end-use services. For example, the team assumed that total vehicle miles travelled continued to scale with economic and population growth.

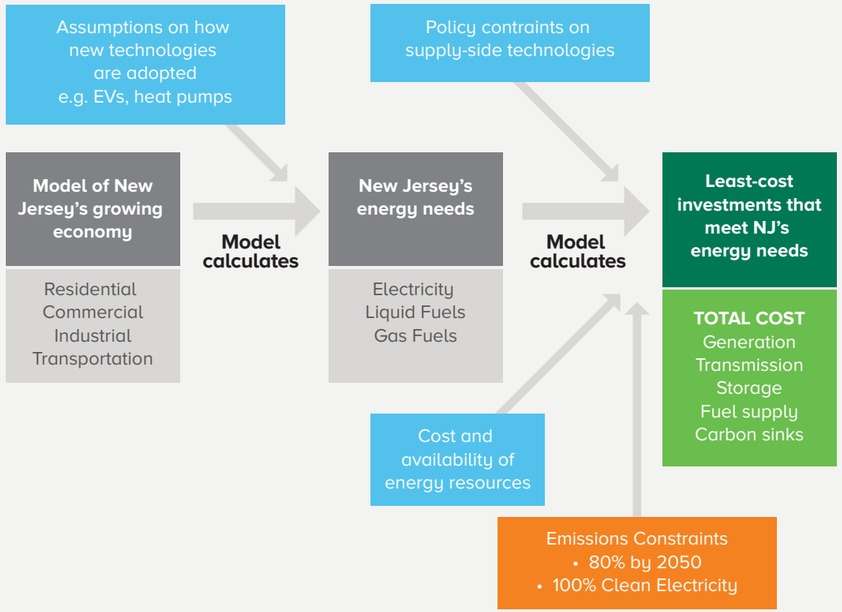
2. **Calculate New Jersey's energy needs.** In the second step, the model calculated New Jersey energy needs in terms of electricity, liquid fuels, and gas fuels. To make this calculation, the team made assumptions about how new technologies are adopted, within a "stock rollover" model.[10] The stock rollover assumptions included efficiency and electrification programs. For example, in the Least Cost scenario (described below), it assumes that drivers adopt EVs at increasing rates until 2035, at which time all new vehicles purchased are electric.

3. **Optimize investments to meet New Jersey's energy needs at least cost while meeting policy targets.** In the final step, the model optimized supply-side investments to allow New Jersey to meet its energy needs and emissions constraints at least cost. All emissions generated within New Jersey were counted against the state's emissions reduction targets, and all electricity generated in-state or imported was required to be carbon-neutral by 2050. Electricity imports, unless they were sourced from dedicated renewables invested in by New Jersey, were assumed to be from fossil gas, the emissions from which also counted against the emissions reduction targets (see the Technical Appendix for emissions accounting details).

[10] A stock rollover model is a tool that simulates the turnover of appliances, vehicles, and other energy-using equipment over time, in order to estimate total energy needs across the economy.

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.

Integrated Energy Plan scenarios

Each step of the analysis relies on a number of key assumptions about uncertainties in future energy policy, technology availability, costs, and other variables. Working with New Jersey stakeholders, the Integrated Energy Plan team collected these assumptions into nine groups, or scenarios, to assess the impact of different variable factors and uncertainties that will affect New Jersey along the pathway to reaching its 2050 goals. The Integrated Energy Plan analysis was repeated nine times using these nine different scenarios.

The scenarios include two reference cases that reflect "business as usual" conditions and that do not meet either the 2050 GWRA goal or 100% clean energy target, as well as seven variations that do meet those targets. The nine scenarios are summarized in Table 1, and the scenario-specific findings are discussed in detail in Appendix A. The full list of assumptions for each scenario is shown in the Technical Appendix.[11]

Governor Phil Murphy signs energy legislation and an executive order creating a statewide energy master plan in South Brunswick on May 23, 2018.

[11] The Integrated Energy Plan Technical Appendix can be found on NJBPU's website: **https://nj.gov/emp/pdf/New_Jersey_2019_IEP_Technical_Appendix.pdf**

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TABLE 1

Scenarios Used in Integrated Energy Plan Modeling

Name	Summary	Key Question	Policy Mandates
Reference 1	No current or prospective energy policies	What are cost and emissions outcomes of "business as usual?"	No constraints on emissions or electricity generation
Reference 2	Existing policy except 2050 GWRA & 100% Clean Energy	What cost and emissions impact do existing policies have?	
Least Cost	Fewest constraints to achieve emissions and clean energy goals	If all options are open to New Jersey, what is the least cost pathway to meet goals?	Meets 100% Clean Energy and 2050 GWRA emissions reductions
Variation 1	Regional deep decarbonization	How does regional climate action affect New Jersey's cost to meet its goals?	
Variation 2	Reduced regional cooperation	How can New Jersey meet its goals internally?	
Variation 3	Retain fuel use in buildings	How would New Jersey meet its goals if it kept gas in buildings, and at what cost?	
Variation 4	Faster renewables & storage cost declines	How would cheaper clean energy affect costs and resource mix?	
Variation 5	Nuclear retires and no new gas plants	How does minimizing thermal generation affect decarbonization costs?	
Variation 6	Reduced transportation electrification	How would New Jersey meet its goals if it kept fossil fuels in vehicles, and at what cost?	

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

FIGURE 7.
Energy Emissions by Fuel Source, Least Cost Scenario

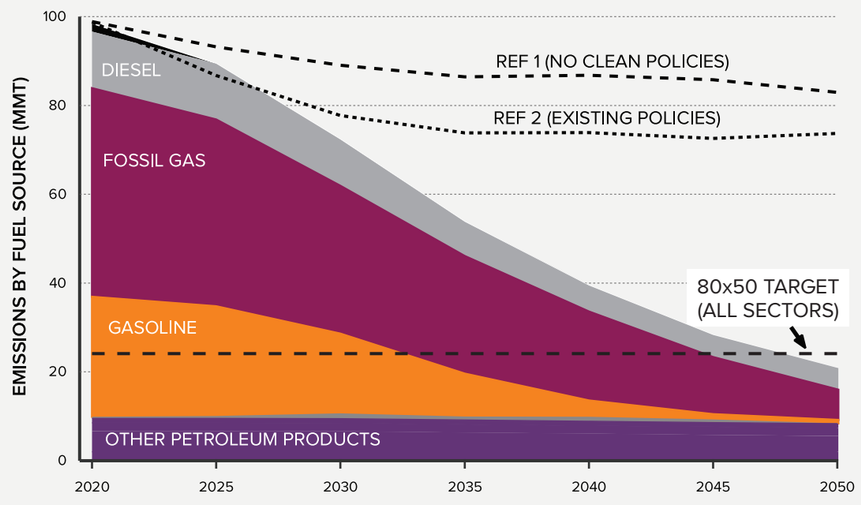
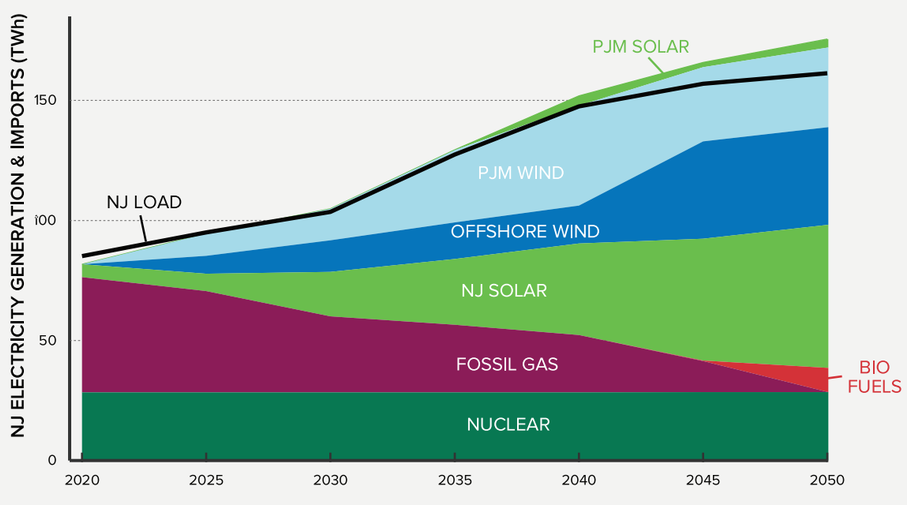


Figure 8. Carbon-neutral electricity grows and transitions to meet 100% clean energy.

FIGURE 8.
Electricity Generation, Least Cost Scenario



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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.

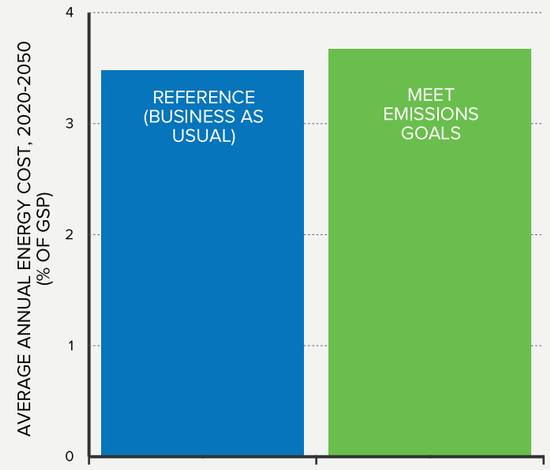
Just as the Integrated Energy Plan does not account for incentives and subsidies, the scenario-based Integrated Energy Plan modeling does not account for the value of health or environmental benefits associated with meeting clean energy and climate goals. However, the Integrated Energy Plan team did compare these cost savings against the incremental investments needed in order to meet New 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: Meeting emissions targets increases the average costs of New Jersey's total annual energy system from 3.5% to 3.7% of GSP.

FIGURE 9.

Average Annual Energy Cost, 2020-2050



[12] **https://19january2017snapshot.epa.gov/climatechange/social-cost-carbon_.html**; range between 2020 and 2050 values at 3% discount rate.

FIGURE 10.

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

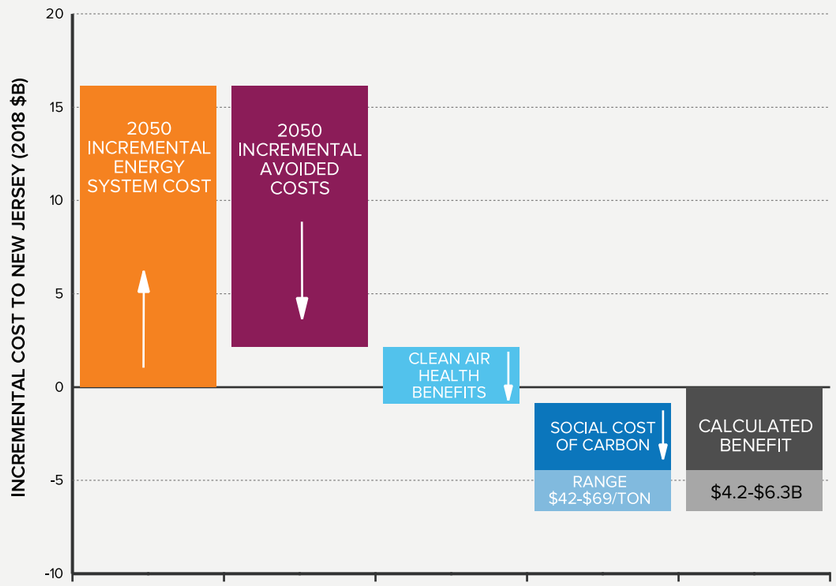


Figure 10. Incremental costs of meeting emissions targets are offset by fossil fuel cost savings and cost savings associated with reduced pollution.

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.

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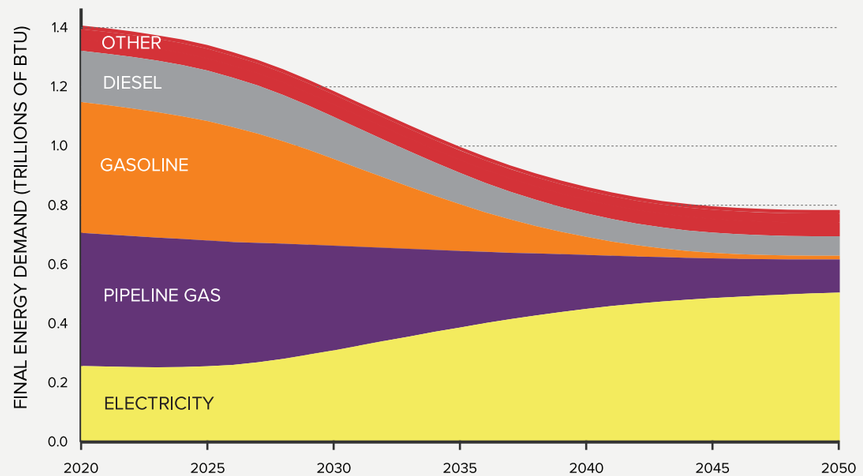
4. A least-cost energy system that meets New Jersey's emissions and clean energy targets looks quite different from today's system, including significantly higher levels of renewables deployment, building electrification, and transportation electrification.

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



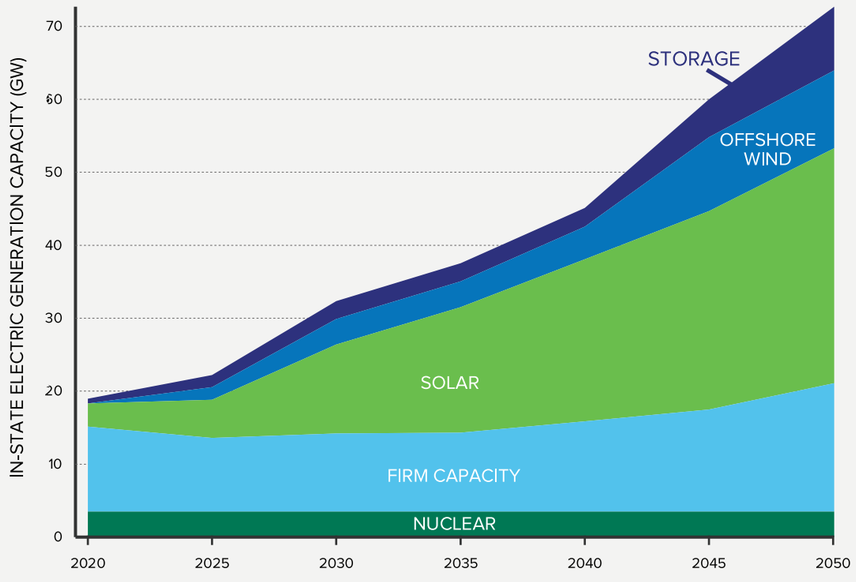
natural gas-fired heating equipment and gasoline- or diesel-fueled engines (Figure 11). In the Least Cost scenario, electricity demand in winter months increases faster than electricity demand in summer months, driven by electrified heating loads, and transitions New Jersey's grid from summer-peaking to winter-peaking.

To accommodate demand growth and shifting load profiles, the Least Cost scenario includes a significant growth in renewable electricity generation technologies. In-state renewables, including offshore wind, utility-scale solar PV, and rooftop solar PV, dominate New Jersey's generation mix in 2050, complemented by the continued operation of existing nuclear resources and high-quality, low-cost wind imported from other states within the PJM electricity market footprint (Figure 12). The Least Cost scenario shows that existing gas capacity stays in operation, but operates much less often, and transitions from serving as a major supplier of electricity to New Jersey in 2020 to serving as a "backup" resource for renewable energy by 2050. In the Least Cost scenario, after 2035 the state will need some additional dispatchable capacity to ensure grid reliability, but can delay investment decisions and technology choices for those resources for a decade or more and reevaluated as technology uncertainty resolves and actual load growth patterns become clearer.

Figure 12. To meet growing electricity demand, renewable and storage capacity increase swiftly in the near-term; some additional firm generation capacity will be needed in the 2040s.

FIGURE 12.

In-State Electricity Capacity, Least Cost Scenario



IN-STATE RENEWABLES DOMINATE NEW JERSEY'S GENERATION MIX IN 2050

5. **Both in-state investment and regional coordination are key to lowering the costs of meeting New Jersey's goals.**

   The Least Cost scenario includes imported, out-of-state renewable energy to complement in-state resources that offer both relatively low-cost energy as well as reliable service not dependent on transmission from out-of-state. The Least Cost scenario finds that some transmission investment (i.e., 2 GW of additional transmission to supplement today's 7 GW) is economically justifiable in order for New Jersey to import some lower-cost resources, but that approximately 80% of electricity to serve New Jersey's load in 2050 will be generated within the state. The complementary dynamic between in-state and out-of-state resources will allow New Jersey to meet its goals in the most cost-effective manner while maintaining reliability and maximum investment benefits within the state.

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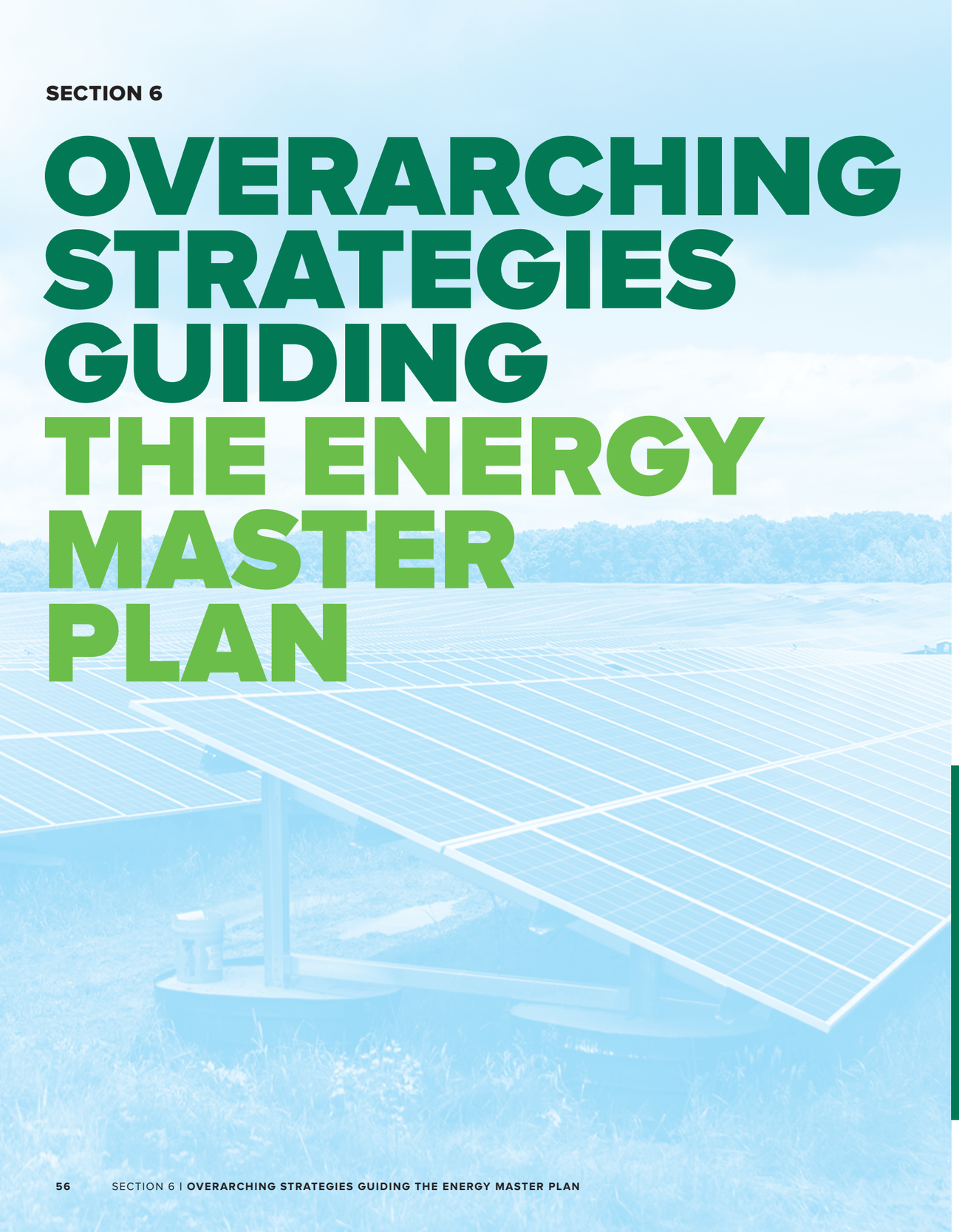
SECTION 6

OVERARCHING STRATEGIES GUIDING THE ENERGY MASTER PLAN



Thirty years ago, the technology landscape had just seen the arrival of the World Wide Web and the first Nintendo gaming system, and the very first of 24 satellites that would eventually comprise the network for a Global Positioning System (GPS) was launched into orbit around the Earth. In 1989, no one could have accurately fathomed how acutely technological advances would transform every essence of our society.

Although energy analyses, forecasting, and modeling are highly informative, it would be short-sighted and presumptive to pretend to have all the answers today about what the state, the nation, and the world will be like in 2050. But it would be equally presumptive, and irresponsible, to expect that future technological advances will solve these problems later, or to suggest that embarking on a clean energy future is too hard, too expensive, or too uncertain.

New Jersey must implement today what it can, and innovate for tomorrow what it can't.

New Jersey must reduce its greenhouse gas emissions immediately and aggressively, implementing existing technologies, processes, and market drivers to begin achieving its emissions-reductions goals. New Jersey must continue to invest in low-carbon solutions to drive further advances and efficiencies necessary to reach long-term mandates. And New Jersey's governmental agencies must work in lockstep with the utilities, businesses, non-profits, communities, and educational institutions to drive

NEW JERSEY MUST IMPLEMENT TODAY, AND INNOVATE FOR TOMORROW

innovation and support all New Jerseyans in participating in and benefitting from the clean energy transition.

Importantly, New Jersey has a supportive global community; several other states, as well as nations around the world, are also pursuing ambitious clean energy agendas that will benefit and complement New Jersey's efforts.

What follows are the strategies, policy guides, and implementation details laid out in this final 2019 EMP to achieve New Jersey's decarbonization and emission reduction goals. They have been refined and supported by the many studies NJBPU and NJDEP are conducting, and will also be reflected in the forthcoming GWRA Report. When possible, the goals, objectives, and policies presented here are considered in a technologically-neutral manner, in order to encourage market-driven (that is, determined by or responsive to market forces) innovations that support the overarching objectives of decarbonization and emissions reductions in the most economically beneficial and cost effective way.

Governor Phil Murphy, alongside First Lady Tammy Murphy and former Vice President Al Gore, signs an executive order more than doubling New Jersey's offshore wind goal on November 19, 2019, at Liberty Science Center.

STRATEGY 1

Primary Goals:

1.1 Decarbonize the transportation sector

1.2 Improve connections between people, jobs, and services

1.3 Reduce port and airport emissions

Reduce Energy Consumption and Emissions from the Transportation Sector

The transportation sector should be almost entirely decarbonized by 2050, with an early focus on electrification of light-duty (passenger) vehicles and short-range medium- and heavy-duty vehicles, particularly in environmental justice communities. Further, there should be a concerted effort to reduce vehicle miles traveled and reduce port and airport emissions through electrification or decarbonized fuels.

Fossil fuel-powered transportation is New Jersey's leading cause of air pollutants.[vi] According to a 2016 American Lung Association report, "Clean Air Future: Health and Climate Benefits of Zero Emission Vehicles," pollution from motor vehicles resulted in $4.6 billion in public health and climate costs to New Jersey residents in 2015. Accelerating the transition to a zero-emission electric transportation sector is necessary to reduce these costs and improve the health and quality of life for our residents, particularly in communities that are disproportionately impacted by pollutants, also known as environmental justice communities.

In New Jersey, the transportation sector accounts for 42% of the state's net greenhouse gas emissions, making transportation the largest of the state's sources of emissions at well above the national average (28%).[vii] Mobile sources are also the largest cause of ozone precursors in New Jersey and are responsible for 71% of the state's nitrogen oxides (NO_x) emissions, as well as particulate matter. Ground level ozone, also called smog, can cause permanent lung damage. Importantly, according to U.S. EPA's National Ambient Air Quality Standards (NAAQS), all 21 counties in New Jersey are in moderate or marginal non-attainment of ground-level ozone standards.[viii]

In order to address the serious climate and health-related impacts from transportation emissions, the state must take concrete steps to start to phase out motor gasoline and conventional diesel consumption as quickly

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.

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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 vehicles are also largely electrified by 2050, though not fully. The Integrated Energy Plan did not directly model the impacts of reduced vehicle miles traveled (VMT), but still illustrates the importance of reduced VMT as an important cost savings opportunity for New Jersey's overall decarbonization strategy.

Integrated Energy Plan Findings

- **Vehicle electrification reduces the cost of meeting New Jersey's 2050 targets.** Failing to electrify the vehicle fleet increases the cost of decarbonization from 2035 to 2050 by an average of $1.6 billion per year.
- **Vehicle electrification reduces total final energy demand.** EVs are more efficient than gasoline-powered vehicles in terms of energy used per mile traveled, and allow New Jersey's final energy demand to decrease in the Least Cost scenario, even as electricity load increases.
- **Vehicle electrification increases flexibility in meeting 2050 targets.** Continuing a dependence on liquid fuels in vehicles would hamper flexibility to further reduce carbon emissions cost-effectively, should the state seek to reduce emissions beyond initial targets, or to adapt if other sectors are unable to decarbonize as modeled in the Integrated Energy Plan.
- **Cost impacts are sensitive to uncertain future prices.** The relative cost of electric and internal combustion vehicles greatly influences the total cost of decarbonization. The Integrated Energy Plan assumes relatively conservative price decreases for EVs, but a sensitivity analysis reveals that if recent EV technology advances and cost declines continue, the Least Cost decarbonization pathway would be less expensive than the business-as-usual Reference 1 scenario.
- **Reducing VMT can compound savings of electrification.** Transportation sector costs comprise a large portion of total energy system costs in New Jersey, whether or not the state's vehicle fleet electrifies. Strategies to reduce VMTs would lower the overall costs of the state's energy system and provide more flexibility to meet New Jersey's 2050 targets.
- **Vehicle electrification benefits environmental justice communities.** By transitioning to EVs, New Jersey would take a transformative step toward elimination of the dominant source of local air pollution, including black carbon, providing large, direct health savings, with outsize benefits to environmental justice communities currently burdened by poor air quality.

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.

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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 available, proven electric models do not yet exist, such as renewable diesel and sustainable aviation fuel.[1]

In 2011, only 338 EVs were registered in New Jersey, and 88% of them were plug-in hybrids; in June 2019, the total number had increased to over 26,000. Battery electric (non-hybrid) cars now make up more than 50% of the state's titled EVs, representing massive growth against hybrid sales. However, while New Jersey has realized a nearly 7,600% increase in adoption over the last decade, battery EVs still make up a very small share of the state's total vehicle registrations, only 0.3% of the 6.8 million total vehicles registered as of 2018.[ix]

An analysis by Bloomberg New Energy Finance suggests that, without proactive government efforts to drive EV adoption, battery EV purchases will continue their slow but steady growth in the near term, increasing from less than 0.5% of all U.S. car sales in 2015 to about 3.5% by 2021.[x] Bloomberg predicts that as EVs become cost competitive with gasoline vehicles in total cost of ownership without government subsidies – likely between 2025 and 2030 – EV sales will start gaining greater market share, reaching nearly 60% of total U.S. new car sales by 2040.

Based on this research, New Jersey is unlikely to meet the Integrated Energy Plan modeling assumption that 100% of all new car sales be electric by 2035 without additional incentives, particularly in the near-term, to

1 Learn more about sustainable aviation fuel at: **https://aviationbenefits.org/media/166152/beginners-guide-to-saf_web.pdf**.

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 experience. The state must also install considerably more Direct Current Fast Chargers rated at 150 kW or above; $3.2 million of Volkswagen settlement funding has thus far been dedicated to support such efforts.

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. The EV industry to date has largely been described as a classic chicken-and-egg problem. The private sector has not made a business case to install charging infrastructure without a critical mass of EVs on the road, and consumers struggle to rationalize the purchase of a more expensive vehicle that has limited range.

As of 2018, New Jersey ranked 45th in the nation in electric charging stations per registered vehicle.[xiv] New Jersey had 275 publicly-accessible fast charging ports at 80 locations and 647 Level 2 ports at 293 locations as of December 2019.[xv]

Ensuring the job, health, and economic benefits of such a rapid expansion of infrastructure requires a collaboration between the state's four main electric public utilities, colleges, universities and technical educational institutions, private EV charger installers, and private property owners embracing the economic benefits of hosting EV infrastructure on their properties.

To keep these efforts affordable, the state should enact policies that:

1. attract private capital into the EV infrastructure sector and substitute shareholder dollars for ratepayer capital wherever possible;
2. minimize the risk of ratepayers paying for stranded EV infrastructure investments, such as the risk that charging station infrastructure becomes technologically obsolete or is simply never utilized at a high level, through strategic mapping and encouraging private investment; and
3. design EV infrastructure policies that are fair to both EV-driving ratepayers and non-EV driving ratepayers, to ensure the benefits of EVs are shared by all ratepayers.

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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;

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(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 provide an outreach and education campaign to planners and local government to provide updated information regarding EV-ready zoning and code changes as well as steps that can be taken to encourage EV-ready infrastructure. The state will explore steps to incentivize New Jersey municipalities to expedite the approval process for EV charging stations. It will also work with private EV charging infrastructure providers to make the charging technology and payment platforms of the various companies active in the state inter-operable.

NJDOT will promote the use of the LOGOS program (the blue signs near highway exits) for the use of the EV charging signage, and NJMVC will develop a methodology to distinguish EVs from non-EVs during the vehicle registration process. The state will also explore ways to work collaboratively with local governments to achieve synergies between energy and transportation planning and land use/housing planning that will enable multi-modal transportation and EV-ready infrastructure.

Finally, NJEDA, through the Partnership to Plug-In, will introduce approaches to establishing public-private partnerships with transportation network companies, investors, and other appropriate parties to establish electric charging infrastructure. As NJDEP undertakes the strategic mapping and establishes criteria for funding publicly accessible charging, consideration will be given to the distance between existing and planned public charging stations, average employee commutes to workplaces, the need to equip multi-unit dwellings and workplaces, accessibility to interstate and state highways, travel patterns, and roads leading to tourism destinations.

In order to ensure that the required grid improvements to support the accelerated deployment of electric vehicles can be implemented cost effectively, NJBPU must work with the state's electric public utilities 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.

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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 in underserved communities. The New Jersey Department of the Treasury (Treasury) will also continue the sales tax exemption program for new and used battery electric vehicles (non-hybrid) and will consider extending the sales tax exemption to new and used plug-in hybrid models in an amount commensurate with battery range. Additionally, the state can work to identify private fleets of vehicles that may be able to utilize incentives to turn over sales and delivery fleets more quickly. Getting many more EVs on the road and normalizing their usage will help to spur further adoption.

Importantly, NJMVC will establish a mechanism to distinguish EVs from conventional vehicles during registration. This will aid in tracking EV metrics, provide data in assessing the most strategic places to establish publicly accessible charging infrastructure, and provide an additional layer of data for electric public utilities to analyze where grid upgrades are necessary to support increased electricity demand.

Goal 1.1.4: Increase consumer and fleet owner awareness and acceptance of electric vehicles.

In addition to NJDEP's continued regional and statewide education through outreach campaigns such as "Drive Change. Drive Electric" and Drive Green

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 service lines to match shifts in population, demographics, and jobs.

Clean vehicle technology, such as electric, hydrogen, or renewable natural gas, all have the potential to further improve net greenhouse gas and air pollutant impacts. As part of an overarching clean fuel strategy, the state should explore introducing the idea of fuel flexibility to achieve an affordable and scalable pathway to decarbonization.

While there are significant aggregate benefits of mass transit, diesel vehicles such as buses that travel in urban and densely populated areas can expose people to pollutants associated with the combustion of diesel fuel. NJ TRANSIT continues to seek opportunities to decrease its impacts on local air pollution as much as possible. Over the last 25 years, the agency has reduced its bus fleet NO_x emissions by 79% by replacing older vehicles with newer, cleaner technologies during vehicle replacement. Over the same time period, fleet particulate matter emissions, including black carbon, were reduced 98%.

NJ TRANSIT will continue to pursue pollutant-reduction strategies prioritizing electrifying buses while pursuing other carbon neutral strategies. Electric bus and alternative fuel technologies are maturing and the agency is in the process of assessing how to incorporate electric and alternative fuel buses into its operations and budgeting, including establishing when

[2] Drive Change. Drive Electric: https://driveelectricus.com/about-us/ and Drive Green New Jersey: **https://www.drivegreen.nj.gov**.

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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 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.

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.

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 to low- and moderate-income and environmental justice communities through a suite of clean transportation options. To accelerate the adoption of clean cars in densely populated or over-burdened communities, the state can establish incentives to help residents of low- and moderate-income and environmental justice communities purchase pre-owned EVs as well as offering upfront incentives to reduce monthly lease payments for the purchase of EVs. Targeted incentives will also facilitate electric charging infrastructure installation through public-private partnerships with property or parking lot owners and/or through electric public utility company filings.

Clean transportation options should also include providing safe multi-modal roadways that encourage use by pedestrians and bicyclists. NJDOT should prioritize multi-modal accommodations in projects located in low- and moderate-income and environmental justice communities, and should explore ways to provide additional incentives and assistance to these communities in its grant programs. Further, New Jersey must ensure that low- and moderate-income and environmental justice communities have equitable access to clean transportation by promoting options such as electric taxis, electric ride sharing, first mile/last mile e-rides, scooter sharing, bike sharing, and community charging hubs. In furtherance of that goal, NJDEP and NJBPU will seek to utilize grants to fund innovative electric ride sharing/hailing and community charging hub pilot projects. Such opportunities will be further explored in "Strategy 6: Support Community Energy Planning."

Finally, NJDEP will continue to prioritize funding for projects that reduce transportation emissions in low- and moderate-income and environmental justice communities.

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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.

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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.

Municipal and statewide fleets transitioning heavy-duty vehicles to electric may require county or shared service investments to facilitate centralized charging or procurement of hydrogen and to make the vehicles more cost effective to local municipalities.

Finally, fuel cell technology powered by hydrogen produced from renewable energy may play a larger role in commercializing zero emission trucks and displacing highly-polluting diesel engines, particularly in sectors that are difficult to electrify using battery technology, such as long-range trucking. Given the potential for fuel cell technology as a zero-emitting source of energy for both mobile and non-mobile (e.g., DER, storage) purposes, and the potential for New Jersey to generate vast amounts of offshore wind energy, New Jersey should evaluate opportunities to promote fuel cell vehicle fleets and work with the Port Authority to resolve concerns related to this technology; at this time, Port Authority does not allow hydrogen fuel cell vehicles to traverse its bridges and tunnels.

Goal 1.1.9: Explore policies that can accelerate adoption of alternative fuels in the transportation sector.

Port Authority recently implemented a broad technical support services agreement with the U.S. National Renewable Energy Laboratory (NREL) to support Port Authority's efforts such as evaluating the solar potential of additional Port Authority sites and evaluating the use of cleaner liquid fuels, such as Sustainable Aviation Fuel and renewable diesel. To further support advancing the potential supply and utilization of cleaner liquid

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.

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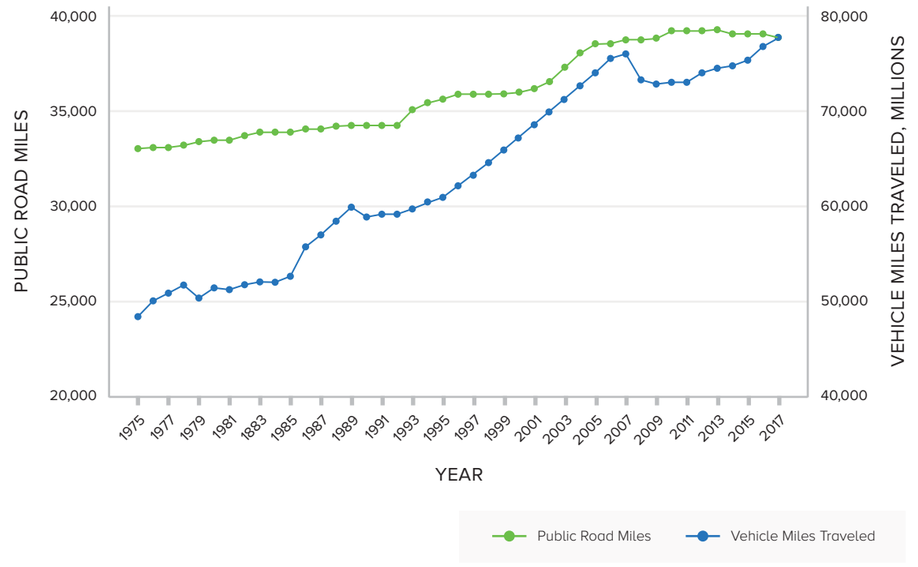
GOAL 1.2: IMPROVE CONNECTIONS BETWEEN PEOPLE, JOBS, AND SERVICES

- 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% carpool 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.

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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 areas to promote urban development.

Telecommuting, compressed or non-traditional work week schedules, and opportunities to move goods by rail instead of truck will also reduce VMT. With the aim of implementing and evaluating the efficacy of actionable policies to reduce VMT and increase walkability, NJDOT will evaluate the Level of Service transportation engineering metric, which measures the free flow of vehicle traffic, in comparison to other available metrics that measure the quality of transportation services.

In an effort to rebuild and reinforce the state's public transportation systems, Governor Murphy increased funding for NJ TRANSIT in his first budget and also signed a bipartisan bill in December 2018 that will implement major structural changes across the agency and beyond. Importantly, continuing to build on efforts to improve the quality of service of NJ TRANSIT rail operations and bus coverage—in a manner that reduces reliance on resource diversions from other state accounts and directly funds the agency toward a path to sustainability and restored ridership—is vital to these efforts.

NJ TRANSIT will examine opportunities such as Bus Rapid Transit, to substantially increase and incentivize mass transit utilization between bus terminals, park and rides, and large communities that aren't easily served

[3] Complete Streets are streets designed and operated to enable safe use and support mobility for all users. Those include people of all ages and abilities, regardless of whether they are travelling as drivers, pedestrians, bicyclists, or public transportation riders. **https://www.state.nj.us/transportation/eng/completestreets/**.

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 municipalities 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 downtowns, as shuttle operations) in a manner than enhances existing public transportation and promotes ridesharing, thereby reducing the need for personal vehicles. In addition to increasing shared vehicle usage, encouraging connections between mass transit, EVs, and connected and autonomous vehicles can foster more multimodal travel and overall emissions reduction. Through the development of The Hub @ New Brunswick Station, a state-partnered technology incubator, Rutgers University's Center for Advanced Infrastructure and Transportation, the City of New Brunswick, and others will be actively exploring aspects of connected and autonomous mobility, smart city innovations, and digital technologies to understand early use cases that may be applied elsewhere throughout New Jersey.

Finally, the state, in partnership with relevant municipalities, should also develop a roadmap for streamlining freight movement and shifting to less carbon-intensive modes of transportation in that part of the sector.

[4] First mile and last mile are used to refer to the means of travel an individual makes from the initial place of departure to public transportation, and from public transportation to the final destination.

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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.

Additionally, in communities without downtowns or downtown transit stops, but within close proximity to transit, the state should encourage programs that would reduce VMT associated with commuting. This could include sidewalk audits to ensure the walkability of neighborhoods to transit, Complete Streets implementation to make roadways bicycle and pedestrian friendly, and the incorporation of Community EVs into the transportation mix to offer alternatives to single occupant rides.

Goal 1.2.3: Relieve congestion and idling throughout New Jersey.

While encouraging sustainable travel is paramount, New Jersey continues to depend on its roadway network to meet the travel needs of people and businesses. Improving traffic flow on existing roadways relieves road congestion and idling; maintaining relatively constant speed and driving efficiently reduces energy consumption and air pollution.

An additional method for relieving road congestion is signal optimization technology, a Transportation Systems Management & Operations strategy. Using funding from the federal Congestion Mitigation and Air Quality (CMAQ) program, NJDOT is rolling out traffic signal optimization technology on Rt. 18 as a pilot project to make traffic patterns more efficient and reduce idling. NJDOT has reported that congestion cost the state's trucking industry approximately $3 billion in 2015.

The CMAQ program is a stable source of federal funds for transportation projects, programs, and strategies that result in a measurable reduction in transportation-related emissions, thereby improving air quality. The majority of New Jersey's CMAQ funds are used to reduce the emissions of NJ TRANSIT vehicle operations, but funds have also been used to reduce freight-related truck and rail emissions at various freight terminals throughout the

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state, reduce construction-related emissions on NJDOT projects, and to improve traffic flow on state roadways by making traffic signals more efficient.

Relatedly, Port Authority has been rolling out all-electronic tolling, starting at the Bayonne Bridge in 2017, and recently at the Outerbridge Crossing. All-electronic tolling reduces congestion by enabling vehicles to maintain speed. The new Goethals Bridge will be all-electronic by the third quarter of 2019. Planning is underway to expand all-electronic tolling to the George Washington Bridge, Holland Tunnel, and Lincoln Tunnel.

Separately, in 2018, Port Authority issued a Request for Information (RFI) related to connected and autonomous vehicles to explore innovative ways to reduce tunnel congestion and related emissions. The intent is to harmonize bus traffic and create a platooning effect in the Exclusive Bus Lane, resulting in increased throughput and safety. Following up on the RFI, Port Authority is currently developing a demonstration project for retrofitting six to ten NJ TRANSIT buses with a "Drive-By-Wire" kit to allow for connected semi-autonomous driving. The outcome of the demonstration project will inform how to implement such a program at scale.

Finally, NJDEP continues to explore innovative ways to educate the general public as well as commercial drivers that idling is against the law in New Jersey. In addition to ongoing sales of "No Idling" signs, NJDEP is looking to refresh its past idling campaign by integrating the use of social media and engaging schools.

Goal 1.2.4: Establish a sustainable funding source for maintaining the transportation system.

As New Jersey moves aggressively to electrify the transportation sector, it must avoid unintended consequences. The draft FY 2020 NJ Transportation Capital Program, which funds both NJDOT and NJ TRANSIT with federal and state transportation funds for a total of $3.679 billion, depends on motor fuels tax revenues for the vast majority of its funding. A major shift in new vehicle purchases from gasoline to electric powered vehicles, without a replacement for lost gas tax revenue, would adversely impact the maintenance of New Jersey's transportation infrastructure. The state should explore, develop, and implement alternative funding sources to the motor fuels tax as it moves down the critically important path toward vehicle electrification. With that need in mind, New Jersey is participating in Phase 3 of a Mileage Based User Fee (MBUF) study, led by Delaware DOT and administered by the I-95 Corridor Coalition. New Jersey's participation will enable the state to learn about the future potential of the MBUF to support the declining purchase power of the gas tax, without making any current commitments.

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GOAL 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

In New Jersey, Port Authority manages Newark Liberty International Airport, marine terminals in Newark, Elizabeth, and Bayonne, the PATH rail system, and the Journal Square Transportation Center in Jersey City, in addition to the bridges and tunnels connecting New York and New Jersey and several real estate ventures. The South Jersey Port Corporation (SJPC) similarly operates marine terminals in Camden, Paulsboro, and Salem.

Owing to the heavily polluting nature of freight transportation as it exists today and the geographic location of the marine terminals, bus depots, and Newark Airport, environmental justice communities have been disproportionately burdened by the impacts of poor air quality. Cleaning up New Jersey's ports and airports will make a significant impact on decreasing New Jersey's overall greenhouse gas emissions and improving the air quality in some of the state's most polluted communities. NJDEP will continue to prioritize funding for projects that reduce emissions in and around the port areas.

In October 2009, the Port Authority, with a cadre of partners that included NJDEP, released recommendations to reduce emissions from goods movement operations by 3% each year. With collaboration, innovation, and funding, that goal was largely achieved. Now that the ten-year period has ended, NJDEP is working closely with Port Authority, its sister agencies in New York, and other stakeholders to develop a refreshed plan for the coming years. The state will look to the "zero emission port" action plans underway in California that could be applied on the East Coast. It is important that these clean port efforts be considered as part of a broader look at reducing near-port sources of air pollution, such as roadway congestion.

In October 2018, Port Authority became the first public transportation agency in the U.S. to embrace the Paris Climate Agreement, setting aggressive interim greenhouse gas reduction targets that call for a 35% reduction by 2025 and reaffirming the agency's commitment to an 80% reduction by 2050. The agency identified an ambitious roadmap to achieve its interim reduction target, as well as programs that will advance decarbonization of its indirect emissions – including those related to its aviation and marine terminal operations. The state will continue to support and work with Port Authority, the Delaware River Port Authority, and the SJPC on emission reduction efforts.

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.

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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 truck (trucks with engine model year 2007 or newer) versus old truck (trucks with engine model year 2006 or older) trips have increased gradually, now accounting for 57% of all trips in the first quarter of 2019. The Truck Replacement Program resumed in June 2019 and has enough funding to convert 150 additional trucks. The state will work with Port Authority and the freight industry to examine opportunities to expand upon the popular Truck Replacement Program and incentivize truck replacement with electric or hybrid vehicles, in addition to newer diesel engines.

Goal 1.3.3: Support community solar developments on port property.

The state should work with and encourage Port Authority, SJPC, municipal governments, and local community groups to collaborate on establishing opportunities to provide solar energy to local communities.

As one example, Port Authority is developing over 16 megawatts of new solar capacity across its facilities, including approximately five megawatts of solar at Newark Airport and PATH facilities, to add to its existing nearly one-megawatt of on-site solar generation at those locations. Early in the second quarter of 2019, Port Authority concluded a deal to construct and operate a $500 million facility that will consolidate ten rental car companies in one location near the new Terminal One at Newark Airport, which is currently under construction. Included in the requirements for the facility design is the installation of a solar roof which is estimated to support approximately 3.5 megawatts of solar energy.

In conducting an evaluation with the project developer to identify the best approach for developing the solar project, Port Authority will seek to work with the local electric public utility and respective state agencies to determine the viability of a community solar project.

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 roadmap 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") *Continued*		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.		
Lead by example and roll over the state passenger vehicle fleet	Treasury is in the process of working with all relevant agencies that use state vehicles to establish a plan to roll over the state fleet to electric vehicles and establish appropriate charging infrastructure and train vehicle mechanics.	Treasury will develop a state fleet transition plan by June 2021. In the fiscal year after the charging infrastructure is fully operational, Treasury will purchase light duty passenger EVs, if available and suitable, or hybrid EVs, as appropriate, as follows: • Year 1 – 50% • Year 3 – 75% • Year 5 – 100%	New Jersey has two passenger EVs and 179 hybrids as of 2019.	Treasury, with support from all agencies using state vehicles

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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 *Continued*		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 rollover 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 has been allocated to NJ TRANSIT for the purchase and operation of 8 electric transit buses in Camden. $1.975 million in VW funds has been allocated to Student Transportation of America to purchase 5 electric school buses for operation in Trenton.	NJDOT, NJDEP, NJBPU, 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 *Continued*		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 *Continued*		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

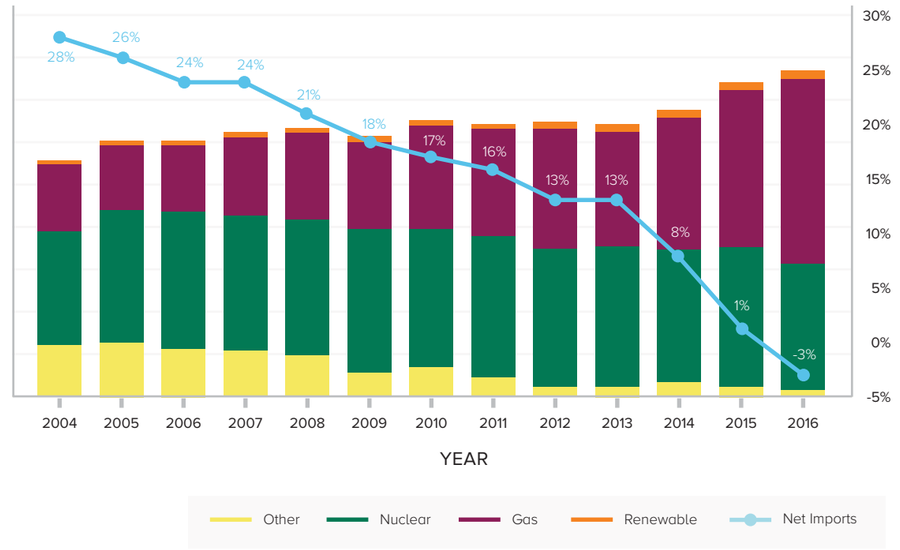
New Jersey has committed to reaching 100% clean energy by 2050. In addition to clean energy targets for offshore wind and storage, the state should establish additional targets for in-state and out-of-state renewable generation, distributed energy resources, and other carbon-neutral supply-side resources. 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 wholesale 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 Power[6]



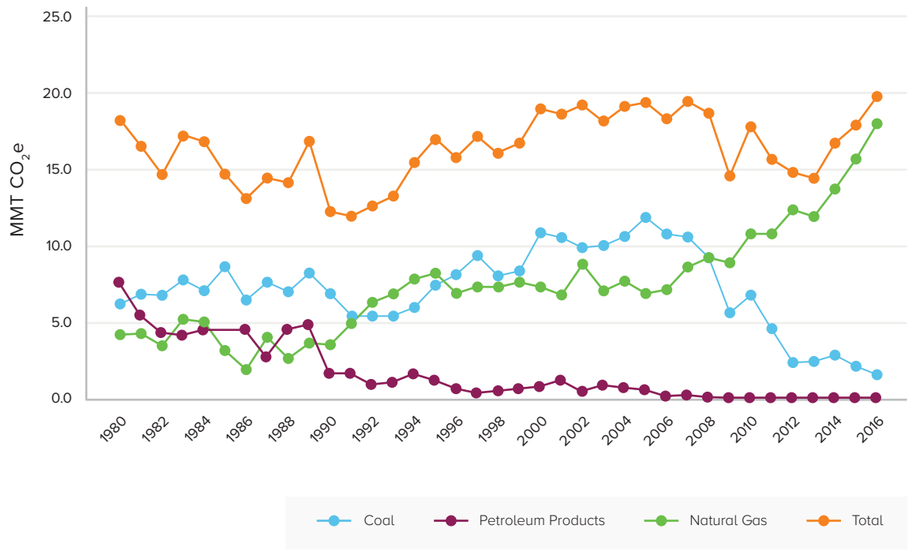
outside of New Jersey when the sun is not shining or the wind is not blowing. However, membership in PJM has also caused a potential challenge to New Jersey's clean energy aspirations. The electricity generation sector in the broader PJM region derives a larger percentage of power from coal than New Jersey does. Further, PJM has experienced a surge in natural gas generation, driven primarily by the discovery of the Marcellus Shale, the largest natural gas field in the United States. Marcellus is spread throughout much of the Appalachian Basin, including in neighboring Pennsylvania. The recent fracking boom has led to a decrease in natural gas prices to historic lows. Low gas prices make natural gas fired generation more competitive in the PJM energy markets and have spurred new gas generation coming on line in New Jersey and across the PJM footprint.

Due to the market forces inherent in the PJM market, natural gas has overtaken nuclear as the dominant electricity source in New Jersey, and coal

6 Data from U.S. EIA. Graph generated by Rutgers Energy Data Center. **http://njenergydata.rutgers.edu/**

FIGURE 15.

Electric Power Sector CO_2 Emissions by Fuel Source (1980-2016)[7]



is almost entirely out of business. In 2004, New Jersey had a net import rate of about 28% from the PJM region. Today, due to a proliferation of new natural gas power plants, New Jersey is considered a net exporter of electricity, having generated about 3% more electricity in 2017 than it sold in-state (Figure 14). In 2018, New Jersey generated 75.255 million megawatt hours (MWh) of utility-scale net electricity,[xix, xx] using primarily a combination of natural gas (51.6%) and nuclear (42.5%) power sources.

Notably, since the closing of the Oyster Creek nuclear power plant in September 2018, New Jersey's share of electricity from nuclear power has fallen to about 32% from its three remaining plants, and natural gas has largely made up the difference.[8] In addition, PSEG Power closed its last two remaining coal plants in May 2017,[xxi] and the coal plant B.L. England

7 Data from U.S. EIA. Graph generated by Rutgers Energy Data Center. **http://njenergydata.rutgers.edu/**

8 Bulk electricity generation in New Jersey, which serves both New Jersey and New York, currently consists of 35 large generating facilities consisting of 101 electric generating units. With the exception of the state's last two coal-fired facilities, these electric generating units are primarily fired with natural gas; one cogeneration facility also fires some refinery gas, and fuel oil is sometimes used as a backup or emergency fuel at certain facilities.

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recently withdrew its proposal to transition to natural gas and instead shut down completely in May 2019. Also resulting from market forces, coal has declined from 10% of net electricity generation in 2010 to 1.6% today. New Jersey's final two coal-powered plants are Combined Heat and Power (CHP) industrial plants that have Power Purchase Agreements through 2024.

Natural gas has helped to lower the cost of electricity. The 'dispatchability,' or on-demand nature of natural gas, also contributes important reliability services to the electric grid. However, New Jersey's electricity generation sector accounts for 19% of state net greenhouse gas emissions, which is almost entirely attributable to natural gas (Figure 15). It is also a significant source of local air pollution. Given current economic conditions, and without a change in state, regional, or federal regulatory structure, natural gas is expected to remain the predominant electricity fuel source in the near future. In order to achieve a 100% clean energy future and reach the 80x50 emissions reduction target, the state must model, assess, and implement ways to minimize reliance on natural gas as the state transitions to a clean energy economy.

Renewable Energy, DER, and the Integrated Energy Plan

Integrated Energy Plan Approach

The Integrated Energy Plan examined least-cost electricity supply mixes to power an increasingly electrified New Jersey economy, including assessing the role of distributed energy resources (DERs) and utility-scale renewable energy in a diverse resource mix. The Integrated Energy Plan used a detailed model of hourly grid operations to ensure that reliability needs were met, coupled with an economic optimization approach to select a least-cost resource mix under different scenarios. The Integrated Energy Plan also analyzed the role of gas, nuclear, and out-of-state resources in complementing in-state renewables and distributed energy resources, including their value in providing reliability when in-state renewables produced energy at a level lower than New Jersey demand.

Relevant Integrated Energy Plan Findings

- **Zero-carbon renewables can provide 78% of New Jersey's electricity in 2050.** In-state renewables, including rooftop, distribution-scale, and utility-scale solar PV, as well as offshore wind, provide 57% of New Jersey's electricity in the Integrated Energy Plan's Least Cost scenario. Other in-state, carbon-neutral resources and out-of-state renewables provide the balance of clean electricity generation.
- **Offshore wind deployment exceeds current goals by 2050.** Building offshore wind is less expensive than building substantial additional transmission to import PJM renewable energy into New Jersey. Deployment in the Least Cost scenario exceeds current targets by 2050.
- **Legacy gas generation can complement renewable energy variability, without additional investment required until 2035.** The Integrated Energy Plan shows that utilization of existing gas-fired generation capacity falls steadily, but that gas generation resources are valuable during lulls in wind and solar output, particularly as those renewables gain market share. As load grows due to electrification in the Least Cost scenario, some new dispatchable capacity is necessary to maintain reliability after 2035.
- **Existing nuclear generation and other "clean firm" technologies are valuable in the context of a 100% carbon-neutral grid in 2050.** The Integrated Energy Plan illustrates the value of maintaining a level of dispatchable, carbon-neutral capacity within New Jersey to provide power during weather events where wind and solar resources produce little energy across the region. The Integrated Energy Plan selects known technologies, including existing nuclear generators and new-build gas plants powered by biogas, to provide this service in 2050, but final investment decisions and policy targets can be delayed until technological readiness of other options is more apparent.
- **Regional coordination and transmission expansion can lower costs of meeting 2050 goals.** Onshore wind and utility-scale PV in neighboring states can complement renewable resources in New Jersey and lower costs, but require an additional 2 GW of transmission in the Least Cost scenario by 2050 to ensure deliverability to New Jersey. The Integrated Energy Plan's Variation 2 scenario shows that if New Jersey instead relied on its own in-state resources to meet 2050 targets, annual costs in 2050 would be $6.2 billion per year higher than the Least Cost scenario.

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GOAL 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 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**

In signing Executive Order Nos. 7, 8, and 28,[9] and the Clean Energy Act of 2018, Governor Murphy signaled his commitment to advance the clean energy economy early in his administration. With the signing of Executive Order No. 92[9] in November 2019, the Murphy Administration continued its aggressive pursuit of building a clean energy future for New Jersey.

The state can use its clean energy target as an opportunity to grow the economy, establish New Jersey as a center for energy innovation, reduce greenhouse gas emissions enough to meet or exceed the 2050 Global Warming Response Act (GWRA) and the U.S. Climate Alliance targets, and bolster resiliency both to increasingly extreme weather events and fossil fuel price fluctuations.

- **Growing the economy:** All electricity generation produced in-state yields direct economic benefits, while both in-state and out-of-state

9 Executive Order No. 7, signed on January 29, 2018, mandated that NJDEP and NJBPU begin the process of reentering the state into the Regional Greenhouse Gas Initiative (RGGI).

Executive Order No. 8, signed on January 31, 2018, directed NJBPU and NJDEP to establish a process and funding mechanism to install 3,500 MW of offshore wind by 2030.

Executive Order No. 28, signed on May 23, 2018, directed NJBPU to lead a multi-agency effort to develop a new Energy Master Plan and establish a roadmap to transition to 100% clean energy by 2050.

Executive Order No. 92, signed on November 19, 2019, increased New Jersey's offshore wind goal to 7,500 MW of offshore wind by 2035.

clean energy resources contribute to the health and welfare of our citizens and help avert the catastrophic effects of climate change. In New Jersey, natural gas power generators directly employ approximately 1,800 people and nuclear power generators directly employ almost 2,700 people.[xxii] The renewable energy market provides even more jobs; the solar industry in New Jersey employs roughly 6,400 people [xxiii, xxiv] and the emerging offshore wind industry is expected to produce roughly 25,000 full-time equivalent jobs through 2035 to build and operate the infrastructure.[10] In addition to this direct employment, these industries are also supporting indirect jobs in our economy by purchasing goods and supplies from local vendors.

Advancing renewable energy and distributed energy resources (DERs) also drives innovation and technological development and can be sited throughout the state, including in dense, urban environments. Commercialization of new storage and power integration technologies, whether core components or products and software needed for system integration, has the power to create significant R&D, design, and services jobs. In addition, New Jersey can also capture manufacturing supply chain jobs in these new fields. If the state is able to build new products and expertise through the development of projects within its own borders, these goods and services can then be exported as other states and regions pursue their own clean energy aspirations.

Locally produced renewable energy is also particularly important for supporting low- and moderate-income (LMI) communities; community solar enables those who have historically lacked access to rooftop solar to enjoy the benefits of clean energy, while urban rooftop solar can be installed and maintained by the local workforce. Finally, an electricity system largely powered by renewable energy yields a hedge against the risk of price shock, should the cost of natural gas rise in the future.

- **Reducing greenhouse gas emissions and other air pollutants:** As noted earlier, electricity generation in New Jersey produces 19% of the state's net greenhouse gas emissions, and also contributes to criteria air pollutants, including nitrogen oxides (NO_X), sulfur oxides (SO_X), particulate matter, and volatile organic compounds (VOCs). Electricity generated from natural gas power plants represents nearly all the state's electricity sector greenhouse gas emissions. In contrast, renewable energy produces zero greenhouse gas emissions or other criteria air pollutants. Further, while greenhouse gas emissions are global in nature, criteria air pollutants have local impacts. Ensuring that regulatory pathways are available to allow renewable electricity generation to support increased electrification and replacement of aging natural gas power plants will be crucial to driving down emissions and improving air quality, especially in New Jersey's most burdened communities.

The Integrated Energy Plan shows that on a least-cost pathway New Jersey could supply 94% of its electricity from carbon-free resources.

- **Resilience:** While the electric grid is designed to operate through a variety of weather conditions, it is not immune to failure. The Northeast Blackout of 2003, Hurricane Irene in 2011, and Superstorm Sandy in 2012 (among many others) have illustrated the vulnerabilities of the energy system. Substantial investment has occurred since those events to bolster the grid's reliability and resilience. Adding decentralized carbon-neutral electricity generation to the system mix adds energy diversity, particularly where those decentralized resources are co-located with critical facilities, such as hospitals and first responders, and are configured to operate even when the larger grid fails.

The state can take several steps to foster local renewable energy generation and DER integration, and will seek to maximize the benefits from installing these resources, as described above. Relevant regulatory agencies, including NJBPU, NJDEP, and NJDCA, will continue collaborative efforts and action needed to improve efficient deployment of DERs and ensure maximum value for ratepayers. The state will evaluate national best practices in interconnection processes, distribution planning (e.g., monetizing avoided distribution costs), locational valuation, and market mechanisms to drive innovation and investment. New Jersey should maintain, and where necessary, expand regulatory oversight and jurisdiction, while coordinating the siting and permitting process for DER and the attendant transmission and distribution system upgrades necessary to deploy DERs. Relevant agencies will collaborate with New Jersey's utilities to implement the state's DER goals.

Goal 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.

In the upcoming years, in order to promote and accelerate renewable energy generation and meet the state's increased Renewable Portfolio Standard (RPS), NJBPU is establishing carve-outs for in-state solar and offshore wind through 2035. Additionally, as mandated in the Clean Energy Act of 2018, NJBPU has begun work on a transition and successor solar incentive program to develop new incentives that motivate additional in-state

10 One full-time equivalent (FTE) year is the equivalent of one person employed full time for a year. It could be, for example, two people employed full time for 6 months or two people employed 50% of the time for a year.

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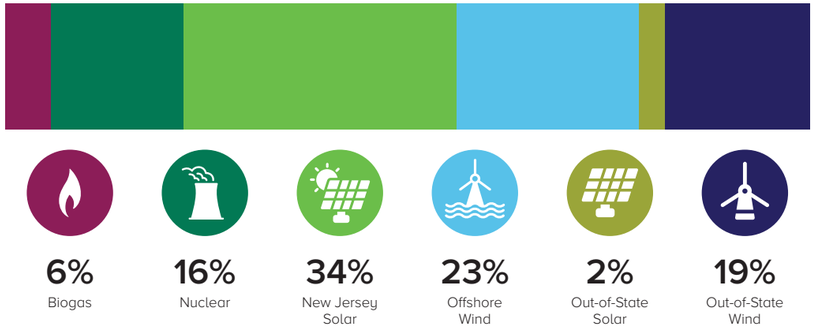
FIGURE 16.

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 energy 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 more parties to participate.

11 "Clean firm" generating resources means dispatchable, carbon-neutral capacity within New Jersey to provide power during weather events where wind and solar resources produce little energy across the region. This is further discussed earlier in the box, "Renewable Energy, DER, and the Integrated Energy Plan."

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New Jersey's current regulatory paradigm is anchored by the state's Electric Discount and Energy Competition Act (EDECA), which in 1999 enabled market competition for electricity generation and established New Jersey's first RPS. As New Jersey strives to meet its 2050 clean energy goals, the state needs to change the way it measures clean energy attainment. Today, New Jersey predominantly uses Class I Renewable Energy Credits (REC) as the means of meeting clean energy goals.[12] Pursuant to the Clean Energy Act of 2018, New Jersey's RPS was increased to 50% of Class I renewables by 2030, with interim milestones of 21% by 2020 and 35% by 2025.

Today, New Jersey's RPS is largely fulfilled through the purchase of out-of-state RECs. RECs represent the environmental attributes of one MWh of electricity generated from an eligible source. The certificate is unbundled from the underlying electricity to facilitate a fungible asset that can be easily traded and tracked to retirement by the entities required to demonstrate compliance with the RPS. RECs can be purchased from new or pre-existing renewable facilities, and can be "banked" for several years. In EY2019, almost 98% of the NJ Class I RPS compliance was met through the purchase of out-of-state RECs; when including NJ Class II RECs and in-state solar, over 74% of RECs retired for RPS compliance were sourced

12 As noted above, New Jersey's Electric Discount and Energy Competition Act (EDECA) enabled market competition for electricity generation and established New Jersey's first RPS. The Act was passed in 1999 and NJBPU promulgated rules implementing EDECA in 2003.

NJ Class I renewables were defined in EDECA to include solar, wind, biomass, tidal, wave, fuel cell, and geothermal technologies; it was amended by statute in 2015 to include new small-scale hydropower facilities of 3 MW or less. The Clean Energy Act of 2018 also maintains a requirement of 2.5% of Class II renewables, which includes resource recovery (i.e., waste-to-energy plants) and hydropower facilities greater than 3 MW and less than 30 MW. Nuclear energy is not defined as a Class I or Class II renewable.

While there are benefits to encouraging access to distant renewable energy generation, such as greater geographic diversity and lower cost, there are also myriad ancillary benefits to in-state renewable energy generation and DER.

from out-of-state. New Jersey's reliance on out-of-state RECs to satisfy the RPS requirement yields lower ratepayer cost, though fewer economic benefits accrue directly to New Jersey as a result.

A clean energy market mechanism, such as a CES, would open the door to improving the environmental benefits of New Jersey's clean energy spending while encouraging competition and limiting ratepayer impact. To successfully ensure that New Jersey's electricity needs are met with 100% clean energy, development of additional metrics, such as time-bound environmental credits or other mechanisms for emissions abatement verification, should be a critical element in the development of a new regulatory structure.

For example, New Jersey could measure regulatory compliance based on an hour-by-hour accounting of how much clean energy is being produced for New Jersey, compared to how much electricity is being consumed by New Jersey customers. This change would ensure that clean energy was being produced and credited when New Jersey consumers use it, which is not the case with RECs today, and would mitigate concern about exporting variability, which could occur with today's REC system in a future with a high penetration of renewable generation. Additionally, out-of-state resources eligible under a clean energy market mechanism should include only new renewable generation resources, built within the PJM footprint, and under contract to New Jersey ratepayers through the CES. This would ensure that New Jersey's clean energy spending is increasing the total supply of zero-carbon resources within the state's home energy market. Today's RECs, by contrast, are usually sourced from existing facilities.

As discussed below, appropriate balancing of in-state benefits and costs is critical to effective use of ratepayer funds. To this end, the new regulatory structure could require that any qualified clean energy be deliverable into New Jersey, respecting PJM transmission grid limits. Any production above the inherent PJM transmission limits would not count towards regulatory compliance, which provides an incentive to locate resources within New Jersey, without running afoul of legal limits. Development of a CES or other clean energy market mechanism for New Jersey could phase in these and other features over time to maximize the value of future regulatory-compliant resource portfolios for New Jersey without unduly constraining the near-term buildout of renewable energy resources that can reduce carbon emissions and help scale the overall renewables market.

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Goal 2.1.2: Ensure at least 75% of electricity demand is met by carbon-free renewable generation by 2050 and set interim targets.

As discussed earlier, New Jersey enacted an ambitious increase to its RPS in 2018, mandating that the state supply 50% of its electricity from renewable sources. While a CES or other clean energy market mechanism may be preferable to achieving state goals, New Jersey must optimize the existing system through the RPS and RECs while it remains in effect. Importantly—with the exceptions of a small and decreasing in-state solar carve-out in the RPS through the issuance of Solar Renewable Energy Certificates (SRECs) and an undetermined future offset for offshore wind in the form of Offshore Wind Renewable Energy Certificates (ORECs)—the state's RPS is currently and typically fulfilled through out-of-state renewable energy generation through the purchase of RECs.

While there are benefits to encouraging access to distant renewable energy generation, such as greater geographic diversity and lower cost, there are also myriad ancillary benefits to in-state renewable energy generation and DER. Local renewable generation produces jobs and investments, and locally-sited DERs, if optimally deployed, may avoid or postpone transmission or distribution investment, lower electricity congestion and locational marginal prices, and increase fuel diversity and system resiliency. Further, in-state renewable energy generation produces ongoing, local jobs in innovation-centered STEM careers such as planning, installation, maintenance, and operations.

Modeling for the Integrated Energy Plan found that by 2050, assuming annual demand increased by a factor of two to roughly 165 TWh due to increased end-use electrification, New Jersey could most cost-effectively meet its electricity demand by building 32 GW of in-state solar, 11 GW of offshore wind, and 9 GW of storage. The modeling showed that while it was cost effective to increase transmission from 7 GW to 9 GW to benefit from a certain amount of lower-cost out-of-state clean resources, it was most cost effective to meet remaining demand with in-state resources rather than build additional transmission.

Through evaluation of evolving renewable energy markets, and pursuant to the state's renewable energy goals identified throughout this section (see in particular Goals 2.2 and 2.3), the state is establishing goals to quantify the amount of zero-emission energy that should be generated through 2050 to meet consumer demand. These interim targets will serve as guideposts to ensure the state is on track to meet its 100% clean energy mandate by 2050 and will enable the state to assess and manage

resource diversification over time. Further, unless or until the state is able to establish a CES or other clean energy market mechanism, New Jersey will need to proactively encourage renewable energy generation and storage increases that serve New Jersey load so that rising demand due to end-use electrification is met with zero-emission resources.

Notably, development of these goals will carefully balance the costs and benefits of in-state and out-of-state renewable deployment, such as affordability, reliability, marginal emissions benefits, transmission limitations, and the direct and indirect benefits of in-state investment. NJBPU must consider appropriate market-based mechanisms to ensure that New Jersey's energy mix meets our zero-emission goals, as described earlier in Goal 2.1.1. To achieve these ambitious targets, as discussed in Goal 2.1.4, the state must ensure sufficient pathways exist to successfully decarbonize the remainder of New Jersey's energy usage, including both in-state and out-of-state generators serving New Jersey load.

Goal 2.1.3: Routinely model scenarios and pathways to achieve 100% clean energy by 2050 with consideration for least-cost options.

As New Jersey transitions to a highly electrified, clean energy economy, several shifts must occur concurrently. Mass electrification can enable demand flexibility, peak load reduction, and an overall decrease in aggregate energy consumption,[13] but poorly managed electrification could exacerbate peak load and greenhouse gas emissions and introduce capacity concerns.

Further, there are many potential pathways to achieving 100% clean energy by 2050. Today, New Jersey sources roughly 10.44% of its electricity from renewable energy sources, including in-state solar and out-of-state hydropower and wind. The vast majority of its transportation is fueled by petroleum, and over 85% of homes are heated with fossil fuels. Clearly, there is a significant gap between 2050 goals and today's energy system. The state can and should strengthen existing mechanisms and rapidly implement new strategies to increase its renewable energy production, accelerate energy efficiency initiatives, and reduce reliance on fossil fuels. However, substantial barriers exist. As New Jersey approaches 100% clean energy in the coming decades, further progress toward a completely zero-emission electricity system will become more challenging without greater technological advancement and necessary changes to regulatory structures and market design.

To achieve the EMP's goals and properly value resilience and fuel security, emphasis must be placed on identifying and defining the specific resource attributes necessary for reliable service.

The state established and modeled full energy system scenarios and pathways in New Jersey and throughout the Eastern Interconnection to inform decisions about how New Jersey can achieve 100% clean energy and an 80% reduction in greenhouse gas emissions (80x50) at the least possible cost. The Integrated Energy Plan sets out the physical costs and asset mix required to reliably meet these goals under a variety of scenarios, as discussed in detail in Section 5: Integrated Energy Plan: Introduction, Approach, and Key Findings. Further advocacy and regulatory changes, as discussed in Goals 2.1.1 and 2.1.4, will be required to ensure that regulatory pathways exist to deploy the necessary resource mix while maintaining reliability.

New Jersey has not previously performed a study of this magnitude. The Integrated Energy Plan results have and will continue to inform energy system decisions and enable state government and industry to put policies and practices in place supporting the 2050 ambitions. Further, modeling of the full energy system scenarios and pathways should be updated every three years, in conjunction with each successive Energy Master Plan, to assess state progress, advancement and maturation of technology, and cost decreases, and to confirm or revise optimal pathways to decarbonization.

Goal 2.1.4: Explore regulatory authority to achieve 100% clean energy by 2050.

Producing the above modeling assessment raises a significant question: is New Jersey's existing regulatory structure sufficient to realize an optimized pathway to 100% clean energy by 2050? Given current regulatory structures and electricity system mix throughout PJM, as impacted by federal policies, the answer is likely, "no." One of the major challenges is New Jersey's reliance on the PJM market to select the generation resources that the state relies on to meet its reliability needs, particularly in the face of a federal administration that is, at best, indifferent to the threats posed by climate change.

When the state restructured its utility industry with the passage of EDECA in 1999, the major concerns were ensuring system reliability, creating a robust retail market, and keeping costs low, along with environmental concerns. As environmental considerations have moved to the forefront, New Jersey may need to update its implementation or design of EDECA. For example, PJM's process for selecting generation resources necessary to

13 As indicated by the Integrated Energy Plan analyses, significant end-use electrification will increase electricity demand but decrease overall energy demand (including energy demand from gasoline, diesel, natural gas, propane, and oil) because electrification is usually more efficient than fossil fuels per unit of energy.

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New Jersey will coordinate with other leading states to drive structural changes at PJM and FERC that would increase compatibility with clean electricity goals.

meet reliability criteria focuses primarily on cost criteria, whereas meeting the goals of the EMP requires the consideration of both cost and environmental factors.

Further, the state is proceeding with its march towards 100% clean energy in the face of federal energy regulators, including the U.S. Department of Energy (U.S. DOE) and the Federal Energy Regulatory Commission (FERC), that are actively attempting to support fossil fuel interests in the PJM region under the guise of promoting "fair" competition or "resilience" planning. In order to meet the state's clean energy targets, consumers in New Jersey must be free to choose a suite of generation resources that meet state policy goals.

Case in point, the December 19, 2019 decision by FERC could effectively bar clean energy resources receiving state financial support from providing reliability services. New Jersey can and will litigate against any attempts by federal or regional regulators to mandate that New Jersey customers purchase reliability services from a generation resource mix that is inconsistent with state policies. New Jersey will also coordinate with other leading states to drive changes at PJM and FERC that would increase compatibility with clean electricity goals.

New Jersey is committed to exploring all possible options, including leaving the PJM capacity market, to ensure that the state can realize a clean energy future at reasonable prices. For example, NJBPU has plenary authority over retail sales of electricity.[14] The state could require its load serving entities to procure a higher percentage of clean energy than the minimum mandated by the Clean Energy Act. Such an initiative could involve several different regulatory options, including a CES, as discussed earlier, or other clean energy markets or mechanisms to competitively source carbon-free energy and ensure appropriate decision-making for resource adequacy. NJBPU may elect to examine these paths early in 2020 through a new proceeding looking at how to best meet New Jersey's resource adequacy needs, consistent with the state's clean energy goals and environmental values.

The issue of "leakage" further complicates New Jersey's efforts to establish a clean energy future and reduce emissions. Leakage is said to occur when a requirement, such as the Regional Greenhouse Gas Initiative (RGGI) carbon price, is placed on a generator in one state but not a neighboring state. The price of the additional requirement is then reflected in

14 The Federal Power Act preserves the authority of the states over retail sales. NJBPU, on behalf of the State of New Jersey, exercises that authority in accord with its regulatory authority in Title 48 of the New Jersey Statutes

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generator bids in the PJM markets. At times, this may lead to out-of-state generation displacing equally or more efficient in-state generation. NJBPU is currently in the early stages of a proceeding to quantify leakage and determine its relative impacts and the appropriate regulatory response. As New Jersey develops the regulatory and administrative measures necessary to re-join RGGI, the state must monitor, and if necessary, establish mechanisms to prevent leakage.

Goal 2.1.5: Update interconnection processes to address increasing distributed energy resources and electric vehicle charging.

NJBPU plans to work with the utilities and other stakeholders to update, enhance, streamline, and accelerate grid interconnection processes without lessening safety or reliability of the electric distribution system in order to increase the amount and improve the process for locating DER on the electric distribution grid.

The existing standardized process under interconnection requirements, detailed in N.J.A.C. 14:8-5.1 – 5.7, includes three levels of review based upon the characteristics of the proposed generator and the status of the distribution circuit where interconnection is requested. Three of the state's four electric public utilities have circuits that are restricted from accepting new requests for DER interconnection, so new requests to interconnect DER are denied. Depending on the level of penetration in relation to the capacity of the circuit, certain circuits are restricted from accepting any new interconnection requests or accommodating interconnection requests above a certain limit.

Without a carefully considered increase to current limitations, and development of further mechanisms discussed in Goal 2.1.6 below, DER penetration will fail to reach its maximum potential. Consistent with other EMP goals, specifically the Integrated Distribution Plans set out in Goal 5.1.1, NJBPU staff, along with stakeholders and the electric public utilities, will explore measures to open currently restricted circuits via strategic adoption of energy storage, energy efficiency, smart inverters, and other distribution system protective equipment.[xxv] Additionally, NJBPU staff will continue to work with PJM in its efforts to expedite utility-scale, transmission-level DER interconnection approvals.

NJBPU recently mandated that the electric public utilities develop, publish, and update capacity hosting maps (N.J.A.C. 14:8-9.9(f)). These maps are intended to provide an approximate overview of the capacity available in various locations on the distribution system. While these maps do not re-

place a full interconnection study or integrated distribution plan, and may at times be imprecise, they are intended to provide valuable guidance to developers seeking to vet potential locations for siting DER. NJBPU will continue to work with the electric public utilities and stakeholders to ensure that the capacity hosting maps are relevant, accurate, and clear.

Goal 2.1.6: Develop mechanisms to compensate distributed energy resources for their full value stack at the regional and federal level.

Well-sited and locally connected renewable energy generation and DER can produce benefits beyond electricity generation, such as increased resiliency, lower grid electricity demand via behind-the-meter energy generation, deferred or avoided grid upgrades, and lower Locational Marginal Prices.[15] Today's distribution grid, however, generally has no means to provide additional revenues or price signals to DER. Without the ability to send meaningful price signals at the distribution level, the state will not be able to recognize the full value that distributed resources may provide. And wholesale market revenues, which are accessible by some DER, are neither sufficient to drive DER investment, nor targeted to maximize the localized benefits that DER can provide.

To fix this disconnect between value to consumers and the lack of payment streams to the DER, resources must be able to engage in value stacking, which is the practice of allowing a single energy resource to receive multiple different streams of revenue corresponding to different services, or "use cases," provided by the resource. NJBPU will recommend pathways to further unlock benefits of DER deployment in competitive markets, such as DER aggregation,[16] as well as evaluate how to better value the services that DER provides at the distribution level. NJBPU will determine the extent of New Jersey's retail compensation program and make recommendations regarding market participation to guard against over-compensation while maximizing competitive opportunities. Further, NJBPU's evaluation will consider optimal utility tariff design, including rate design, to encourage DER deployment while avoiding undue cross-subsidization between entities with DER and those without. In addition, the review of interconnection processes set out in Goal 2.1.8 should provide critical detail as to the relative value of installed DER by location. Locational value could be assigned to maximize policy goals (e.g. brownfield development), to maximize the benefit of real-time operating conditions, or to avoid or delay the need for construction of new distribution assets (which would be verified as part of the Integrated Distribution Planning process (per Goal 5.1.1)).

15 Locational Marginal Prices (LMP) are wholesale energy prices set by PJM at each node throughout its system based on generator offers, demand-side energy bids, and the expected load. PJM operates a Day-Ahead energy market and a Real-Time balancing energy market. In the predominant Day-Ahead market, all dispatched plants receive the same LMP, with adjustments for losses and congestion, equal to the bid of the last, most expensive dispatched plant, regardless of their own bid prices.

16 See Participation of Distributed Energy Resource Aggregations in Markets Operated by RTOs and ISOs, Post-Technical Conference Comments of the NJBPU, FERC Docket No. RM18-9 (Jun. 26, 2018).

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Market barriers, such as limited size or scale of a project, unproven payback schedules, or increased risk, can limit the access to competitive loan rates.

Consistent with the Clean Energy Act, the state will engage with PJM to ensure that planning, interconnection, market rules, and cost allocation for DERs are just and reasonable. NJBPU will also explore the establishment of distribution-level retail demand response programs that can complement the FERC jurisdictional markets, as well as examine distribution tariffs and rate design. This assessment will be further informed by integrated distribution plan submissions by the electric public utilities, as established in Goal 5.1.1.

Goal 2.1.7: Develop low-cost loans or financing for distributed energy resources.

Market barriers, such as limited size or scale of a project, unproven payback schedules, or increased risk, can limit the access to competitive loan rates. The state can lower the cost of capital to develop renewable energy and DER through equitable access to low interest loans and financing through mechanisms such as establishment of a State Green Bank, Commercial Property Assessed Clean Energy (C-PACE) lending, on-bill financing, and other financial options discussed further in Strategy 7: Expand the Clean Energy Innovation Economy.

Further, residents or companies may lack necessary cash on hand to make an upfront investment, even with a known payback schedule. Current state practice is often to encourage DER investments with incentives through New Jersey's Clean Energy Program or the RPS. NJBPU and NJEDA should determine if continued reliance on rebates and RECs is the most optimal way of encouraging clean energy investments once additional financing mechanisms are developed to leverage public funding.

Finally, development of an incentive program for in-state renewable energy resources that signals rational, justifiable, and predictable long-range plans will improve forecasting and therefore lower the risk to investors, developers, installers, and other market participants. Establishment of ORECs and the transition to a new solar incentive program will be discussed below.

Goal 2.1.8: Coordinate permitting and siting processes for renewable energy development.

Entities wishing to build carbon-neutral energy generating units like solar, offshore wind, and biomass must receive approvals for permitting and siting at the municipal, state, and sometimes regional and federal levels, in

In order to enhance smart siting of solar, the state should better define areas that are considered marginalized, such that they have constrained economic or social value.

addition to interconnection approvals from the utilities. The relevant state agencies, municipalities, and utilities should assess methods to improve coordination, transparency, and predictability in the full permitting and siting process to reduce the uncertainties and soft costs of renewable energy development. This may be facilitated through expansion of state agency programs, such as NJDEP's Office of Permit Coordination, through programs hosted within the Wind Innovation and New Development (WIND) Institute (Goal 7.4) or a Community Solar Center, or through new developments or a combination of the above. NJDEP will partner with NJDCA to provide permitting guidelines with the goal of streamlining and standardizing the process. Given the rapid pace of battery technology advancements, energy storage systems have been particularly challenging to permit at the local level; NJDCA's Division of Fire Safety will include education on energy storage systems awareness in its training and continuing education classes in the future, including in its Firefighter I curriculum. Further, the state must determine and establish with appropriate authority, and in collaboration with local siting entities and municipalities, clear guidance and rules on where renewable energy should and shouldn't be sited (also further discussed in Strategy 6: Community Energy Planning). For solar energy, investments should be steered toward rooftops, carports, and marginalized land and away from open space. Further, in concert with New Jersey's Climate Resilience initiatives, investments should be steered away from flood zones and other areas deemed especially vulnerable to climate change.

NJDEP's Solar Siting Analysis Update (2017) identifies areas in New Jersey where NJDEP encourages and discourages solar PV development by utilizing a Geographic Information System (GIS) mapping tool and NJDEP's 2012 Land Use/Land Cover data. The Solar Siting Analysis found that only 29% of New Jersey's land area is generally appropriate for the siting of solar PV installations. It is vital that solar and other renewable energy projects are sited mindfully in order to protect New Jersey's vital land and ecosystem services. In the Integrated Energy Plan's Least Cost scenario, assumed PV deployment covered approximately 0.6% of land area.

In order to enhance smart siting of solar, the state should better define areas that are considered marginalized, such that they have constrained economic or social value. For example, there are areas of non-preserved farmland that may have poor soil conditions, or non-pristine open spaces that are underutilized, both of which could potentially serve as host sites for solar projects while not compromising the state's commitment to preserve open space. Dual-use opportunities may exist for siting solar on areas of open space or non-preserved farmland, but they must be examined carefully for environmental impacts. NJDEP and NJBPU will coordinate land use policy for solar siting with the New Jersey Department of Agriculture to identify sites that could be used to expand New Jersey's commitment to renewable energy while still protecting the state's farmland and open spaces.

These policy initiatives, as well as other locational analysis, should be evaluated for potential inclusion as part of an upgraded transparent and predictable interconnection process. Proper incentives consistent with EMP goals will maximize ratepayer value and ensure appropriate compensation.

Goal 2.1.9: Begin stakeholder engagement to explore rules to limit carbon dioxide emissions from electric generating units.

Consistent with Executive Order No. 7, NJDEP enacted rules in June 2019 for New Jersey to rejoin RGGI, and the state will participate in the first auction of calendar year 2020. This is an important step to realizing significant greenhouse gas emissions reductions from in-state electricity generation as New Jersey moves forward to attain its 2050 goals. However, additional regulation of CO_2 may be prudent to ensure that the state meets its 80x50 GWRA mandate. NJDEP will begin stakeholder engagement in the coming months to solicit ideas and inform potential future rulemaking options. Leakage (generation shifting to electric generating units outside of New Jersey) will be a key consideration in any future regulatory construct, and will be additionally discussed in the upcoming GWRA Report.

GOAL 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**

Offshore wind is a highly promising opportunity for New Jersey to produce renewable energy, to create ongoing, unionized (and non-union) jobs, and to grow the economy. Offshore wind is already a mature industry in countries like Germany, Denmark, and the United Kingdom, and New Jersey is leading its fellow states along the eastern seaboard to bring the market to the U.S. and develop a home-grown supply chain.

Many states across the U.S. are also pursuing offshore wind opportunities (see Table 2 and Figure 17). On the east coast, New Jersey, Massachusetts, Rhode Island, Connecticut, New York, Delaware, Maryland, and Virginia

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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 footprint. Advances in turbine technology will continue to support siting and reducing environmental impacts. U.S. DOE estimates that the existing and proposed federal lease areas located off the coast of New Jersey could support up to 12.5 GW of offshore wind energy, using a very conservative power density ratio of 3 MW/km^2, which equals 0.01 MW/acre.[17, xxvi] Using a more accepted power density ratio could double the amount of offshore wind that could be supported in these lease areas.[xxvii]

Importantly, the cost of offshore wind power continues to drop. Block Island Wind Farm, which became operational in 2016, has a power purchase agreement of $0.244/kWh; two years later, two projects in Maryland established power purchase agreements for $0.132/kWh, representing a 45% drop.[xxviii] In addition, the U.S. Energy Information Administration's projected Levelized Cost of Energy Analysis for unsubsidized offshore wind generation entering service in 2023 was $0.118/kWh.[xxix] By comparison, New Jersey's first 1,100 MW project offers a first year OREC price at $0.0981/kWh and a levelized OREC price of $0.1168/kWh. The Levelized

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) 804 MW (Mayflower Wind)
Rhode Island	1,000 MW	400 MW (Revolution Wind)
Connecticut	2,000 MW	300 MW (Revolution Wind)
New York	9,000 MW	816 MW (Empire Wind) 880 MW (Sunrise Wind) 130 MW (South Fork)
New Jersey	7,500 MW	1,100 MW (Ocean Wind LLC)
Maryland	480 MW	248 MW (U.S. Wind) 120 MW (Skipjack Offshore Energy LLC)
Virginia	2,500 MW	12 MW (Dominion Energy Research Project)
Total	**24,080 MW**	**5,690 MW**

17 BOEM uses the cited power density ratio, which is a measure of how much electricity generating capacity the wind turbines have in a given area, based on discussions with industry, states, and a study from NREL **(https://www.nrel.gov/docs/fy16osti/66599.pdf).**

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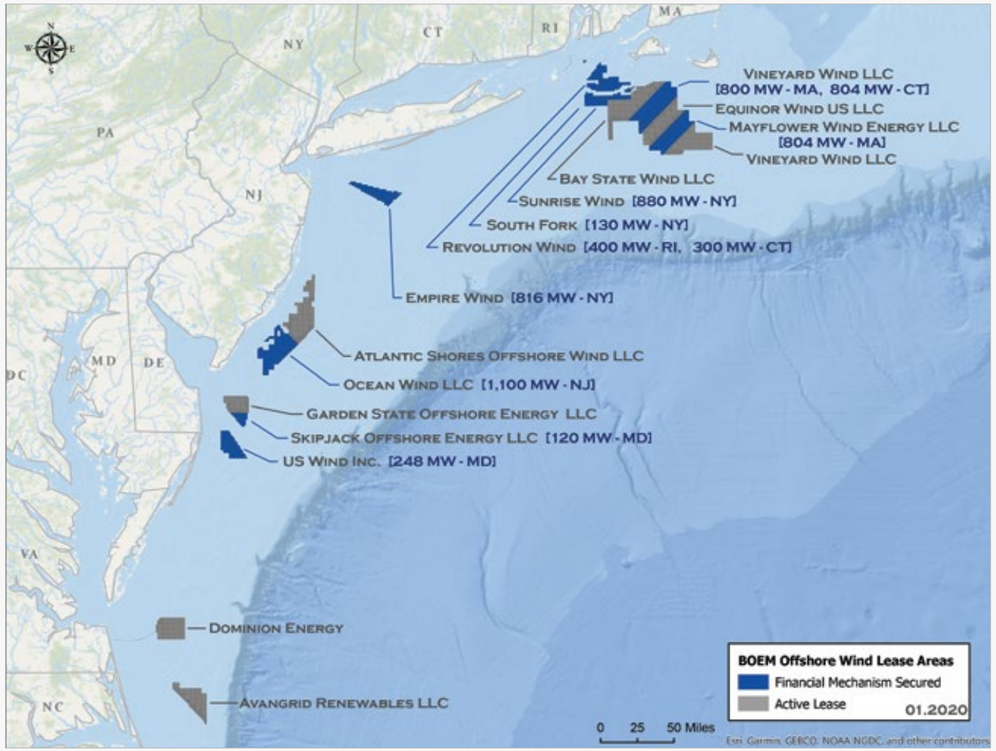
FIGURE 17

East Coast Offshore Wind Projects (as of January 2020)



Net OREC Cost is $0.0465/kWh.[18, 19] Most recently, in September 2019, an offshore wind solicitation in the U.K. cleared at $0.0497/kWh,[xxx] representing a dramatic plunge in costs.

Because renewable energy's cost is largely front-loaded due to the capital cost of construction, and because operation of renewable generation resources is not impacted by fluctuating fuel prices, it provides more cost stability to investors than traditional energy generation, though the intermittent nature of renewable energy can create a revenue risk. As the industry develops and technologies and processes mature, costs are expected to continue to decrease.

18 New Jersey Board of Public Utilities Docket No. Q018121289

19 LNOC is the OREC Price less the expected value of project revenue, including energy, capacity and environmental attributes, all of which is returned to ratepayers. The LNOC represents the net price paid by ratepayers.

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As the offshore wind industry develops and technologies and processes mature, costs are expected to continue to decrease.

Further, planned transmission to accommodate the state's offshore wind goals provides the opportunity to decrease ratepayer costs and optimize the delivery of offshore wind generation into the state's transmission system. This planning may include strengthening the onshore portions of the transmission system and extending the existing grid into the ocean. Although the transmission component of the Ocean Wind 1,100 MW project, which was bundled with the generation component, has its benefits, this model would likely not lead to efficient growth of the offshore wind industry into the future. Transmission planning is important in order to reach the state's long-term offshore wind goals. Coordinating transmission from multiple projects may lead to considerable ratepayer savings, better environmental outcomes, better grid stability, and may significantly reduce permitting risk.

As discussed in Goal 2.1.6, NJBPU must continue to advocate at the federal and regional levels to ensure that clean generation resources, including offshore wind, are not the subject of undue discrimination in the wholesale markets, including in their capacity valuation. If unsuccessful, New Jersey must evaluate whether other regulatory structures are more appropriate to realize the state's goals, as discussed earlier.

NJBPU should endeavor to collaborate with PJM to ensure that transmission planning and interconnection rules accommodate these resources. Moreover, NJBPU should continue to advocate at the federal and regional level for fair allocation of costs associated with such interconnections between various states. As discussed previously, NJBPU may have to exercise previously untapped authority, or expand its regulatory jurisdiction, to realize these goals.

Goal 2.2.2: Develop the offshore wind supply chain.

The U.S. wind industry, including onshore wind, employed over 100,000 people as of 2016, a 32% increase from 2015,[xxxi] and wind turbine technician is one of the two fastest-growing jobs in the country.[xxxii] If the U.S. succeeds in installing the onshore and offshore wind energy capacity by 2050 that U.S. DOE anticipates, the wind industry could support over 600,000 jobs nationally.[xxxiii]

As part of New Jersey's efforts to ensure that the state is a leader in offshore wind in the Northeast, New Jersey is targeting high-value companies in the wind industry supply chain to encourage them to base their operations in the state. New Jersey's value proposition to these companies includes a central location within the U.S. East Coast wind belt, global connectivity to other global offshore wind hubs in Europe and Asia, a strong

base of port infrastructure, universities that are already active in many offshore wind research areas, and a supportive political environment.

As signaled by NJBPU's first 1,100 MW OREC award, New Jersey is committed to attracting offshore wind supply chain jobs across the project and talent spectrum. Given the state's current labor market profiles, New Jersey is in a prime position to capture supply chain jobs including manufacturing, painting, installation, logistics, project development, engineering, finance, and technology development.

In addition to active outreach to encourage European offshore wind companies and U.S. onshore wind companies looking to locate in New Jersey, NJEDA and NJBPU are developing specific tools and programs to support the industry's supply chain development.[20] For example, NJEDA recently established the New Jersey Offshore Wind Supply Chain Registry that allows companies to publicly indicate their interest and ability to supply components and services for U.S. East Coast offshore wind projects. Simultaneously, it serves as a resource for companies looking to buy from and partner with New Jersey-based firms. Illustrating the strong appetite for New Jersey's expanding offshore wind industry, as of November 2019, 462 businesses have joined the state's Offshore Wind Supply Chain Registry since it was launched in April 2019. As an additional supply chain support tool, NJEDA is now developing a technical assistance program to help NJ-based small and medium-sized companies identify and acquire the certifications and competencies needed to sell into the offshore wind supply chain. This program will ensure that local companies understand the investments they need to make in order to capture a portion of the new multi-billion dollar supply chain.

NJEDA's Offshore Wind Tax Credit, which is new in 2019, provides a $100 million pool of tax credits to support major, cluster-anchoring investments in manufacturing and port-related facilities. The Offshore Wind Tax Credit provides reimbursement for eligible capital investments in a qualified wind energy facility. Businesses must make a capital investment of at least $50 million and must also create at least 300 new, full-time jobs that could include supply chain jobs such as manufacturers, suppliers, and installers associated with the qualified wind energy facility.

In addition, NJEDA's general lending and incentive programs will be critical tools to support the development of a New Jersey-based supply chain. Many of the companies that are located in the state today will need to

20 See additional New Jersey State resources at **https://www.njeda.com/OET/Offshore-Wind**.

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invest in increasing quality and developing new competencies in order to sell into the offshore wind supply chain. NJEDA's financing tools can help these businesses invest in the new equipment and training they need.

Goal 2.2.3: Develop job training programs to support the offshore wind industry.

As New Jersey builds out to its goal of 7,500 MW of offshore wind through 2035, the state projects to create approximately 25,000 full-time equivalent positions through the construction, operations, and maintenance of offshore wind generators.

In June 2019 Governor Murphy signed EO No. 79 creating the Council for the WIND Institute, to lay the groundwork for the establishment of the WIND Institute. One of the primary roles of the Council is collaborating with industry to establish a workforce needs assessment. This assessment is looking at talent pipelines across a wide-variety of technical, trades,

As the WIND Institute develops and hosts new and innovative training programs, New Jersey will be able to establish pathways for careers within the offshore wind industry.

and professional jobs necessary to develop the offshore wind industry, as described previously. However, the significant talent demands created by the offshore wind industry will ultimately require a coordinated effort from universities, community colleges, and other training providers such as unions and private companies. In addition, New Jersey will expand upon its established pipelines via its County Apprentice Coordinators, Pre-Apprenticeship in Career Education (PACE), Growing Apprenticeship in Non-traditional Sectors (GAINS), and Industry Partnerships initiative to upskill state residents to meet growing offshore wind workforce needs.

As the WIND Institute develops and hosts new and innovative training programs, New Jersey will be able to establish pathways for careers within the offshore wind industry (see Goal 7.4 for more information about the WIND Institute).

Importantly, given New Jersey's geography and coastline, the state is well-positioned to develop occupations for offshore wind production and the establishment of the supply chain to support the growing offshore wind industry throughout the East Coast.

Clean energy job training is further discussed in Strategy 7: Expand the Clean Energy Innovation Economy.

Goal 2.2.4: Support the offshore wind industry through port infrastructure development and inter-regional collaboration.

The port infrastructure required to manufacture, install, and service offshore wind turbines is a critical component of the offshore wind industry. To start, New Jersey has some of the best port assets on the East Coast including those in the New York/Newark/Raritan Bay region, the Delaware River region, and over 130 miles of North Atlantic Coastline. Together these assets constitute a variety of port and waterfront facilities that may serve a wide array of functions in offshore wind development. However, offshore wind also requires customized port facilities due to the massive size and weight of the components.

The three primary types of port facilities that are needed by the offshore wind industry are: manufacturing; staging/marshalling/load-out; and operations and maintenance. While the state is looking at all three of these types of ports, special early attention is being given to manufacturing (foundations, turbines, and associated components) and staging/marshalling/load-out ports given their size, complexity, and ability to help anchor a local supply chain.

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Strategic investment in port facilities is a key component to attracting developers and Original Equipment Manufacturers (OEMS) to situate supply chain jobs in New Jersey. Several state agencies are currently considering various options for how to support the required investment in port infrastructure, including options for public-private partnerships. Inter-regional collaboration with New York, Delaware, and other states is also important as New Jersey looks to further develop its port infrastructure.

GOAL 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**

The success of New Jersey's early solar program propelled the state into a leading position in the solar industry, a position that New Jersey maintains today despite its small size and lower solar insolation values[21] relative to some of the western and southern states. Bolstered by the federal Investment Tax Credits and a supportive state energy policy, including an increasing solar photovoltaic (PV) set-aside in the RPS, solar PV installations in New Jersey have continued to climb in the residential markets (over 111,000 installations at approximately 930 MWdc) and commercial markets (over 6,600 installations at 1,488 MWdc). Utility-grid solar has increased as well, with 639 MWdc online through October 2019.[22] As of the second quarter of 2019, New Jersey had the seventh largest installed solar capacity in the country;[xxxiv] the state had 3,097 MW of installed capacity as of November 30, 2019, and 558 MW[xxxv] in the pipleline (Figure 18).[23] Furthermore, Treasury has

21 Solar insolation is a measure of solar radiation energy received on a given surface area in a given time, and can be affected by such variables as weather, time of day, the angle of the sun, altitude, and geographic location.

22 New Jersey's Office of Clean Energy reports solar installations as "MWdc." The Integrated Energy Plan modeling reports solar installations as "MWac."

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.

23 Learn where solar PV is currently installed in the New Jersey via NJDEP's interactive NJ County Solar PV Dashboard at **https://www.state.nj.us/dep/aqes/opea-solar.html**.

24 See New Jersey's Bid RFQ T3104: **https://www.njstart.gov/bso/external/bidDetail.sdo?bidId=18DPP00260**.

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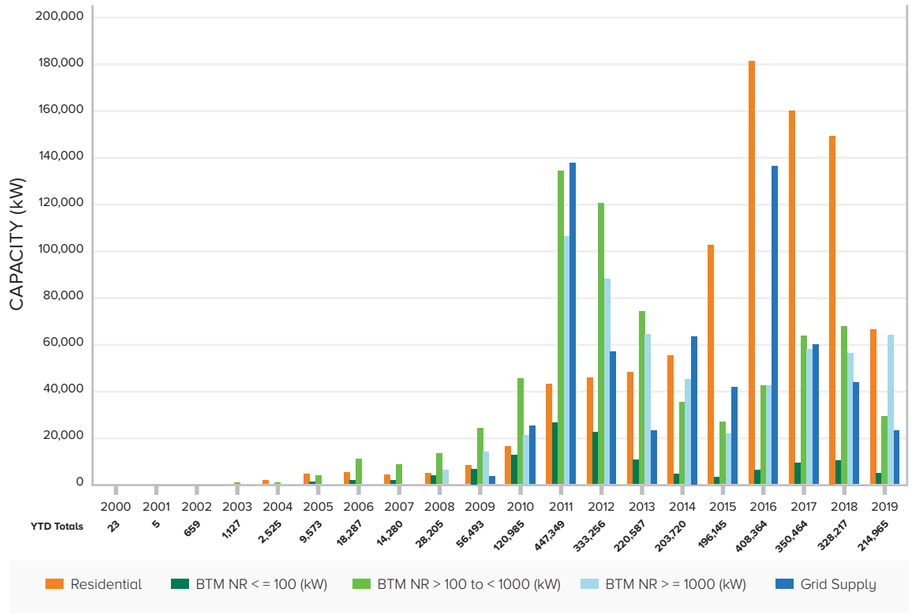
FIGURE 18.

New Jersey Solar Installations as of 08/31/19



NJBPU received a total of 252 applications in the first year of the pilot program, of which 232 were for projects that would serve at least 51% low- and moderate-income customers. The applications represented over 650 MW of capacity. In December 2019, NJBPU awarded 45 community solar projects, totaling 77.61 MW of solar energy capacity, which is enough to power an estimated 15,500 homes; 100% of the projects will serve LMI households in the state.

Over the next two years, NJBPU will work with stakeholders to refine and improve the pilot program in order to best serve the ratepayers of New Jersey. NJBPU should pay particular attention to ensuring that community solar is fully accessible to low- and moderate-income customers, through such reforms as streamlining the application process and ensuring adequate compensation levels. Beginning in early 2021, NJBPU will consider how to transition the pilot program into a full-scale Community Solar Ener-

Over the next two years, NJBPU will work with stakeholders to refine and improve the community solar pilot program in order to best serve the ratepayers of New Jersey.

gy Program. As part of the state's solar goal, and in conjunction with other NJBPU initiatives such as the Solar Transition Plan and as part of Goal 2.1.2, NJBPU should aim to meet or exceed the Clean Energy Act's goal for at least 150 MW community solar installed per year in a full-scale program.[25] Further, NJBPU should work with local and environmental justice communities to better ensure that community solar meets the needs of the communities it aims to serve, in addition to meeting or exceeding the existing 40% carve-out for projects that serve at least 51% low- and moderate-income customers (see also Goal 6.2.1).

Goal 2.3.2: Transition to a successor solar incentive program.

The Integrated Energy Plan modeling suggests that New Jersey should install 5.2 GW of solar by 2025, 12.2 GW by 2030, and 17.2 GW by 2035. Smoothed out over 15 years and considering that New Jersey already has roughly 3 GW of solar, this represents installing an average of roughly 950 MW annually from 2020 through 2035. Historically, New Jersey has installed an average of 152 MW of solar PV annually, and averaged over 320 MW over the last five years.

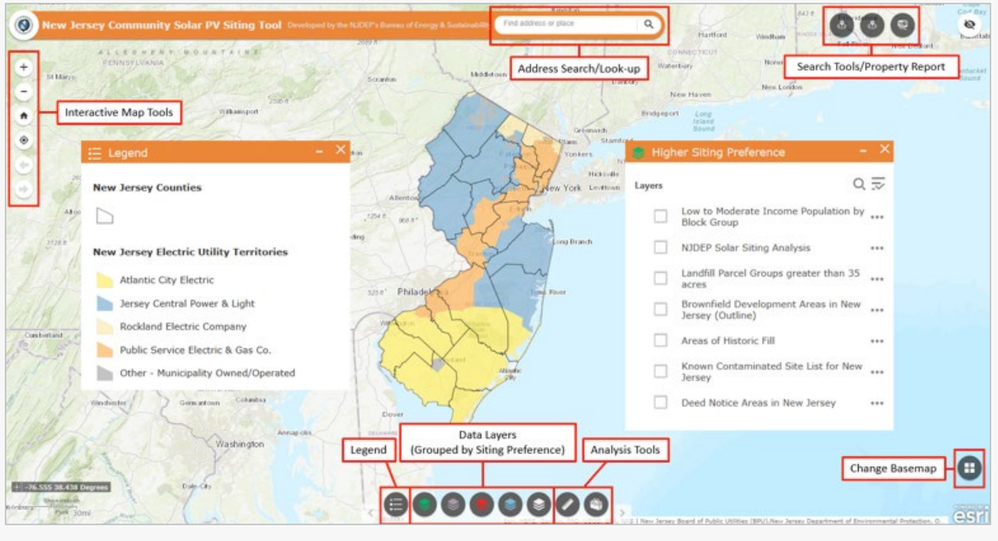
NJBPU is currently moving from its existing Solar Renewable Energy Certificates (SREC) incentive program to a successor incentive program that will continue to support sustained growth of solar generation in the state in a cost-effective manner. The Clean Energy Act of 2018 mandates that NJBPU replace or modify the existing solar incentive delivery mechanism. The law also subjects the combined costs of solar and non-offshore wind renewable energy incentives to a cap of nine percent of the total cost paid for electricity by all customers in the state in the first three years after enactment, followed by a seven percent cap thereafter. NJBPU issued an order in December 2019 to initiate a proceeding to better define how to calculate these caps and ensure compliance with the statute. The law also requires NJBPU to develop megawatt-based targets for different installation types and incentive payment caps. NJBPU has affirmed the importance of solar energy to meeting the state's ambitious clean energy goals consistent with the mandates of the Clean Energy Act. Staff from NJBPU has been guided by a set of seven "Solar Transition Principles," which include "provid[ing] maximum benefit to ratepayers at the lowest cost," and "support[ing] the continued growth of the solar industry."

Based upon feedback from stakeholders, NJBPU has proposed to conduct the solar transition in two phases: 1) development of a transition incentive, which will be designed to serve as a bridge between the current SREC program and a to-be-determined successor program, and 2) the successor program. The transition incentive program was presented to NJBPU's Commissioners in December 2019, and a successor to the SREC incentive system is anticipated to be presented for NJBPU consideration in 2020.

Through the transition and successor incentive program development, NJBPU will establish offset goals that will mandate a certain amount of solar energy to be procured by the load serving entities to satisfy the RPS. Looking ahead, NJBPU should also continue to consider how solar can best be integrated into other goals identified throughout this Energy Master Plan, including storage (Goal 2.3.6) and community energy planning (Strategy 6).

Goal 2.3.3: Maximize solar rooftop and community solar development in urban and low- and moderate-income communities using the local workforce.

As further discussed in Goal 6.2, the state aims to maximize the amount of solar that can be located on top of roofs, carports, and other built environments. The program should also foster economic and environmental benefits to underserved and environmental justice communities through expansion of community solar development and the training of the local workforce to build, maintain, and operate these facilities. State agencies should make a concerted effort to work with utilities and developers to



25 To support the Community Solar Energy Pilot Program, NJDEP's Bureau Climate Change and Clean Energy developed a Community Solar PV Siting Tool to help solar developers, municipalities and interested stakeholders find locations to site community solar arrays: **https://www.state.nj.us/dep/aqes/solar-siting.html#cstool**.

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steer development toward urban rooftops, and coordinate with the Department of Labor and Workforce Development (NJDOL) to establish or expand apprenticeship programs to design, build, and operate rooftop solar and community solar projects in their local communities.

Goal 2.3.4: Develop programs to increase the deployment of solar thermal technologies.

Solar thermal energy systems use rooftop panels to provide water heating, which is particularly cost-effective in residences, as well as commercial or industrial facilities with large water heating costs, such as kitchens or laundry facilities. Solar thermal energy systems serve as an efficient complement to traditional water heating systems and can offset energy demand and greenhouse gas emissions. Beyond their climate and energy benefits, solar thermal technologies provide cost savings for consumers. As an example, according to U.S. DOE, the installation of a domestic solar water heating system can lower water heating energy bills by 50% to 80%.[xxxvii]

Given the relatively small footprint of solar thermal energy systems in comparison to solar photovoltaic panels, solar thermal energy systems may be an option for those who have some rooftop space, but not enough to generate their own electricity. Further, regarding efforts to improve energy efficiency across the building sector, in certain situations, a solar thermal water heating system may be an alternative, cost-effective, and less disruptive energy efficiency measure than whole-home weatherization.

Solar thermal energy systems have the potential to provide clean, cost-effective water heating across all building sectors. States including Massachusetts, California, and Hawaii currently have programs to subsidize installation costs for solar thermal systems. New Jersey should explore developing similar programs to increase the deployment of these technologies through incentives and other applicable mechanisms.

Goal: 2.3.5: Mandate non-wires solutions on state-funded projects, including new construction and rehabilitations.

Non-wires solutions is an umbrella term for projects or investments that may defer or replace distribution or transmission upgrades by reducing load. Such alternative investments may include distributed energy, demand response programs, energy efficiency, energy storage, and grid software and controls. For instance, as EV charging proliferates on the grid and increases demand, managed charging will enable a greater number of vehicles to be adopted before necessitating an upgrade to the distribution grid to accommodate increased demand.

Given the relatively small footprint of solar thermal energy systems in comparison to solar photovoltaic panels, solar thermal energy systems may be an option for those who have some rooftop space, but not enough to generate their own electricity.

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State-funded buildings and projects should seek to assess and implement non-wires solutions to the greatest extent practicable in order to reduce energy demand and consumption. Importantly, New Jersey cannot realize a clean energy future without maximizing energy reduction through energy efficiency and other types of DER, which create more net economic value for New Jersey if incorporated into non-wires solutions. In conjunction with the goals in Strategy 3 and the legislated energy efficiency targets (Goal 3.1.1), as well as modeling for the Integrated Energy Plan (Goal 2.1.3) and the utilities' integrated distribution planning (Goal 5.1.1), state agencies will work together to ensure that state-funded buildings and projects are maximizing opportunities to reduce anticipated energy demand, including electrical and thermal, prior to issuing project approvals.

Goal 2.3.6: Develop mechanisms for achieving 600 MW of energy storage by 2021 and 2,000 MW of energy storage by 2030.

As New Jersey increases the amount of renewable generation in its energy mix, variability and balancing become critical. Energy storage resources are extremely well-suited to provide these services, and the Integrated Energy Plan modeling found that New Jersey will need 2.5 GW of storage by 2030 and 8.7 GW of storage by 2050.

The promise of storage only becomes more pronounced as costs decrease and long-duration storage technologies mature. Energy storage can provide numerous services to New Jersey's energy system, such as load balancing, frequency regulation, and resiliency services. In particular, storage is one of the few resources that can provide diurnal balancing as the state increases the amount of renewable energy on the grid. Specifically, the National Renewable Energy Laboratory (NREL) defines the many value streams of storage to include: demand charge reductions; energy arbitrage; demand response; resiliency/back-up power; frequency regulation; capacity markets; voltage support; and transmission and distribution upgrade deferral.[xxxviii]

Pursuant to the Clean Energy Act of 2018, NJBPU conducted an Energy Storage Analysis that the agency released in June 2019. Building on the progress of that report, NJBPU must establish a process and mechanism for achieving the stated energy storage goals of 600 MW by 2021 and 2,000 MW by 2030. NJBPU will soon issue a straw proposal for stakeholder input as the first step in establishing the process and mechanism for achieving these goals.

Currently, New Jersey has 475 MW of existing energy storage, the majority of which is from one pumped hydroelectric energy storage facility. Find-

Currently, New Jersey has 475 MW of existing energy storage, the majority of which is from one pumped hydroelectric energy storage facility.

ings from the Energy Storage Analysis prepared by Rutgers University[26] found that pumped hydroelectric and thermal storage technologies are currently cost effective and do not face financial barriers to deployment. Battery energy storage can provide more flexible, modular, and mobile options, as well as local energy resilient enhancement over other storage technologies. However, wholesale market revenues alone are insufficient to make battery storage a reality, and New Jersey does not currently have a means of pricing the benefits that batteries can provide at the distribution level. New Jersey is committed to adopting changes in regulatory policy that recognize the full wholesale and distribution value of batteries. To make this commitment a reality, as further discussed in Goal 2.1.6, the state will develop a mechanism to compensate DER, including storage, for its resilience, low carbon, and transmission and distribution system benefits, as well as to advocate at the federal and regional level to recognize the benefits of batteries in the capacity and ancillary services markets.

NJBPU will seek to achieve its energy storage targets at the least cost, setting annual capacity goals that increase as costs decrease and accelerating the adoption of energy storage enabled infrastructure improvements. In addition to properly valuing storage, the state can also consider a mechanism to pair storage with offshore wind and encourage developers to pair storage with solar to take advantage of the federal Investment Tax Credit. Such pairings could improve the value proposition for both advanced energy technologies. Finally, pairing storage with EV DC fast chargers could reduce excess demand charges, improving the business case for developers of fast-charging infrastructure (see Strategy 1) while limiting the cost of grid upgrades to accommodate high-capacity EV chargers.

Upscaling of battery production, as is anticipated to happen with the growth of the EV market, will help drive down battery costs. Complementarily, if properly valued, EV owners could be incentivized to participate in demand response mechanisms as they pertain to timed charging, vehicle to grid (V2G), and vehicle to home (V2H) technologies, thus helping to smooth the demand curve and potentially reduce electricity rates. NJBPU is currently evaluating the effectiveness of V2G technology, and will then determine how to implement its findings.

Finally, targeted deployment of lithium-ion (battery) systems could potentially provide increased hosting capacity for behind-the-meter solar PV systems in areas of the distribution system where lines are overloaded. They can also increase resiliency of critical facilities that utilize solar energy, as well as assist in energy bill management for commercial facilities with solar power systems to manage high demand charges. NJBPU is currently looking at optimal locations to site storage on the grid; these efforts will be further informed by the electric public utilities' integrated distribution plans, as further discussed in Goal 5.1.1.

Goal: 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.

Biomass-to-energy projects can reduce greenhouse gas emissions through use of waste biomass as fuel in electric generation and for heating needs. The avoided waste disposal provides the potential for additional benefits such as reducing waste transport and disposal costs and eliminating emissions from landfills. Biogas generated at wastewater treatment facilities or food processing facilities using anaerobic digestion can be used to generate electricity and heat that can help satisfy the energy needs of the facilities and reduce the load demand from the grid. This reduces overall greenhouse gas and criteria pollutant emissions and also improves the resiliency of these critical facilities.

In the interest of maximizing the utility of what would otherwise be considered waste emissions, the state will consider requiring regulation that mandates source separation of food waste from large food waste generators. Separation of food waste and other organic wastes from municipal solid waste provides a valuable feedstock that can be used in the production of sustainable bio-gas and bio-fuels. New Jersey can position itself as a leader in sustainable bio-fuel production if it has a reliable source of organic waste feed stock and appropriately incentivizes anaerobic digestion and sustainable bio-gas and bio-fuel production technologies. Bio-fuel and bio-gas can provide a mechanism that will allow for the decarbonization of energy end uses that are difficult to electrify with today's technologies. Further, the state should identify strategies for optimal sludge management that preclude incineration and may provide alternative beneficial uses such as an alternative to chemical fertilizers. The above recommendations are consistent with the establishment of a circular waste loop that can benefit wastewater treatment plants and that can reduce related emissions and energy use.

26 Rutgers, the State University of New Jersey. New Jersey Energy Storage Analysis Final Report, May 23, 2019. **https://www.bpu.state.nj.us/bpu/pdf/commercial/New%20Jersey%20ESA%20Final%20Report%2005-23-2019.pdf.**

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STRATEGY 2

Accelerate Deployment of Renewable Energy and Distributed Energy Resources

Goal	Description	Commitments & Timeline	Baseline	Agencies
Meet the 50% RPS by 2030 and explore possible regulatory structures to enable New Jersey to transition to 100% clean energy by 2050	New Jersey should explore options to establish a clean energy market-based mechanism that would enable competition among zero-emission generating resources in all-inclusive and technology-neutral manner.	NJBPU will open a proceeding in 2020 to explore how to enable the state to adapt the electricity sector to achieve 100% clean energy by 2050, such as implementation of a Clean Energy Standard or similar mechanism, potentially including a requirement that its jurisdictional utilities procure clean energy.	RPS compliance reports from regulated entities are due to NJBPU by October 1 annually.	NJBPU
Coordinate permitting and siting processes for renewable energy development	The relevant state agencies, municipalities, and utilities should assess methods to improve coordination, transparency, and predictability in the full permitting and siting process to reduce the uncertainties and soft costs of renewable energy development.	NJDEP, NJBPU, NJDCA, NJEDA, and the NJ Dept. of Agriculture (NJDA) will assess methods to improve coordination, transparency, and predictability in the full permitting and siting through evaluation of existing regulations, the expansion of existing programs, or the development of new programs. Initial assessment and recommendations will occur in the first half of 2020. NJBPU staff, along with stakeholders and the electric public utilities, will explore measures to open currently restricted circuits through the IDP process.	NJBPU mandated in February 2019 that the electric public utilities develop, publish, and update capacity hosting maps (N.J.A.C. 14:8-9.9(f)) NJDEP maintains a Solar Siting Analysis tool using GIS and NJDEP's 2012 Land Use/Land Cover data that identifies areas in New Jersey where NJDEP encourages and discourages solar PV development.	NJDEP, NJBPU, NJDCA, NJDA, and NJEDA

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STRATEGY 2

Accelerate Deployment of Renewable Energy and Distributed Energy Resources

Goal	Description	Commitments & Timeline	Baseline	Agencies
Coordinate permitting and siting processes for renewable energy development *Continued*		NJDEP, NJBPU, NJDCA, and NJDA, in collaboration with local siting entities and municipalities, will determine and establish clear guidance and rules on where land-based renewable energy should and shouldn't be sited. This will include: • coordinating land use policy for solar siting in mid-2020. • guiding investments away from flood zones and other areas deemed especially vulnerable to climate change, in concert with New Jersey's Climate Resilience initiatives, by mid-2020. NJDCA's Division of Fire Safety will incorporate education on energy storage systems awareness in its training and continuing education classes by 2021, including in its Firefighter I curriculum.	NJDEP Office of Permit Coordination (OPC) offers a voluntary permit coordination meeting for DER project developers to explain their proposed development plans to relevant affected divisions within NJDEP, and with other agencies, including NJBPU, NJDA, and NJDCA as appropriate.	
Begin stakeholder engagement to explore rules to limit CO_2 emissions from electric generating units	In addition to rejoining RGGI, further regulation of CO_2 may be prudent to ensure that the state meets its 80x50 GWRA mandate.	NJDEP will begin stakeholder engagement by March 2020 to solicit ideas and inform potential future rulemaking options.	18.1 MMT CO_2e as of the 2018 GHG Inventory.	NJDEP

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STRATEGY 2

Accelerate Deployment of Renewable Energy and Distributed Energy Resources

Goal	Description	Commitments & Timeline	Baseline	Agencies
Develop 7,500 MW of offshore wind generation by 2035	Pursuant to Executive Order No. 92, the state will develop 7,500 MW of offshore wind by 2035 to strengthen New Jersey's clean energy resources and leverage its related economic growth and industry development opportunities.	The WIND Council will issue recommendations to lay the groundwork for the establishment of the WIND Institute in early 2020. NJBPU will develop a consistent and transparent solicitation schedule through 2035 in early 2020. NJBPU will continue to explore and plan for future offshore wind transmission needs. NJEDA will continue to grow the New Jersey Offshore Wind Supply Chain Registry, which was launched in April 2019. NJEDA will launch a technical assistance program in mid-2020 to help NJ-based small and medium-sized companies identify and acquire the certifications and competencies needed to sell into the offshore wind supply chain. Ørsted's Ocean Wind Project will be operational in 2024.	1,100 MW solicitation of offshore wind generation was awarded in June 2019. 462 businesses joined the state's Offshore Wind Supply Chain Registry as of November 2019.	NJBPU, NJEDA

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STRATEGY 2

Accelerate Deployment of Renewable Energy and Distributed Energy Resources

Goal	Description	Commitments & Timeline	Baseline	Agencies
Continue to grow a 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. 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.	NJBPU will hold a stakeholder meeting in early 2020 to help develop best practices for Year 2 of the pilot program, with the application released in the first half of 2020. NJBPU will initiate a proceeding in early 2021 to transition from the pilot to full-scale Community Solar Energy Program with a focus on LMI and EJ communities. NJBPU will explore how to provide financial and technical support to LMI communities and community organizations wishing to develop a local community solar project, beginning in 2020. NJBPU, NJDEP, and NJDCA will support and encourage community outreach aimed at educating LMI communities about adopting community solar as both hosts and subscribers to ensure that there is active participation in the program, beginning in 2020.	NJBPU launched a three-year Community Solar Energy Pilot Program in 2019, receiving 252 applications for the first year. In December 2019, NJBPU awarded 45 projects for Year 1.	NJBPU, NJDEP, NJDCA

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STRATEGY 2

Accelerate Deployment of Renewable Energy and Distributed Energy Resources

Goal	Description	Commitments & Timeline	Baseline	Agencies
Transition to a successor solar incentive program	The Clean Energy Act of 2018 mandates that NJBPU replace or modify the existing solar incentive delivery mechanism and subjects the combined costs of solar and non-offshore wind renewable energy incentives to a cost cap.	NJBPU issued an order in December 2019 to establish a Solar Transition incentive (TREC) for solar projects that do not receive permission to operate prior to the state attainment of solar providing 5.1% of the kWh sold in the state. NJBPU also initiated a proceeding to better define how to calculate the cost caps and ensure compliance with the statute; the proceeding will begin in early 2020. NJBPU will present a successor to the SREC incentive system for Board consideration in 2020.	N/A	NJBPU
Develop mechanisms for achieving 2,000 MW of energy storage by 2030	Energy storage can provide numerous services to New Jersey's energy system, such as load balancing, frequency regulation, and resiliency services. Pursuant to the Clean Energy Act of 2018, New Jersey must develop 2,000 MW of energy storage by 2030.	NJBPU will issue a straw proposal for stakeholder input in the first half of 2020 as the first step in establishing the process and mechanism for achieving these goals.	475 MW as of 2019.	NJBPU

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STRATEGY 2

Accelerate Deployment of Renewable Energy and Distributed Energy Resources

Goal	Description	Commitments & Timeline	Baseline	Agencies
Explore regulatory authority to achieve 100% clean energy by 2050	NJBPU must ensure that appropriate legal pathways at the federal and regional level exist that are fully compatible with New Jersey's efforts to realize 100% clean energy by 2050.	New Jersey will coordinate with other states to advocate that any changes to structures currently under PJM and federal jurisdiction remain compatible with clean energy EMP goals. NJBPU may initiate a proceeding in early 2020 to examine the best approach to meeting New Jersey's resource adequacy needs, consistent with the state's clean energy goals, to ensure that New Jersey ratepayers have access to adequate amounts of clean electricity at affordable prices, and will make regulatory or legislative changes as necessary following the proceeding. NJBPU will evaluate its options to challenge FERC's December 2019 Order on the PJM Capacity Market.	N/A	NJBPU

STRATEGY 3

Primary Goals:

3.1
Increase New Jersey's overall energy efficiency

3.2
Manage and reduce peak demand

3.3
Strengthen building and energy codes and appliance standards

Maximize Energy Efficiency and Conservation and Reduce Peak Demand

Strengthen state and utility efforts toward promoting energy efficiency and reducing peak load, including clear energy reduction goal setting, consistency, and accountability; reduction of wasted energy through improvements in building thermal envelopes, appliance efficiency, energy benchmarking, equipment controls, strategic energy management, and attention to peak demand reduction; and ensuring access to increased efficiency for all residents so that energy burden disparities are not amplified.

Energy efficiency and load management are the most cost-effective energy resources for meeting customer needs[xxxix] and are critical to successfully meeting New Jersey's goal of 100% reliance on clean energy sources by 2050. Nationwide, energy efficiency is the third-largest electricity resource[xl] and is the cheapest method to meet customer needs. Importantly, NJBPU's recent study on the energy efficiency potential within the state established that New Jersey could realize a 21% reduction in electric energy demand and a 20% reduction in peak electricity demand by 2029.[xli]

Energy efficiency employs 33,815 individuals in New Jersey[xlii] and contributes to greenhouse gas emissions reductions and improved water quality, as well as strengthens grid resilience and improves health and comfort. Further, aggressive energy efficiency actions will foster job growth through necessary state and utility investments in energy efficiency and related technologies; increase opportunities for manufacturers and providers to scale their work and reduce costs; and increase competition throughout the state.

With a renewed focus on increasing New Jersey's overall energy efficiency in the electricity and gas sectors, reducing peak demand, and increasing efficiency standards in appliances and the built environment, New Jersey will leverage this growing clean energy sector to drive down costs, reduce utility bills, lower emissions, and enhance economic development.

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Energy Efficiency and the Integrated Energy Plan

Integrated Energy Plan Approach

The Integrated Energy Plan modeled the effects of energy efficiency primarily through different assumptions placed on the evolution of the appliance stock and other end-use equipment within New Jersey. The Reference 1 scenario represents stasis in efficient technology adoption, with equipment assumed to be replaced like-for-like at end-of-life, with minimal efficiency gains. Reference 2 models the impact of New Jersey's current efficiency targets (annual savings of 2% and 0.75% in electricity and gas, respectively), leading to further energy savings. The Least Cost scenario assumes even higher levels of efficiency savings by modeling the impact of replacing electricity-consuming equipment at end-of-life with the most-efficient available option.

In addition, the Integrated Energy Plan models the operation of air-source heat pumps to heat space and water at significantly higher efficiency levels across a wide range of temperatures compared to direct combustion of natural gas, oil, and propane. In the Least Cost and other scenarios with high uptake of heat pumps, the Integrated Energy Plan does not model significant efficiency investment in fossil-fueled heating equipment, as the majority of such equipment is gradually replaced with heat pumps by 2050.

Relevant Integrated Energy Plan Findings

- **Efficiency investments timed with equipment stock can reduce electricity use significantly.** In the Least Cost scenario, the modeled turnover of equipment stock allows New Jersey to reduce the energy consumption from major sources of demand through 2050. For example, electricity use from lighting falls by 79% in the residential sector and 55% in the commercial sector through 2050, and total appliance energy use in both sectors falls by 24% through 2050.
- **Even with end-use efficiency, electricity demand grows through 2050.** Fuel-switching from natural gas, oil, propane, and gasoline to electricity improves overall, economy-wide energy efficiency, reducing total final energy demand by 44% even while growing total electricity demand by 97%.
- **Efficiency savings contribute to a feasible, cost-effective energy system that meets 2050 targets.** Aggressive energy efficiency mitigates the total increase in electricity demand, and lowers requirements for carbon-neutral electricity supply that would otherwise be provided by limited in-state resources or by out-of-state resources requiring transmission upgrades.
- **Peak demand growth due to electrification is reduced by energy efficiency.** Peak electricity demand in the Least Cost scenario from non-electrified end uses falls even as average daily peak electricity demand grows by 120% due to electrification. These efficiency savings reduce the costs of grid modernization, transmission, and other system upgrades that would otherwise add costs to New Jersey's energy economy as building and vehicle electricity demands grow.

GOAL 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

New Jersey can support and enable a number of policies and programs to improve efficiency efforts and leverage efficiency as a valuable resource[xliii] in New Jersey's clean energy portfolio. More importantly, promoting efficiency throughout all customer classes and industries will allow New Jersey to meet its clean energy goals, improve equity, and reduce greenhouse gas emissions.

Over the next year, New Jersey must establish a comprehensive statewide energy efficiency program; clarify the role that utilities and third-party providers will play in implementing energy efficiency programs; provide critical governance, strategy, program approval, and oversight of utility programs; and eliminate redundancies between state- and utility-run programs. Further, the state will need to integrate short-term and long-term planning for consistency, market development, and goal achievement.

Ingrained in these mandates are a series of priorities which will help to shape energy efficiency policies, programs, cost-benefit analyses, and qualitative performance indicators. These priorities include affordability; equity; environmental justice; economic development; decarbonization; and public health. As the state develops new programs and refreshes existing programs, it must determine how to incorporate and value these non-quantifiable attributes in an effort to align state efforts with Governor Murphy's commitment to a stronger and fairer New Jersey and a clean energy future.

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New Jersey is in the process of establishing appropriate parameters for development of a comprehensive state energy efficiency plan and the adoption of the Clean Energy Act's gas and electric energy efficiency portfolio standards.

Goal 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.

Utilities and third-party providers are critical allies in achieving the state's clean energy goals through energy efficiency, and can help deliver efficiency programs, including by meeting customized needs of particular customer segments.

The Clean Energy Act mandates that electric public utilities must reduce consumption by at least 2% annually and gas public utilities must reduce consumption by at least 0.75% annually. Public utilities are required to promote and implement programs to achieve both aggregate and peak demand reduction, and may be incentivized or penalized in relation to their respective success in meeting targets specific to each utility.

New Jersey is in the process of establishing appropriate parameters for development of a comprehensive state energy efficiency plan and the adoption of the Clean Energy Act's gas and electric energy efficiency portfolio standards. NJBPU published the study "Energy Efficiency Potential in New Jersey" in May 2019 and is continuing its stakeholder engagement, including holding regular stakeholder meetings and collaborating with and incorporating feedback from the newly established Energy Efficiency Advisory Group.

Based on ongoing input, guidance, and engagement with stakeholders, utilities, and other interested parties over the next several months, NJBPU will determine the role of the utilities and the New Jersey Clean Energy Program (NJCEP) in program administration and provide clear strategic direction; establish qualitative performance indicators and related assessment of incentives and penalties; establish the structure for cost recovery mechanisms; assess an optimal process to evaluate, measure, and verify energy reductions; and adopt a methodology for utility filing and reporting requirements. The above program parameters and guidelines will be issued by NJBPU in the spring of 2020.

NJBPU will review and clarify the processes for utilities to submit proposed programs and report program progress. NJBPU will apply consistent reporting requirements and clarify the roles of the NJCEP and the utilities. As NJBPU establishes the structure for cost-recovery and the assessment of incentives and penalties, it will also establish mechanisms

NJBPU will continue to engage with stakeholders on a regular basis to evaluate and enhance the metrics and evaluation methods utilized to measure energy savings and utility program progress as well as to support innovative programs to advance energy efficiency.

for how the state will measure, report, and account for energy efficiency gains and potential within its own suite of programs and adjust the utilities' energy efficiency targets appropriately. NJCEP and the utilities' current and future programs should report measures using the same evaluation, measurement, and verification protocols.

The Clean Energy Act mandate for energy reductions specific to the gas and electric utilities, although critically important, is not wholly consistent with the state's efforts to enable or encourage fuel-switching from fossil fuels to electricity or zero-carbon alternatives. NJBPU must also establish an aggregate, fuel-neutral energy indicator to measure reductions in energy demand economy-wide. This will necessitate accounting for consumption of gasoline, diesel, propane, and heating oil, which are part of the state's economy-wide energy consumption, though not regulated by NJBPU. As indicated by the Clean Energy Act, NJBPU must also establish mechanisms to account for increases in electricity demand from electrification of the transportation and building sectors, and ensure that electric public utilities are not unduly penalized for potentially increasing electricity demand caused by fuel-switching, despite success with their own energy efficiency programs. Fuel-switching from propane or heating oil to natural gas has also occurred and is anticipated to continue, and NJBPU must similarly ensure that the gas public utilities are not unduly penalized for increased gas consumption due to fuel-switching of heating sources. NJBPU must also account for externalities including weather, power outages, customer growth, and other factors, and how they will affect utility goals.

NJBPU will continue to engage with stakeholders on a regular basis to evaluate and enhance the metrics and evaluation methods utilized to measure energy savings and utility program progress as well as to support innovative programs to advance energy efficiency. Preliminary quantitative performance indicators were set by Board Order in May 2019. As utilities increase their investment in energy efficiency, NJBPU will re-establish utility-specific targets for reductions in energy consumption and peak demand to support the mandated minimum reductions established by the Clean Energy Act. These targets will be regularly re-evaluated in order to ensure that New Jersey continually achieves cost-effective energy efficiency. Ongoing attention to and evaluation of these targets will advance New Jersey toward its 2030 and 2050 clean energy goals. Further, energy efficiency policies and utility targets should also be continually evaluated and updated based on emerging technologies, innovations in program design and customer engagement, market-shaping activities like bulk procurement or contractor training, and precedents from other utilities.

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Goal 3.1.2: Increase awareness of and access to New Jersey's Clean Energy Program and its suite of statewide programs.

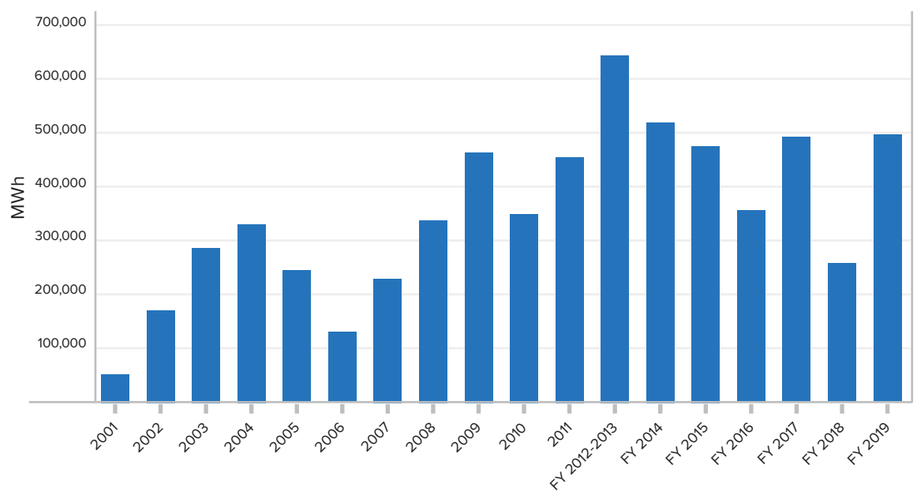
Any program administered by the state should be marketed and made available consistently statewide. As noted in Goal 3.1.1, NJBPU must share information and provide details for savings gained within utility territories due to state-administered programs in order to meet the mandates of the Clean Energy Act.

Since 2001, New Jersey has spent $2.29 billion on statewide energy efficiency programs through New Jersey's Clean Energy Program (NJCEP). Through June 2019 these investments have saved 79.7 million lifetime MWh and 236 million lifetime Dtherms across the residential, commercial, and industrial sectors (Figure 19). These lifetime savings have been achieved through the participation of more than 1.82 million New Jersey electric and gas customers and resulted in the elimination of 79 MMT of CO_2 (equivalent to 7.7 billion gallons of gasoline consumed).[xliv]

FIGURE 19.

NJCEP Annual Electricity Savings (CY 2001-FY 2019) in MWh

Annual MWh from measures installed in years shown



NOTE: Savings transitioned from being measured by calendar year (CY) to fiscal year (FY) in 2012. The FY 2012-2013 savings occurred during an 18-month period in which this transition occurred.

New Jersey's statewide programs are an important component of advancing the state's clean energy goals, as they ensure access to consistent programmatic opportunities across the state. The state's role in providing programs for education and market transformation can be particularly beneficial. New Jersey's administration of energy efficiency programs ensures that all customers who contribute to the Societal Benefits Charge have equitable access to the resulting programs and incentive opportunities. However, the New Jersey State Budget and Procurement Process can create lengthy delays for contractors, utilities, and customers, and the state should find ways to address these challenges. New Jersey should evaluate the role of contractors and installers in accessing rebates and programs to maximize participation statewide.

In order to facilitate and optimize access to energy efficiency programs, the state should implement user-centered design in program access and application to ensure the website and process is accessible to all customers. New Jersey should maintain a state-run portal that is comprehensive and inclusive of both state and utility-led programs. It will be important to closely monitor technology advancements and opportunities to explore and invest in deeper energy saving measures, allowing the state to lead the way in supporting the development and adoption of new technologies. Program design will need to be updated as certain equipment and building standards are achieved on a ubiquitous basis, and as market forces such as consumer demand and pricing are altered. Continued efforts toward increased efficiency will mirror advancements in other clean energy areas moving forward.

Goal 3.1.3: Establish strategic and targeted energy efficiency programs to increase energy reductions and customer engagement.

As New Jersey undergoes its energy efficiency transition, NJBPU must assess, establish, and potentially realign existing energy efficiency programs to meet the state's economic, energy, and climate goals. NJBPU should target optimal opportunities to ensure the greatest reductions in energy demand and enable broader access to programs.

For example, NJBPU should establish a minimum threshold or applied metrics for performance indicators for hard-to-reach customer bases like multi-unit dwellers, income-eligible households, and small commercial and residential customers. Particular attention should be paid to energy efficiency opportunities for renters as well as people with disabilities.

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Wastewater treatment facilities could also be critical in driving energy reductions. New Jersey should consider a coordinated water-energy investment program that would allow for peak load shaving and load shedding.

A wider variety of programming that provides opportunities for residents of all income levels and without regard to metering and ownership configurations is important. Programs that target moderate-income customers are helpful in closing gaps in program affordability. In addition, the utilities can reach customers through localized programs, support the adoption of energy efficiency by incorporating on-bill financing into its customer relationships, and pilot new technologies.

Further, New Jersey can consider new targeted sector-specific programs or additional rebate tiers to capture savings from sectors with significant energy-saving opportunities. For example, incentives can be offered to homes that combine Home Performance with ENERGY STAR™ with solar projects to amplify the benefits of solar installation and encourage building net zero carbon homes.

In addition, New Jersey should look to new energy-saving opportunities in complementary sectors, such as the water sector. Energy costs associated with running pumps is one of the top three costs for water utilities in New Jersey. Wastewater treatment facilities could also be critical in driving energy reductions, as could monitoring and replacement of leaking water supply pipelines. New Jersey should consider a coordinated water-energy investment program that would allow for peak load shaving and load shedding.

Goal 3.1.4: Establish a clearinghouse for home energy and health and safety programs targeted to low-income households.

New Jersey administers several programs with state and federal funding that serve low- and moderate-income (LMI) populations, and also partners with the utilities to administer the energy efficiency program Comfort Partners. One of the state's major goals should be to increase the ability for eligible customers to access these programs. Further, the state should also consider addressing health and safety when making energy efficiency upgrades, in what is referred to as a "whole house intervention." New Jersey can make the delivery of these programs more customer friendly by developing a clearinghouse for all low-income-targeted home energy programs in order to lower overall costs, increase enrollment, improve public health and safety, and maximize program potential.

The Murphy administration is committed to a stronger and fairer New Jersey, and the state must take additional measures to ensure that all residents benefit from and can participate in state energy efficiency initiatives. New Jersey's Comfort Partners program, which provided over $38

Programs that serve low-income customers should be consolidated to ensure that health and safety, comfort, and energy efficiency offerings can be better marketed and provided, and structural, health, and safety issues are addressed at the time of energy upgrades.

million to LMI customers for energy efficiency projects in Fiscal Year 2018, and the Weatherization Assistance Program (WAP), funded by the U.S. DOE and administered by NJDCA, help to decrease the energy burden and increase the comfort of low-income residents. Currently, there are efforts nationwide to expand eligible WAP technologies to include those that acknowledge the cost-effectiveness of supplemental heating and cooling technologies relative to weatherization. For example, to reduce water heating expenses, solar thermal water heating may be more cost-effective, faster to deploy, and less disruptive than whole-home weatherization (see Goal 2.3.4). New Jersey could be a leader in ensuring WAP funding is used for the most cost-effective measures, which could be outside traditional energy efficiency measures.

NJBPU and NJDCA have a memorandum of understanding to guide customers to utilize both resources. However, requiring households to speak with multiple administrators and complete multiple applications is an unnecessary barrier that limits the full potential and accessibility of the programs. Streamlining and minimizing barriers to New Jersey's full suite of programs, regardless of administrator, will be important for all customers.

There are additional health and safety concerns that can act as barriers to full utilization of the energy programs, and the state should conduct a statewide survey to identify and understand the scale of barriers. For example, structural improvements, such as addressing roofs, drafts, or insulation, are sometimes required to qualify for or to realize the full potential of energy efficiency measures. In addition, improving the thermal envelope of buildings also improves the quality of life for residents by eliminating leaks, drafts, and other housing inequities, in addition to saving money. However, an unintended consequence of such thermal improvements is that it can decrease ventilation and therefore exacerbate the impact of indoor air pollutants, such as mold or radon, which are common to low-income homes. In certain geographic and demographic regions, state incentives should be deployed to assist funding structural capital improvements required for the energy efficient upgrades beyond what is currently offered by NJCEP.

Programs that serve low-income customers should be consolidated to ensure that health and safety, comfort, and energy efficiency offerings can be better marketed and provided, and structural, health, and safety issues are addressed at the time of energy upgrades. Making energy efficiency policy equitable is crucial to success in meeting New Jersey's clean energy goals and, with the proliferation of energy efficiency, will enhance equity in the state overall.[xlv] Energy efficiency measures should be included in strategies to tackle health inequity and fuel poverty (i.e., needing to choose between paying heating or cooling bills versus other household essentials).

Goal 3.1.5: Adopt equitable clean energy financing mechanisms that enable greater penetration of energy efficiency opportunities for all customers.

While energy efficiency can be improved in a variety of ways, programs must continue to create additional opportunities for individuals of all income levels and for all types of buildings. Many customers, and especially low-income customers, may face numerous barriers to participation in energy efficiency programs.

Challenges such as ownership structure, metering configuration, split incentives, lack of available financing, lack of knowledge regarding program availability, and limited disposable income create gaps in the accessibility of energy efficiency programs. NJBPU should continue to engage with stakeholders to determine opportunities for increased program accessibility, as well as develop program structures and methods for evaluating program success and utility goal achievement that value priorities such as increased program accessibility for hard-to-reach customers.

A New Jersey Green Bank could enable financing for energy efficiency projects to be offered on better terms and help address an existing financing gap in customer segments: those who lack access to the capital necessary to fund energy efficiency projects on their own but earn too much to qualify for low-income incentive programs. On-bill financing and rebates at the point of sale are additional mechanisms that would broaden accessibility to energy efficiency improvements.

Enabling instant rebates, low-cost financing, and easier access to financing for all customer segments, coupled with incentives, education, and awareness, will increase the number of energy efficient installations statewide. This will lower energy bills, grow the energy efficiency job sector, reduce energy consumption, and reduce greenhouse gas emissions and criteria air pollutants. Financing the clean energy economy is further discussed in Strategy 7: Expand the Clean Energy Innovation Economy.

Goal 3.1.6: Streamline and increase marketing, education, awareness, and program administration.

The state should coordinate, streamline and consistently market the multitude of programs that are or will be offered through the utilities, New

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Jersey's Clean Energy Program, and other state and federal programs administered in New Jersey with the goal of reducing market and trade ally confusion, as well as programmatic and administrative costs and inefficiencies, clarifying and increasing awareness of program options, and maximizing penetration. The state should also increase marketing outreach and education support to increase awareness of energy efficiency programs and benefits.

For example, other states have pioneered using community-serving non-profits as a means of delivering energy efficiency services to low- and moderate-income communities. The state could consider developing these types of community partnerships and developing a single tablet-based program that is designed to serve community members by identifying major upcoming purchases or needs, and then using that consumer information to tailor delivery of program information.

Goal 3.1.7: Revise street lighting tariffs as necessary to incentivize mass adoption of energy efficient initiatives.

NJBPU is investigating methods to encourage street light replacement programs in each electric public utility territory. The energy savings from replacing outdated streetlight heads with more energy efficient LED fixtures is significant, and has been clearly recognized by a number of towns and municipalities. While currently authorized, LED replacement under existing electric public utility tariffs fails to deliver the full scope of savings on both operation and maintenance. NJBPU is initiating a proceeding to consider the conversion process, including the impact upon energy use, utility operations, and ratepayer cost; the stakeholder process will begin in early 2020. This proceeding will consider timing, technology, and the use of additional elements such as lighting control and SmartCities components. Upon its conclusion, NJBPU will identify the lighting systems to be changed, the tariff revisions required to reflect the true value and cost of the lighting, and a process for transition. NJBPU will likewise consider including traffic signals and other lighting equipment in this process.

Additionally, new energy efficiency projects developed on and at state facilities are already using LED lighting for parking lots and parking garages to save state energy costs, and this will continue to be required of all state projects to maximize savings and efficiency.

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GOAL 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

Meeting state energy and climate goals will require decreasing peak demand in addition to reducing overall energy demand. Peak demand is often met by placing in service the most polluting and expensive energy generators. Utility management of peak load and policies that encourage peak demand reduction are required under the Clean Energy Act. As such, the state should complement greenhouse gas emission reduction policies, such as transportation and building electrification, with efficiency policies that encourage the management and reduction of peak demand. The energy efficiency potential study found that it is economically feasible for New Jersey to reduce its total peak electricity demand by 20%, or 4,162 MW, over the next ten years.[xlvi]

Goal 3.2.1: Support and incentivize new pilots and programs to manage and reduce peak demand.

Empowering customers with pricing and consumption data, control, and incentives will enable them to manage their energy demand and shift consumption habits to off-peak times. Advanced Metering Infrastructure (AMI, or "smart meters") can provide granular data about energy use and costs to educate customers about their consumption and enable customers to manage their demand. Control over usage should include new rate designs such as Time of Use (TOU) rates to incentivize customers to reduce energy use during periods of peak energy demand. Other rate design tools, such as peak-time rebates that provide refunds to customers who adjust their energy consumption upon utility request, have also proven effective in other places.

In addition to establishing peak demand reduction goals, NJBPU should explore the development of a Clean Peak Standard for meeting a percentage of New Jersey's peak demand needs through clean resources that reduce greenhouse gas emissions. A Clean Peak Standard is designed to set a minimum amount of clean generation resources that must be used to meet peak demand, in lieu of traditional peaker plants. These clean generation resources could include renewable energy, energy storage, and demand response strategies. In 2018, Massachusetts became the first

Given the rapidly advancing state of EV technology and increasing variety of vehicle models available for lease or purchase, as well as the rebate program, New Jersey is likely to see rapid growth in demand for EV charging in the near future.

state to establish a Clean Energy Standard,[27] and other states are considering similar measures.

The state must continue to advocate at PJM and federal levels for appropriate compensation of the full value stack that demand response, energy storage, and other forms of distributed energy resources (DER) contribute to the grid. Such tools are a necessary part of the energy efficiency landscape, and the state should encourage utilities, third-party providers, and customers to engage in pilot programs that incorporate demand response and other load shifting and load reduction programs.

AMI, rate design, rate structure, and other components of a modern utility model and distribution grid are further discussed in Strategy 5: Decarbonize and Modernize New Jersey's Energy System.

Goal 3.2.2: Pilot alternative rate design to manage electric vehicle charging and encourage customer-controlled demand flexibility.

Electrification of the transportation and building sectors will increase load on the grid. However, electrified vehicles, buildings, and appliances are also responsive and adaptable to demand shift and reduction programs. Given the rapidly advancing state of electric vehicle (EV) technology and increasing variety of vehicle models available for lease or purchase, as well as the rebate program, New Jersey is likely to see rapid growth in demand for EV charging in the near future. Managed EV charging will be important, as typical usage patterns include charging after arriving home from work in the evenings, which is coincident with peak demand. The state should pursue opportunities to encourage load shaping and load shifting, such as charging later at night, or during periods of lower load and higher solar output during the daytime. Peak demand reductions can be achieved by working with utilities to pilot alternative rate design to manage EV charging, thus limiting grid impact as EVs proliferate. The state would also then need to work with utilities to educate customers on the impact of EV charging timing on their cost to charge, the impact on the utility system, and impact on climate and environmental emissions (see also Strategy 1).

NJBPU should also work to advance new demand response and demand management technologies, such as vehicle-to-grid (V2G). In September of 2019, NJBPU was notified by the National Governor's Association (NGA) that its application for technical support on V2G under NGA's Request for Applications for State Retreats on Policy Innovations in Grid Modernization was accepted. A tailored in-state policy retreat was convened by NGA Solutions, with support from experts in public and private sectors. This retreat was a one-day session held on January 22, 2020 and included presentations and panel discussions by V2G stakeholders. The retreat will be used to develop a list of action steps regarding V2G.

NJBPU can additionally develop programs for EV charging to be deployed in conjunction with storage or other DER to reduce impact on peak demand. Commercial and industrial customers with solar facilities can reduce their load and energy bill while also providing flexibility to the system by absorbing excess solar output during the day and shifting EV charging away from peak periods.

GOAL 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**

Additional policies crucial to limiting and reducing growth in energy consumption include the adoption of building codes or above-code alternatives that encourage efficiency, building energy use and efficiency labeling, and increased appliance standards. Across the U.S., buildings consume 74% of the electricity and 41% of the total energy used; they also account for 40% of CO_2 emissions.[xlvii] Improving thermal efficiency in the built environment can similarly reduce demand for fossil fuels, as over 85% of New Jersey homes are heated with natural gas, oil, or propane. A 2016 U.S. DOE and Pacific Northwest National Laboratory report found that from 2010 to 2040, New Jersey could achieve cumulative site energy savings of 81.24 TBTU in electricity, 140.55 TBTU in natural gas, and 8.53 TBTU in fuel oil through the continued adoption of updated building codes.[xlviii] This translates to consumer cost savings of $4.96 billion ($2016) and 25.99 MMT of avoided CO_2 emissions.[xlix]

27 Massachusetts Department of Energy Resources. "Clean Peak Energy Standard." **https://www.mass.gov/service-details/clean-peak-energy-standard**

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Goal 3.3.1: Advocate for net zero carbon buildings in new construction in the upcoming 2024 International Code Council code change hearings.

NJDCA adopts updated International Code Council (ICC) building codes into the state's Uniform Construction Code (UCC) on a three-year cycle. To the extent that the ICC remains aggressive in establishing building codes to tighten the thermal envelope of new construction, and assuming NJDCA successfully adopts the ICC codes in full, New Jersey will naturally adopt the established international codes for every three-year cycle. California recently set state goals, beginning in 2020, to mandate net zero carbon buildings in which the property is built to the most efficient standards, offsets some or all of its energy demand, often through rooftop solar generation, and connects to the grid of a local, clean power generation source for the balance of its energy demand. This will likely drive industry trends as well as building code updates and new legislation throughout several states. New Jersey should work with its peer states in advocating that the ICC adopt net zero carbon building standards for new construction in the 2024 code update. Net zero carbon buildings will be further discussed in Strategy 4: Reduce Energy Consumption and Emissions from the Building Sector.

Goal 3.3.2: Establish transparent benchmarking and energy labeling.

Opportunities for building energy savings include programs that require publicly available energy use benchmarking and energy labeling. Research has shown that increased energy use transparency, in both the commercial and residential sectors, is a significant factor toward market-driven increases in efficiency. Limits in awareness and understanding among consumers, particularly in home-buying, has curtailed the ability of consumers to make well-informed decisions based on energy use.[l]

Energy labeling is mandated by the current energy subcode of the UCC. All new buildings are required to have a certificate at or near the electrical panel of the home or building stating the conditions of the thermal envelope (i.e., insulation levels) and efficiencies of the installed mechanical equipment. Further, the Clean Energy Act's requirement that commercial buildings over 25,000 square feet benchmark their energy and water consumption via the U.S. Environmental Protection Agency's Portfolio Manager, an online tool to measure and track buildings' energy and water consumption and greenhouse gas emissions, is an important step towards benchmarking in New Jersey.

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NJBPU and NJDCA should collaborate to assess how new or existing energy efficiency programs or changes to the energy code can establish pathways to reducing energy demand as buildings are being renovated, beyond what is currently required.

However, there are additional opportunities to promote efficiency through building energy use benchmarking and labeling for smaller buildings, such as residential and small commercial, as well. The state should explore industry best practices, such as providing an energy audit or disclosing home energy labels during real estate sales and leases, to increase interest, awareness, and transparency of energy consumption and provide additional tools and motivators to reduce energy use. Finally, benchmarking is a necessary first step in establishing appropriate building performance standards in existing buildings (see Goal 3.3.3).

Goal 3.3.3: Establish mechanisms to increase building efficiency in existing buildings.

New construction codes ensure new buildings are built to high thermal efficiency standards. The state must also consider mechanisms and opportunities to address building and energy codes in existing buildings when they are being rehabilitated or retrofitted with the aim of promoting increased energy efficiency and thermal comfort, in addition to health and safety.

Retrofitting existing buildings and upgrading equipment has the potential to save 4,247,130 MWh of electricity in the residential sector and 10,172,845 MWh in the commercial and industrial sectors by 2029, which equates to a collective annual average savings of roughly 2% compared to the state's electricity consumption in 2017. For gas, residential retrofits and equipment replacement have the potential to save 19,771 BBTU while commercial and industrial upgrades could save 31,514 BBTU, or roughly 0.7% annually compared to the state's natural gas consumption.[li]

The state should consider setting performance standards for existing buildings, such as large commercial and multifamily buildings, in order to drive efficiency and electrification retrofits. Data from benchmarking will help characterize the energy and emissions intensities by property type and allow the state to identify the highest emitting buildings, set an appropriate performance standard for each sector, and develop an appropriate path towards decarbonization.

Consideration for providing rehabilitation or retrofit incentives for efficiency achievements that are above-code is an important opportunity to phase in higher costs and improvements in building envelope performance. NJBPU and NJDCA should collaborate to assess how new or existing energy efficiency programs or changes to the energy code can establish pathways to reducing energy demand as buildings are being renovated, beyond what is currently required. For example, home and building audits may be necessary as well as incentives to encourage

Cost effective energy efficiency upgrades in state buildings will not only pay for themselves over time, but will also ultimately reduce costs to state government operations.

building owners to update and upgrade their buildings. Additionally, examination of the limitations created by current laws and statutes should be performed and modifications promoted and made by the Legislature to conform with this directive.

Goal 3.3.4: Build state-funded projects and buildings to a high performance standard.

Complementary to the above goal, state-funded buildings and projects should be built to the highest attainable, above-code building performance standard using a whole-building approach, such as Passive House design. The state should use building science principles in consideration of building envelopes, building systems, equipment, appliances, and operational controls to design its high-performing buildings.

New state building construction must be built to at least LEED Silver standards, which is established through certification by the U.S. Green Building Council's green building rating system by earning a certain number of points for including sustainability measures in the building and property. The state should consider incorporating standard language into the Owner's Project Requirements mandating that 75% of the available points in the Energy and Atmosphere category be obtained specifically from the energy efficiency measures. Currently, no such restriction applies, which creates a missed opportunity for the state to actively engage in minimizing additional load growth on the distribution grid and to reduce emissions generated from natural gas heating.

Goal 3.3.5: Improve energy efficiency in, and retrofit state buildings to, a high performance standard.

Energy use in state buildings is managed by NJBPU and the Department of Treasury. The state will perform energy audits in all existing state-owned buildings and establish a plan to implement energy efficiency standards, whether through traditional low-hanging fruit like lighting upgrades; HVAC equipment upgrades; weatherization; whole building automation and other "smart building" techniques; and retro-commissioning, which optimizes the performance of existing systems and equipment and identifies inefficiencies.

The starting point for energy retrofits and upgrades should be requiring an ASHRAE Level 3 energy audit prior to the start of the upgrade design. This will provide a baseline by which the reduction target can be established. Windows, siding, roofs, and open spaces will all have an impact on the efficiency of any upgrades and their effectiveness in energy reduction, so energy system upgrades should be paired, where appropriate, with structural upgrades. The current ASHRAE 90.1 standard also has many controls built in related to lighting and HVAC usage, which would be a helpful guide for audits.

A cost-benefit analysis (CBA) should be performed after the audit to determine the overall energy cost savings after the upgrades given the upfront capital construction and simple payback; an extended payback period may be necessary. Cost effective energy efficiency upgrades in state buildings will not only pay for themselves over time, but will also ultimately reduce costs to state government operations.

Goal 3.3.6: Increase compliance of mandated building and energy codes.

Evaluation related to code compliance and attribution would provide information to policymakers and allow the state to appropriately enhance opportunities for energy savings through building codes. Programs that provide guidance and encourage the proliferation of net zero carbon use in buildings of all types are critical to New Jersey's code portfolio.

Stringent building and energy codes are already required. The Uniform Construction Code (UCC) Act, N.J.S.A. 52:27D-119 et. seq requires New Jersey to adopt the most current national model codes, such as the International Codes. The state adopted the most recent 2018 version of the codes in September 2019. The state could explore further opportunities to leverage existing, quality-controlled, third-party verification platforms to strengthen code compliance and simplify enforcement. For example, requiring new homes to get a Home Energy Rating System (HERS) assessment and disclose that report to prospective buyers and local governments could also serve as an effective energy code enforcement tool.

Goal 3.3.7: Adopt more stringent appliance standards.

Residential and commercial appliance efficiency standards also play a significant role in decreasing utility bills. New Jersey was formerly a leader in establishing appliance standards, but those standards have since been surpassed by federal standards and have remained untouched for years.

However, the state Legislature has the authority and the opportunity to increase appliance standards in a number of residential and commercial applications. Particularly in light of shifting federal focus away from increased standards, New Jersey must take a more aggressive stance and adopt a suite of updated appliance standards through the state legislative process. For example, Colorado recently passed HB19-1231, which sets

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up-to-date minimum energy and water-saving standards for 15 different residential and commercial appliances sold in the state. The bill also adopts current federal lightbulb standards into state law, in response to a proposed rollback of such standards.[lii] Vermont and Washington have also passed similar laws, and Connecticut, Rhode Island, and Massachusetts have bills pending.[liii]

The Appliance Standards Awareness Project (ASAP) estimates that, through a suite of appliance standards, by 2025 New Jersey could save 557 GWh of electricity and 1,993 BBTU of natural gas annually, resulting in an annual savings of $176 million. These savings would double by 2035 and could be reinvested in New Jersey's economy rather than go to energy costs.[liv] Such appliances include: commercial cooking equipment, computers and computer monitors, high-CRI fluorescent lamps, showerheads, faucets, portable air conditioners, and residential ventilating fans.

Improving appliance standards is one of the most cost-effective methods of reducing energy costs and consumption, and oftentimes, improved standards cost the buyer nothing. Seven of the appliance standards that ASAP recommends carry no incremental cost and provide immediate savings to the consumer. The remaining ten standards have a median payback period of less than one year, ranging from 0.7 to 2.8 years. These short payback periods lead to long-term benefits that are three times greater than the amount invested.[lv] However, appliances are usually only installed when existing appliances break or become outdated, perpetuating the slow turnover to adopt more efficient appliances. It is therefore crucial that the state consider legislation to adopt more stringent appliance standards immediately to reap the greatest benefits. Further consideration for the state Legislature to empower NJBPU and NJDEP to perform cost impacts and review and adopt updates to appliance standards every three years would enable the state to realize continuous improvement in efficiency standards.

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STRATEGY 3

Maximize Energy Efficiency and Conservation and Reduce Peak Demand

Goal	Description	Commitments & Timeline	Baseline	Agencies
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 quantitative performance indicators and evaluation, measurement, and verification methods	New Jersey is in the process of establishing appropriate parameters for development of a comprehensive state energy efficiency plan and the adoption of the Clean Energy Act's gas and electric energy efficiency portfolio standards.	In response to the Clean Energy Act, NJBPU staff solicited input related to the energy efficiency requirements throughout 2019. Following the release of the "Energy Efficiency Potential in New Jersey" study and that first phase of engagement, NJBPU is currently in the process of working with stakeholders to develop recommendations in order to transition how New Jersey's energy efficiency programs are administered, measured, and verified and to incorporate performance standards. NJBPU will consider issuing guidance on the transition in June 2020, and new programs will commence in July 2021.	NJBPU appointed an Energy Efficiency Advisory Group in August 2019. NJBPU issued a straw proposal regarding program administration in December 2019.	NJBPU and partner agencies where applicable
Establish a clearinghouse for home energy and health and safety programs targeted to low-income households	State-funded programs that serve low-income customers should be consolidated to ensure that health and safety, comfort, and energy efficiency offerings can be better marketed and provided, and structural, health, and safety issues are addressed at the time of energy upgrades.	New Jersey will explore mechanisms to enable "whole house interventions" that will address health, safety, and structural issues at the same time as energy efficiency upgrades by mid-2020.	New Jersey agencies administer a number of programs, such as the Weatherization Assistance Program (WAP), Low Income Home Energy Assistance Program (LIHEAP), and Comfort Partners.	NJDCA, NJBPU, NJDEP

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STRATEGY 3

Maximize Energy Efficiency and Conservation and Reduce Peak Demand

Goal	Description	Commitments & Timeline	Baseline	Agencies
Streamline and increase marketing, education, awareness, and program administration	Creating a statewide marketing brand for all state and utility-administered energy efficiency programs will reduce market and trade ally confusion, clarify and increase awareness of program options, and maximize penetration.	NJBPU will launch a state-wide multi-media marketing campaign in early 2020. NJBPU will explore partnering with community-serving non-profits as a means of delivering energy efficiency services to low- and moderate-income communities.	N/A	NJBPU and the electric and gas public utilities
Establish transparent benchmarking and energy labeling	Energy benchmarking and labeling will enable New Jersey to gather necessary data on building energy use, establish performance standards, and increase transparency to the public.	NJBPU will require the owner or operator of each commercial building over 25,000 square feet in New Jersey to benchmark energy and water use for the prior calendar year using the U.S. EPA Portfolio Manager tool, beginning in 2023. The state will explore industry best practices to promote efficiency through building energy use benchmarking and labeling for smaller buildings in FY21.	NJBPU offers free energy benchmarking for commercial and industrial buildings through New Jersey's Clean Energy Program (NJCEP). Several other NJCEP C&I program offerings include a benchmarking component.	NJBPU, NJDCA
Improve energy efficiency in, and retrofit state buildings to, a high performance standard	The state will perform energy audits in all existing state-owned buildings and establish a plan to implement energy efficiency standards.	The state will continue to work through the Energy Capital Committee (ECC) to identify energy efficiency potential and projects for state facilities. The ECC is continuing to identify large energy consumer facilities and operational categories to target as funding becomes available.	Current projects are identified in the NJBPU/DPMC MOU and ECC project lists. This list will expand as funding and targeted facilities are identified.	Treasury, NJBPU

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STRATEGY 4

Primary Goals:

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

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

Reduce Energy Consumption and Emissions from the Building Sector

The building sector should be decarbonized and largely electrified by 2050 with an early focus on new construction and the conversion of electric baseboard heating and oil- and propane-fueled buildings.

Space heating, water heating, appliances, and industrial use account for 28% of New Jersey's greenhouse gas emissions, including 15.2 MMT of CO_2e in the residential sector, 9.4 MMT of CO_2e in the commercial sector, and 7.2 MMT of CO_2e in the industrial sector. Buildings are also responsible for a combined 62% of the state's total end-use energy consumption, including similar energy consumption in commercial buildings (26%) and residential buildings (25%), followed by the industrial sector (12%).[lvi]

Seventy-five percent of residences in New Jersey are heated with natural gas; another 10% use oil or propane.[lvii] Much of the infrastructure, technology, and assets used to power the building sector have decades-long lifespans. Therefore, continuing to expand the gas distribution system and rely on fossil fuel heating for new construction and replacement of aging heating systems will lock in decades of continued emissions and risk financing what will become stranded assets.[lviii] Delaying the transition might pose a missed opportunity to replace existing equipment with more efficient electric options. Further, the Integrated Energy Plan (IEP) modeling shows that a delay in building electrification will result in higher economic costs and limited flexibility to further reduce New Jersey's emissions or compensate for other sectors that decarbonize more slowly than planned.

Decarbonizing the building sector will be a substantial undertaking because New Jersey is already highly developed, and the transition to electrification will depend on technologies that are still maturing. To reduce reliance on natural gas for building heat, the state must weigh the competing demands and opportunities to phase out fossil fuel use, transition to a clean energy system, and reduce climate emissions and other air pollutants. The state will study and plan the transition for strategic electrification and determine how to foster heating and appliance fuel conversions in a

The state will study and plan the transition for strategic electrification and determine how to foster heating and appliance fuel conversions in a least-cost scenario while accounting for current asset viability and remaining useful life.

least-cost scenario while accounting for current asset viability and remaining useful life. The state will also consider the need and optimal use for bio or synthetic fuels or other decarbonization measures to replace fossil fuels when electrification is not a viable or cost-effective option. Finally, the state will need to establish a tolerance threshold for costs of implementation.

Modern air- and ground-sourced electric heat pumps have similar operating costs to natural gas furnaces and are approximately twice as efficient as electric baseboard heating. The U.S. Energy Information Administration (EIA) summarized Northeastern 2017-2018 home heating costs using different fuels, as shown in Table 3.[lix] The EIA found that electricity heating costs were nearly twice the cost of natural gas costs. However, the majority of homes in New Jersey with electric heating rely on baseboard heating, which use double (or more)[lx] the electricity of today's air- and ground-source heat pumps. In contrast, efficient heat pumps would have similar or lower operational costs than natural gas furnaces[lxi] (last row in Table 3), and would be much less expensive to operate than furnaces using home heating oil or propane. Because of the large cost advantage compared to heating oil and propane, the state should target existing homes using baseboard electric heating and delivered fuels for conversion to modern, efficient heat pumps, in addition to new construction, as the most cost-effective first step in decarbonizing existing buildings.

TABLE 3

Average Consumer Expenditures for Heating Fuels in the 2017-2018 Winter in the Northeast U.S.[28]

Natural Gas	$742
Heating Oil	$1,376
Electricity (mostly baseboard)	$1,406
Propane	$1,856
Electricity (modern heat pump, estimated assuming average performance)	$703

28 The data in the four upper rows of this chart reflect costs reported to the EIA. The data in the last row is a cost estimate based on data from the paper, The Economics of Electrifying Buildings: How Electric Space and Water Heating Supports Decarbonization of Residential Buildings, by Rocky Mountain Institute (see endnotes).

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The fossil fuel mix used for building heat contributes greatly to the state's greenhouse gas profile as summarized above. Heating oil emits 161.3 pounds of CO_2 per million BTUs of energy, propane emits 139 pounds of CO_2 and natural gas emits 117 pounds of CO_2,[lxii] while each technology also contributes varying amounts of criteria pollutants including nitrogen oxides, sulfur oxides, and particulate emissions, including black carbon. Each of these fuels also carries different pollution profiles in how they are extracted, processed, and distributed. Recognizing the need to significantly reduce the use of all fossil fuels to meet climate goals, the state should consider both cost and emissions in the early stages of the building heat system transition.

GOAL 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 dwelling and commercial construction**

New Jersey should begin its transition to building decarbonization by targeting state facilities and new residential and commercial construction. New construction is the most cost-effective option to target because it requires no retrofitting or rehabilitation and it eliminates the need to extend gas distribution pipelines. Additionally, new construction can use the most efficient and cost-effective building techniques and measures, reducing overall energy demand.

Further, the state should develop programs and incentives to pair building electrification with onsite power generation, storage, and smart load controls in order to reduce utility bills and carbon emissions. New construction built to net zero carbon[29] standards has the benefit of reducing overall energy demand by building to high efficiency standards and contributing clean energy to the distribution grid. Offsetting energy consumption

29 The World Green Building Council defines "net zero carbon" as when the amount of carbon dioxide emissions released on an annual basis is zero or negative. The Council's definition for a net zero carbon building is a highly energy efficient building that is fully powered from on-site and/or off-site renewable energy sources and offsets (**https://www.worldgbc.org/thecommitment**).

Building Decarbonization and the Integrated Energy Plan

Integrated Energy Plan Approach

In each scenario, the Integrated Energy Plan represented building energy demands, associated fuel and electricity use, and resulting emissions as part of its approach to model the least-cost investments to meet New Jersey's Global Warming Response Act emissions reductions targets. With the exception of Variation 3, the scenarios assumed that buildings began to be retrofitted and electrified aggressively starting in 2030, so that 90% of building water and space heating was powered by electricity in 2050. In Variation 3, "Retain gas use in buildings," the Integrated Energy Plan tested the cost impact to meet the Global Warming Response Act (GWRA) targets if buildings were not electrified.

The Integrated Energy Plan model accounts for the full costs of electrification, including the purchase of new, efficient appliances, additional electricity consumption, and any requirements to improve the capacity of the electricity distribution system to handle increased electricity load. To calculate electric distribution costs, the model assumed that distribution costs scaled in direct proportion to electric load (i.e., if electricity demand doubles, electric distribution system costs also double). This approach captures increasing costs as New Jersey's peak electricity demand grows and shifts it to winter months. However, even with substantial building electrification, the model took a conservative approach and did not assume any savings potential from a smaller or less utilized gas distribution system.

Relevant Integrated Energy Plan Findings

- **Electrification reduces annual costs by 50% in 2050, compared to retaining gas use in buildings, in order to meet emissions targets.** Electrification is cheaper, despite low natural gas costs, because emissions targets require substituting a significant fraction of natural gas with carbon-neutral fuels. In the Least Cost scenario, carbon-neutral fuels are not required until the late 2040s and are primarily used in the electricity sector. In Variation 3, carbon-neutral fuel use starts earlier, and five times as much carbon-neutral fuel is required in 2050.
- **Building heating and cooling appliance costs are lower when buildings are electrified.** Total appliance costs are lower in the Least Cost scenario compared to Variation 3 because modern heat pumps provide both heating and cooling needs, negating the need to purchase separate furnaces and air conditioners.
- **Building electrification contributes to increased New Jersey electricity demand, and shifts the electricity demand peak to winter months.** As buildings electrify, peak demand shifts from the summer (in which air conditioning drives peak demand) to the winter, in which newly electrified heat sources drive increased demand.
- **New Jersey will need to expand electric distribution system capacity to meet the higher electricity loads from building electrification.** The Integrated Energy Plan shows that grid costs in 2045 are more than twice as high in the Least Cost scenario than in Variation 3, though the Least Cost scenario is still cheaper overall due to the efficiency of heat pumps and reduced need for carbon-neutral fuels. If the distribution system capacity can be increased in combination with grid modernization or other ways of optimizing growth, building electrification will be even more cost effective than retaining gas use in buildings.
- **Building electrification reduces total energy use.** While building electrification increases electricity use, it reduces total energy needs because heat pumps are much more efficient than direct combustion of fossil fuels for heat. In 2050, Variation 3 requires 25% more total final energy than the Least Cost scenario.
- **Building electrification is the most cost-effective path to achieving further emissions reductions beyond those required by the GWRA.** If gas use in buildings is retained, further emissions reductions require either substituting natural gas with much more expensive carbon-neutral bio- or synthetic gases, or transitioning buildings to electrification by retrofitting gas appliances with heat pumps before their useful life is over. In comparison, in the Least Cost scenario, buildings are retrofitted during stock rollover events, in which gas appliances are replaced with heat pumps at the point of an appliance's natural retirement, thus limiting stranded assets.

through rooftop solar generation or through connection to a local distributed generation source, such as a microgrid, also supports local resiliency. Notably, as buildings decarbonize and become more efficient, and renewable energy proliferates on the grid, net zero carbon buildings will become widely achievable.

For the measures later discussed in more detail, the appropriate state agencies should start the immediate review and analyses of new technologies (including real-time baseline development), construction methods, financing models, and net zero carbon building code requirements (which will require modifications due to the mandatory Uniform Construction Code (UCC) for construction and restrictions by the UCC Act).

While the end goal is to build net zero carbon buildings, the state should encourage progress toward electrification and reduction of aggregate energy demand even if it does not fully achieve net zero status. In other words, the inability of a building to become 100% carbon neutral should not hinder efforts toward fuel-switching, energy efficiency measures, or integration of distributed energy resources (DER).

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The state will also analyze the energy efficiency of each facility and structure itself, such as roofing and windows, to determine if structural improvements are necessary to enable the most efficient system installations and to avoid energy losses due to structural deficiencies.

Goal 4.1.1: Electrify state facilities.

The state must continue its efforts to lead by example and will adopt the processes, mechanisms, and best practices to build and retrofit net zero carbon state facilities.

New state building construction projects should be designed to be fully electric (i.e., no fossil fuels), including energy supply, energy system management, and appliances. This includes identifying and sourcing equipment, HVAC appliances, and lighting at the start of design, planning for DER and storage integration, and incorporating a building management system.

Retrofit projects for building electrification are unique. For each building, the existing HVAC, lighting, and control systems will be analyzed to determine if it is more cost-effective for the state to invest in facility upgrades or equipment replacement. Additionally, the state must establish facility baseline energy needs. The state will also analyze the energy efficiency of the facility and structure itself, such as roofing and windows, to determine if structural improvements are necessary to enable the most efficient system installations and to avoid energy losses due to structural deficiencies.

New Jersey can begin taking steps toward implementation immediately. Developing a real-time cloud-based data collection system will create a best practice foundation for the state to allow for true energy management. Key components of this include, but are not limited to: demand management, energy procurement, right-sizing equipment, renewable energy planning, clean energy incentives, energy financial justification, and energy best practices across the state.

Further, each state agency should appoint a Department Energy Manager, as directed in Treasury's Circular 10-04-OES/OMB,[30] to monitor and manage energy use and costs across all of the agency's facilities, as well as to work with Treasury's Division of Property Management and Construction (DPMC) to develop and manage the agency's energy savings plan.

In addition, DPMC has implemented several strategic technologies to reduce energy consumption, which will assist in balancing the overall systems in state facilities. These include: upgrading the office and warehouse lighting from fluorescent to LED; installing vestibules, variable frequency drives, and lighting control programs; upgrading Building Automation Systems; replacing windows; and assessing and repairing building envelopes. Going forward, these steps should be mandatory for all existing and new state facilities or structural construction wherever possible. DPMC will also install electric vehicle charging if an agency requests it, and is exploring opportunities for demand ventilation, installation of high efficiency transformers, heat recovery (water and air), Combined Heat and Power (CHP), renewable energy potential, and water savings measures.

Finally, the state will establish a working group to identify and address barriers to implementation and to develop a rollout plan for new construction and retrofits, including determining how to address new state projects that are already in development. Notably, electrification of existing buildings may not be feasible in every case and situation. Therefore, the state will conduct a study to identify and prioritize the facilities for which electrification is the most beneficial and cost effective. This will be done in conjunction with state building energy audits, as discussed further in Goal 3.3.5. For buildings in which electrification of existing buildings is not feasible, the state will consider if incorporating CHP systems can measurably improve energy efficiency savings and carbon reductions, or if alternative fuels are a suitable option.

Goal 4.1.2: Partner with private industry to establish electrified building demonstration projects.

The state will seek to advance demonstration projects by incentivizing private developers to build residential, commercial, and mixed-use properties using only the latest electrification technologies. Such demonstration projects, which must be developed in concert with rate protections for the occupying owners or tenants, will enable the state to track energy demand, usage, and cost; monitor performance of the installed technologies; and assess such qualitative measures as personal comfort.

Demonstration projects will enable the state and private developers to navigate roadblocks, work through potential challenges, and ensure the viability of latest-technology cold-climate heat pumps in real world applications.

To that end, use of new Public Private Partnership (P3) legislation measures may provide the best platform to demonstrate the efficiency measures and feasibility of carbon reduction through electrification. The state should partner with housing and commercial developers in the concept phase of a project. This would allow for proper identification of electrical demands and early design of facility equipment, HVAC systems, building management systems, DER options, and other possibilities. Without any baseline metric targets, the state should identify what energy efficiency and demand response requirements are desired, supplemented by historical data as necessary. If necessary due to increased construction expens-

30 https://www.nj.gov/infobank/circular/cir1004b.pdf

es, the state, through New Jersey's Clean Energy Program (NJCEP), the Economic Development Authority (NJEDA), or a Green Bank, could offer financial incentives, either in grant form or lending options.

Goal 4.1.3: Expand and accelerate the current statewide net zero carbon homes incentive programs for both new construction and existing homes.

The Residential New Construction Program is a program currently administered through NJCEP and designed to increase the energy efficiency and environmental performance of residential new construction buildings (single and multi-family) in New Jersey. The Residential New Construction Program strategy is to establish standards for energy efficient new construction in New Jersey based on national programs, including the U.S. Environmental Protection Agency's (EPA) ENERGY STAR® Certified New Homes Program, U.S. Department of Energy's (DOE) Zero Energy Ready Home Program, and the EPA's ENERGY STAR Multifamily High Rise Program. The Residential New Construction Program offers technical support and incentives to builders of new single or multi-family residential structures or homes undergoing a complete rehabilitation (gutting) that comply with these standards. To participate in the Residential New Construction program, builders agree to work with independent third-party inspectors (raters) who inspect, measure, and test the home's performance during and after construction. The incentives are designed to partially offset the construction costs associated with building higher efficiency homes.

The Residential New Construction Program offers builders flexibility and options to participate in the program by building homes to varying standards or guidelines. In all cases, the Home Energy Rating System (HERS) Index is used to calculate the level of energy efficiency achieved in the home.

NJBPU is assessing the success of this program to date and will consider what additional mechanisms and incentives are available to increase utilization of the U.S. DOE Zero Energy Ready Home Program (i.e., zero carbon homes), including all-electric single and multi-family residences, and to broaden the availability of the program to include existing buildings seeking retrofits. Further assessment regarding program design and administration will also be considered as part of the state's ongoing energy efficiency transition. Notably, the state should also explore opportunities to encourage use of low-carbon construction materials, as well.

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The state should study various zero carbon construction methodologies, evaluate payback time periods, and implement into construction codes those that meet the seven-year payback requirement.

Goal 4.1.4: Study and develop mechanisms and regulations to support net zero carbon new construction.

State regulations enable the New Jersey Department of Community Affairs (NJDCA) to establish energy codes that are more aggressive than those set in the International Energy Conservation Code (IECC). However, to enable NJDCA to adopt codes above the national standards, an institution of higher education must be able to establish expected payback within a seven-year period for the desired energy conservation measures to justify the increased capital costs.[lxiii] The state should study various zero carbon construction methodologies, evaluate payback time periods, and implement into construction codes those that meet the seven-year payback requirement.

Several national studies from leading authorities such as Lawrence Berkeley National Laboratory and Rocky Mountain Institute have shown that building electrification in new construction can be cost effective, even compared to natural gas.[lxiv] For example, Rocky Mountain Institute recently analyzed the electrification of water heating and space conditioning in the residential sector across four U.S. cities: Oakland, CA; Houston, TX; Providence, RI; and Chicago, IL. The study found that for new construction building electrification with heat pumps offered consistent cost savings compared to residential customers of oil, propane, and natural gas. For retrofits, electrification was found to be cost effective for oil and propane customers as well as for certain natural gas customers.[lxv]

NJBPU, in partnership with NJDCA, has contracted with Rutgers University to develop 10-year energy price projections and seven-year cost recovery projections for a number of building electrification techniques and electricity generation techniques, including the installation of electrified heat pumps, electrified water heaters, rooftop solar panels, and solar thermal water heaters.

Based on the results of the analysis, expected in late 2020, NJDCA should consider adopting new regulations guiding developers to the clean energy technologies that have been shown to be cost effective, thus establishing a pathway for New Jersey to electrify the building sector and decrease reliance on fossil fuels for thermal and appliance use. This may also include a thorough review of previously successful methodologies, such as Passive House Standards,[31] for implementation in new construction, as well as possible incorporation into state building and energy codes. Further, the state should perform a study to identify in which facilities, structures, and usage categories net zero carbon is most effec-

31 **https://passivehouse-international.org/index.php?page_id=150**

New construction offers New Jersey the most cost-effective opportunities to incorporate modern technologies into buildings.

tive, and should prioritize efforts and incentives to enable electrification in those use cases.

To support the electrification of private new construction projects, the state will consider: (1) drafting new NJDCA codes, if appropriate; (2) developing new construction and metric guidelines; (3) establishing requirements for private facilities utilizing state funds to use predefined metrics and standards outlined by NJBPU and NJEDA; or (4) supporting local municipal requirements.

The identification and implementation of these measures needs to be established for private projects, and the state will form an interagency group to create these requirements, which should parallel the state project requirements for consistency, albeit with variations to account for differing types of facilities.

Complementing efforts to build net zero carbon buildings, the state must work with industry and stakeholders to increase job training, education, and awareness about building electrification and net zero carbon technologies. This will be discussed further in Goal 7.6: Establish a Clean Buildings Hub.

Goal 4.1.5: Develop electric vehicle-ready and demand response-ready building codes for new multi-unit dwelling and commercial construction.

New construction offers New Jersey the most cost-effective opportunities to incorporate modern technologies into buildings. As discussed earlier in Strategy 1: Reduce Energy Consumption and Emissions from the Transportation Sector, a common barrier to electric vehicle (EV) adoption is the lack of charging opportunities, particularly at the workplace and at multi-unit dwellings. The state should consider mechanisms, such as new legislation or incentives, to ensure that new commercial and multi-unit dwelling construction are built to EV-ready standards. Development of these mechanisms should be done in conjunction with stakeholders and local municipalities.

Similarly, as discussed in Strategy 3: Maximize Energy Efficiency and Conservation and Reduce Peak Demand, electrified buildings can be responsive to the technologies and efficiencies of a modern grid, including demand response. Certain large commercial and multi-unit dwellings may offer opportunities to engage with the utilities in robust demand response programs.[lxvi] NJBPU, NJDCA, and the utilities should establish criteria for effective demand response parameters, and should determine if incentives and rules are enough to help the state meet its energy efficiency potential, or if new legislation will be required.

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GOAL 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

Given how much of New Jersey is already developed, significantly electrifying the building sector will take a few decades. Modeling results from the Integrated Energy Plan suggest it would be most cost effective to begin constructing all-electric buildings by 2025 and to begin transitioning existing building stock during natural stock rollover events beginning in 2030. Such a significant shift in today's common practices will require strategic and deliberate planning and training, as well as acceptance by the building community and stringent testing, monitoring, and assessment to ensure affordability, reliability, and comfort.

The state will carefully, and with the guidance of today's best building practices, navigate a complicated path of balancing the need to aggressively decarbonize the existing building sector using rapidly improving but still immature technologies and processes, while also maintaining fiscal responsibility. Further, the state will develop a roadmap including goals and timelines to encourage accelerated development of this technology and to strategically target certain geographies and building use cases for early decarbonization. Finally, the state will consider which building use cases are more appropriate candidates for alternative fuels, rather than electrification.

Over the next 10 years, the state should prioritize buildings with the lowest cost, and the most pollution, for electrification by incentivizing electrification for existing oil- or propane-fueled buildings, as well as upgrading buildings that are heated with older and inefficient electric technologies such as baseboard heating. NJBPU should also provide incentives for natural gas-fueled properties to transition as well as terminate existing programs that incentivize the transition from oil heating systems to natural gas heating systems.

Goal 4.2.1: Incentivize transition to electrified heat pumps, hot water heaters, and other appliances.

New Jersey should prioritize buildings with oil and propane heating systems for electrification given the cost benefits and pollution reduction potential. Because efficient, electrified heat from air- and ground-source heat pumps is less expensive than propane and heating oil, the most

significant expenditures will be the one-time capital cost of installing the electric heating system, which costs an average of $4,000 to $7,000 for a typical residence. However, homeowners would only be exposed to the much smaller, incremental cost of a heat pump versus a replacement fossil-fuel unit if the switch were made at or near end-of-life of the legacy heating equipment (i.e., during a stock rollover event). The American Council for an Energy-Efficient Economy (ACEEE) found the paybacks to be in the two-year timeframe to replace oil or propane furnaces with air-source heat pumps (which can also act as air-conditioners), and six to nine years to replace oil and propane boilers with ductless air-source heat pumps. In addition, since the heat pump can also provide high-efficiency air conditioning, there is also an electricity savings.[lxvii] Notably, New Jersey has a high percentage of buildings that utilize boilers and that lack ductwork, which can increase installation costs. NJBPU and NJDCA should perform a state-specific study of the costs to retrofit existing buildings for electrification based on a number of variables, including existing heating systems. NJBPU should then further develop a program to ease the financial burden of making these one-time upgrades.

Combined, oil and propane fuel is utilized in 10% of New Jersey residences, which produce more pollution at the point of combustion than natural gas. Prioritizing the transition away from oil and propane for residential and commercial buildings is an aggressive but achievable goal with a low-cost impact and a noticeable reduction in carbon emissions. It will also set the stage for the more complicated transition away from natural gas in the coming years.

Further, New Jersey should also prioritize and incentivize the upgrading of older and inefficient electric heating technologies to today's air- and ground-source heat pump technologies. This benefit will reduce demand on the grid and reduce the building ratepayer's electric bills.

Additionally, NJBPU should offer financial incentives for natural gas-heated properties to upgrade to electric heating and cooling now, and should quickly ramp down approval of subsidies that incentivize building owners to retrofit from oil heating systems to natural gas heating systems. Notably, because electric heat pumps provide heating and cooling services, owners of natural gas heating systems can find cost savings and efficiency gains if high-efficiency heat pumps are installed to replace an aging boiler or furnace and air conditioning units.

Finally, benchmarking and transparency in building energy consumption, which can be accomplished with energy labeling, will be an important tool in opening additional financing mechanisms beyond state incentives to encourage and facilitate private investment in energy efficiency and electrification upgrades. Benchmarking are financial tools and further described in Strategies 3 and 7, respectively.

Early construction and rehabilitations will enable industry experts to become familiar with new technologies and building techniques and will buy time for the technology to improve and economies of scale to drive down costs.

Goal 4.2.2: Develop a transition plan to a fully electrified building sector.

NJBPU will create a roadmap through 2050 that transitions existing building stock away from fossil fuels. NJBPU will chart a strategic and economically beneficial path forward and will consider best practices, available and maturing technologies, affordability, and stranded assets. NJBPU will assess which geographic regions need additional electrical transmission or distribution upgrades, how to identify which building types, building uses, or regions are most appropriate for early adoption, and also interweave such related issues as training, education, and financing. The agency will consider available technologies for energy efficiency and electrification of facilities, the costs and benefits resulting from electrification of facilities (which should include a monetary carbon reduction representation), and the feasibility of building electrification targets. NJBPU will engage in a stakeholder process, including seeking guidance and information from the building, manufacturing, labor, utility, advocacy, and financial sectors, to inform this roadmap.

NJBPU will further establish goals and a timeline within this roadmap with the aim of targeting new construction and electric, oil- or propane-fueled buildings first to use these early targets as opportunities to adopt lessons learned and to mature the industry and technologies.

The use of heat pumps, solar arrays, energy storage, and "smart" building management systems will be key to achieving net zero carbon buildings, and as these technologies are adopted and proliferate, the technology will continue to improve. Early construction and rehabilitations will enable industry experts to become familiar with new technologies and building techniques and will buy time for the technology to improve and economies of scale to drive down costs. It is expected that heat pumps will become more economically feasible in colder regions as technology continues to improve and becomes more efficient.[lxviii] The state expects, based on the Integrated Energy Plan modeling, as well as the International Panel on Climate Change (IPCC) and other national and international findings, that beyond 2030, state policy will have to aggressively target existing natural gas-heated buildings to reduce emissions and achieve aggregate energy demand reductions.

The state must set aggressive energy efficiency targets for buildings to reduce energy demand and facilitate decarbonization. NJBPU and NJDCA

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should develop a uniform building metric that allows appropriate comparisons for efficiency measures on all types of buildings. A useful metric to achieve this would be electric consumption per square-foot (KBTU/sq.ft.). A uniform building metric, combined with benchmarking across different types (residential, commercial, industrial) and different sizes of buildings will enable the state to establish appropriate standard energy efficiency targets within each structure usage category. Energy efficiency is further discussed in Strategy 3: Maximize Energy Efficiency and Conservation and Reduce Peak Demand. The state should also consider an environmental benchmark, such as CO_2e/sq.ft., to assist in the prioritization of building retrofits.

New Jersey must also assess how to maximize existing codes to integrate building electrification efforts and also learn from and collaborate with states and cities that have developed or modified their own building codes to establish successful electrification programs. The state already requires the implementation of stringent building and energy codes. The UCC Act requires New Jersey to adopt the most current national model codes, such as the International Codes, and in September 2019 NJDCA adopted the 2018 codes, which are the most current. New Jersey Statutes Title 52. State Government, Departments and Officers 52:27D-120 through 122 states that the applicable codes must insure health, safe, and sanitary construction at lesser costs to New Jersey citizens; the state will consider and balance the costs and benefits of all proposed code modifications, including quantifying the difference between lifecycle costs and capital costs. Rules may need to be established via NJDCA guidelines or legislation governing all new construction and upgrades to facilitate the transition to a decarbonized building sector. Further, municipal concurrence and compliance must be integrated.

Finally, NJBPU and NJDCA will work with critical facilities, such as hospitals and emergency services, to ensure that these buildings are held to the same increasingly stringent efficiency standards as other commercial and industrial buildings while still maintaining a redundant power supply.

Implementation of these recommendations can be accelerated through the wider deployment of existing financing mechanisms such as utility on-bill financing, and adoption and rapid deployment of newer financing mechanisms such as Commercial Property Assessed Clean Energy (PACE) lending, and Residential PACE. These and other financing mechanisms are discussed in detail in Strategy 7: Expand the Clean Energy Innovation Economy.

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STRATEGY 4

Reduce Energy Consumption and Emissions from the Building Sector

Goal	Description	Commitments & Timeline	Baseline	Agencies
Electrify state facilities	The state will continue its efforts to lead by example and will adopt the processes, mechanisms, and best practices to build and retrofit net zero carbon state facilities.	The state will establish an inter-agency working group to identify and address barriers to implementation and to develop a rollout plan for new construction and retrofits in early 2020. Each state agency will appoint a Department Energy Manager, as directed in Treasury's Circular 10-04-OES/OMB, to monitor and manage energy use and costs across all of the agency's facilities in June 2020.	Not yet established.	Treasury, NJBPU, and NJDCA, with partner agencies where applicable
Partner with private industry to establish electrified building demonstration projects	The state will work with private developers to build residential, commercial, and mixed-use properties using only the latest electrification technologies.	Relevant state agencies will explore mechanisms to attract and incentivize developers to build all-electric buildings. The state will aim to begin development of these demonstration projects in 2021.	N/A	NJEDA, NJBPU with partner agencies where applicable

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STRATEGY 4

Reduce Energy Consumption and Emissions from the Building Sector

Goal	Description	Commitments & Timeline	Baseline	Agencies
Study and develop mechanisms and regulations to support net zero carbon new construction	The state will study various zero carbon construction methodologies, evaluate payback time periods, and implement into construction codes construction and efficiency measures that meet New Jersey's seven-year payback requirement.	NJBPU, in partnership with NJDCA, has contracted with Rutgers University to develop 10-year energy price projections and seven-year cost recovery projections for a number of building electrification techniques and electricity generation techniques, including the installation of electrified heat pumps, electrified water heaters, rooftop solar panels, and solar thermal water heaters. The study is due in late 2020. NJBPU and NJDCA will collaborate beginning in 2020 to recommend new or modified codes to support net zero carbon building standards (informed by the above study), and to perform a study to identify in which facilities, structures, and usage categories net zero carbon is most effective.	N/A	NJBPU, NJDCA, Treasury
Develop a transition plan to a fully electrified building sector	NJBPU will create a roadmap through 2050 that transitions existing building stock away from fossil fuels.	NJBPU will establish a stakeholder process beginning by mid-2020 to collect data and inform decision-making necessary to create a roadmap.	N/A	

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STRATEGY 5

Primary Goals:

5.1
Upgrade the distribution system to handle increased electrification and DER

5.2
Exercise regulatory jurisdiction and increase oversight over transmission upgrades

5.3
Modify current rate design and ratemaking processes

5.4
Maintain gas pipeline system reliability and safety and plan for future reductions in consumption

Decarbonize and Modernize New Jersey's Energy System

Plan for, finance, and implement the necessary distribution system upgrades to handle increased electrification and integration of distributed energy resources; support bi-directional grid power flow; empower customers to manage power consumption and self-generation; actively engage in transmission planning and siting; and assess how to safely, reliably, and affordably reduce reliance on natural gas.

Future-proofing New Jersey's electric and gas utilities requires rethinking the way the state plans and pays for utility infrastructure. New Jersey can make its electric distribution system more resilient by enabling customers to produce their own power and to actively manage their power consumption. Enabling a transactive customer-centric grid will require the development of distribution-level markets that reward resilient homes and businesses. At the same time, increased electrification of homes and businesses will increase the benefit of demand flexibility on the distribution system and other reforms.

These trends also mean that New Jersey expects to burn less natural gas in the future as it moves toward consumer electrification. The gas public utilities need to adapt to this low-carbon future by identifying tools for decarbonizing and reducing gas usage while maintaining a safe and reliable system that meets the immediate needs of New Jersey's gas consumers.

The electric and gas utilities of the future must continue to deliver reliable, resilient, and affordable service, while also realizing New Jersey's goals of 100% clean energy and an 80% reduction in greenhouse gas emissions relative to 2006 levels by 2050 (80x50). Grid modernization will provide the backbone on which all other efforts to transition to a clean energy economy will rely. The benefits of electrification, including incorporation of renewable energy, energy storage, demand flexibility, energy efficiency, load shifting, resiliency, microgrids, decentralization, and decarbonization, all necessitate a 21st century distribution grid.

Economy-wide decarbonization will require a significant amount of fuel switching from fossil fuels to electrification, as has been suggested in the previous strategies. Modeling performed in the Integrated Energy Plan suggests that to meet climate goals, New Jersey will reduce overall consumption of natural gas by approximately 75% from 2020 to 2050; this reduction will be caused by decreased demand in the power sector and thermal building use. Just as New Jersey must direct its electric public utilities to assess capacity in the electric distribution system, so too must the gas public utilities assess the gas distribution system capacity and plan for a gradual reduction in system use.

Implementing grid modernization will take place on many levels, including development of transparent price signals at the distribution level; a method for valuing non-wires and non-pipeline solutions; strategic and transparent integrated distribution plans; hardware and software upgrades necessary to implement smart meters and an Advanced Distribution Management System; and engineering upgrades to handle additional electricity loads, variable energy generation, distributed energy resources (DERs), and bi-directional power flow and communication. Critically, New Jersey must properly and comprehensively regulate this transition to ensure strategic and prudent investments are made over time to maximize value and minimize costs to ratepayers.

GOAL 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 electric utilities to propose and adopt non-wires solutions**

Utilities of the future must adapt their distribution systems to accommodate significant increases in renewable energy generation and energy storage, as well as accommodating a presumed doubling of electricity demand by 2050 due to mass electrification of the transportation and building sectors. New Jersey's four electric public utilities vary in their level of preparation to adjust to changes in the way consumers use and produce power. Certain utility territories have excess capacity to absorb increased

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New Jersey's Modern Energy System and the Integrated Energy Plan

Integrated Energy Plan Approach

The Integrated Energy Plan models the infrastructure requirements and associated costs to deliver electricity and natural gas to New Jersey consumers. The Integrated Energy Plan modeling includes representation of the peak electricity demand impacts of newly electrified end uses (i.e., electric vehicles (EVs), building space and water heating), including modeling of the demand flexibility potential of each end use, and estimates cost increases associated with increasing peak demand. The Integrated Energy Plan recognizes that future electricity transmission and distribution (T&D) costs are uncertain, especially given a lack of recent historical precedent for T&D system costs under a scenario of sustained load growth, and thus models T&D costs as increasing linearly with electricity demand. This is likely a conservative (i.e., too high) assumption, as historic periods with sustained load growth show that per-kWh T&D costs fall as load increases.[lxix] The Integrated Energy Plan does not assume any cost savings associated with lower use of New Jersey's natural gas delivery infrastructure, given the gas system's role in continuing to provide some energy to New Jersey customers in 2050.

Relevant Integrated Energy Plan Findings

- **Total electricity demand and delivery costs in New Jersey increase 97% by 2050.** Electrification of vehicles and building loads increases electricity demand, even as final energy demand in the state falls. Per the assumptions of the Integrated Energy Plan that per-kWh costs of the T&D system remain flat, this also increases the total spending on the T&D system by the same value.
- **Peak electricity demand grows by 120% through 2050.** Even with modeled demand flexibility associated with electrified end uses (e.g., managed EV charging), average daily peak load in the Least Cost scenario grows by 120% between 2020 and 2050, and shifts to winter months due to electrified building heating loads.
- **Electricity generation from distributed resources grows by 200%.** The Integrated Energy Plan models the generation associated with rooftop solar photovoltaic (PV) systems required by current policy targets (e.g., 400 MW per year of deployment through 2030, renewable portfolio standard in 2030) and when included as part of a least-cost expansion through 2050, finds that behind-the-meter capacity grows from 2 GW in 2020 to 6 GW in 2050.
- **The quantity of gas delivered to power plants and end-use customers falls by 75% from 2020 to 2050.** In the Least Cost scenario, electrification of space and water heating and adoption of renewable energy resources within the electricity supply lowers the consumption of natural gas by 85%. In 2050, biogas or other low-carbon alternatives are used in power plants to meet New Jersey's 100% clean energy targets, meaning total delivery of gas fuels through the gas transmission and distribution network falls by 75% compared to 2020 levels.

The state has an interest in encouraging locally produced renewable energy and DERs, but existing structural impediments and policies limit potential growth in this market.

demand, while others are already imposing significant limitations on new customer-sited generation facilities. The state should direct the electric public utilities to develop plans that integrate grid modernization and capacity improvements that support demand growth from electrification, demand flexibility, DER penetration, grid resilience, and grid efficiency.

Goal 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.

The state has an interest in encouraging locally produced renewable energy and DERs, but existing structural impediments and policies limit potential growth in this market. Furthermore, the state expects to see significant growth in electricity demand in the coming years as the transportation and building sectors electrify, increasing as much as 2.3 times by 2050 according to the Integrated Energy Plan model.

To optimally and most cost effectively plan for and accommodate increased demand through electrification and further penetration of DERs — including but not limited to renewable energy generation, storage, microgrids, and electric vehicles (EVs) — NJBPU will direct the electric public utilities to develop Integrated Distribution Plans (IDPs), which should additionally include plans for a pilot non-wires solutions program, as further discussed in Goal 5.1.4. Both NJBPU and the electric public utilities may be informed, but not limited, by the "Integrated Distribution Planning for Electric Utilities: Guidance for Public Utility Commissions"[32] manual published by the Mid-Atlantic Distributed Resources Initiative. Following proceedings in 2020, in which NJBPU with stakeholders will establish and the Board will adopt appropriate guidelines for the development of the IDPs, the electric public utilities should develop their respective plans for submittal to NJBPU within one year of the Board Order. NJBPU will review and approve the utilities' IDPs. Approved IDPs shall be made publicly available in the interest of containing costs and fostering private investment, local adoption, and industry growth.

Further, through development of the IDPs, mechanisms and policies should be determined to enable equal and efficient access to interconnect DERs, as discussed in Goal 2.1.5. In addition, IDPs will enable DERs to be fully valued for their avoided distribution costs, congestion mitigation, risk diversification, resiliency, and reliability, as discussed in Goal 2.1.6. Through this planning process, the electric public utilities will assess and recommend physical, market, and operational changes to the electric grid to ensure safe, reliable, and affordable services and to create streamlined and equally accessible integration of DERs. Further, electric public utilities must ensure the distribution grid is upgraded to handle the dynamic, decentralized, and bi-directional nature of evolving grid technology. Although some concerns have been expressed regarding reliability associated with increasing DERs, the purpose of the IDPs is also to ensure that the electric public utilities plan to maintain reliable service notwithstanding the deployment of DERs.

Another crucial aspect of IDP development is modeling demand growth and prioritizing grid upgrades where they are most needed to accommodate anticipated electrification. In particular, significant and localized upgrades will be needed to accommodate fleet and port electrification (see also Strategy 1). Utilities should demonstrate whether costs can be minimized by combining grid modernization plans with capacity upgrades. IDPs will also enable the electric public utilities to send price signals to customers and private investors that encourage development of DERs where they can provide the most value, potentially deferring additional grid upgrades and increased electrical capacity.

Ultimately, IDPs are a helpful and necessary step in strategically modernizing the electric grid to prioritize investments and manage ratepayer impact. Without IDPs, there is minimal visibility for state regulators, the utilities, private investors, and ratepayers and, therefore, limited opportunity for strategic input and private sector investment to optimally plan for system upgrades while reducing redundancy and sub-optimal investments.

Goal 5.1.2: Support bi-directional grid power flow and modernize interconnection standards.

Traditional distribution infrastructure was designed to send electricity in one direction from a central electric generating unit to end-use customers. New Jersey's interconnection studies and standards were also designed in a time when bi-directional power flow was the exception, not the rule. With the emergence and anticipated proliferation of decentralized renewable energy generation, battery storage, demand response, and microgrids, existing rules and infrastructure must be adapted and replaced as necessary to support bi-directional grid power flow; interconnection standards will be reviewed and revised as part of the IDP process.

The utilities must proactively plan to ensure that their grid can handle two-way power flows and take other steps necessary to implement the transactive, high renewable-penetration grid of the future. Such upgrades

32 https://www.madrionline.org/wp-content/uploads/2019/10/MADRI_IDP_Final.pdf

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could include adopting new software and operational guidelines to manage power flow on the distribution grid; modernizing local interconnection rules to allow solar and battery storage facilities, or other DER, to interconnect more easily (consistent with reliability standards); or incorporating strategically located smart inverters into grid planning.

For example, in some parts of the country, interconnection rules allow for two-way power flows at substations without triggering the need for expensive and time consuming upgrades. Allowing for bi-directional flow increases the amount of DERs that can be interconnected at that location when the infrastructure is in place to handle the changing demand and generation profiles. This is particularly important for opening up utility systems to increased solar penetration. While each electric public utility distribution system is unique, utilities are fully expected to meet these future needs by adopting a potentially standardized and coordinated approach to maximizing distribution level flexibility and replacing grid infrastructure that is not designed for the modern grid. These grid modernization costs should be included in future rate filings. As always, NJBPU's objective would be to ensure that all interests are balanced with the overall goal of increasing grid safety and reliability, while maximizing the cost savings and resilience that DERs provide.

Similarly, the interconnection standards that New Jersey utilities use to evaluate new generation requests must also evolve to accommodate the state's clean energy ambitions. Without significant changes in the interconnection technical standards and interconnection queue reform, increasingly large portions of the state will be closed to new renewable and DER interconnections. NJBPU will play an important role in adopting and implementing the new IEEE 1547-2018 standards[33] and should modernize its interconnection rules to accommodate increased renewable penetration in a cost-effective and timely manner. IEEE 1547-2018 enabled inverters will have the additional benefit of allowing behind-the-meter solar photovoltaic (PV) to power critical home loads during a grid outage, improving resilience for customers. See Goal 2.1.5 for additional information on interconnection standards.

Goal 5.1.3: Assess integration of Volt/Var Control.

Voltage optimization, or Volt/Var Control, is a set of technologies that manage and "right-size" the voltage received by end-users to minimize wasted electricity. Like Advanced Metering Infrastructure (AMI), voltage optimization may prove to be a cost-effective, foundational platform for maximizing distribution grid efficiency.

33 IEEE 1547-2018 standards are the industry technical specifications for and testing of the interconnection and interoperability between utility electric power systems and distributed energy resources. **https://standards.ieee.org/standard/1547-2018.html**

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NJBPU will enable electric public utilities to propose a pilot program to identify approaches, best practices, and opportunities for making non-wires solutions standard practice in their infrastructure planning, investment, and operations.

Consistent with the Clean Energy Act, NJBPU instructed electric public utilities to ascertain the optimal voltage for their distribution systems, identify where operational and regulatory flexibility is needed, and in conjunction, assess the opportunities for and effectiveness of Volt/Var Controls. Results are expected in early 2020. Following the results of this study, NJBPU will assess the value of rolling out Volt/Var Controls in some or all of the electric public utilities' service territories if such measures aid in maximizing the efficiency of the modern grid, including reducing aggregate electricity consumption. Further, existing commercial three-phase inverters, which deploy variable power factor capabilities, may be sufficient to manage voltage control and should be reviewed. The use of Volt/Var compatible equipment should facilitate the broader inclusion of Volt/Var Controls into AMI.

Goal 5.1.4: Instruct electric utilities to propose and adopt non-wires solutions.

Consistent with the state's goal of transitioning to a clean energy economy established in this Energy Master Plan (EMP), as well as the mandates of the Clean Energy Act of 2018 and Executive Order No. 28, electric public utilities must begin routinely and methodically integrating non-wires solutions (NWS) into planning and operations as an alternative or complement to traditional infrastructure, capacity upgrades, or expansions, as referenced in Goal 5.1.1.

By adopting alternative resources — including but not limited to energy efficiency; demand response; peak shaving; load shifting; microgrids; storage; renewable energy generation; co-location of resources, storage, and loads; and grid modernization — utilities may be able to defer, reduce, or eliminate otherwise necessary investments or upgrades to the electricity system. In accordance with the IDP guidelines, NJBPU will direct utilities to propose NWS as an alternative to traditional infrastructure investments by mid-2020. NJBPU and the utilities should also consider if the cost of implementing NWS may be reduced over time as they are more routinely implemented.

If during the planning process NWS are found to be a cost-effective alternative, it will be necessary to document the baseline, the cost of alternatives, and the effectiveness of the investment. Under the IDP guidelines, NJBPU will enable electric public utilities to propose a pilot program to identify approaches, best practices, and opportunities for making NWS standard practice in their infrastructure planning, investment, and operations.

To further facilitate NWS, as part of the IDP proceeding, NJBPU will evaluate existing laws and regulations that currently prohibit multiple types of DER interconnection behind the meter (see Strategy 2). Further, NJBPU,

with stakeholder input, will develop distribution-level financial incentives that recognize the value of avoided electric infrastructure. Relatedly, NJBPU will develop a methodology that is fair, efficient, and effective for sharing savings with developers who defer or eliminate the need for additional infrastructure. NJBPU anticipates that the full process of proposing, implementing, and evaluating NWS pilot programs and integrating them into future filings will be completed by December 2021.

GOAL 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

During the last 10 years, New Jersey has seen tremendous growth in transmission investment, which has significantly increased costs to customers. Transmission upgrades have been built in New Jersey that provide benefits to customers out of state, though the Federal Energy Regulatory Commission (FERC) has repeatedly reallocated significantly larger shares of the project costs to New Jersey ratepayers rather than the out-of-state ratepayers.

Rising transmission costs have been an ongoing concern in New Jersey for three primary reasons: 1) lack of sufficient oversight, 2) unjustly high Return on Equity (ROE), and 3) unfair reallocation of transmission costs, all of which are borne by the ratepayers. Particularly given future needs to increase transmission as the state modernizes the electric grid, in-state electricity generation increases, and as transportation and building electrification add more stress to the electric grid, the state must fully exercise its authority and advocate at the federal and regional level to drive down transmission costs. Successfully advocating for these changes and exercising regulatory jurisdiction could potentially save New Jersey ratepayers hundreds of millions of dollars.

This is not to diminish the critical importance of transmission infrastructure, or the significant role the electric utilities play in its construction, for reasons including, but not limited to, reliability and lower bills for ratepayers. However, NJBPU endeavors to ensure that rates are just and reasonable. Where both FERC and NJBPU have authority to ensure just and reasonable rates, doing so will advance the goal of affordability.

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Goal 5.2.1: Exercise regulatory jurisdiction to review and approve the need for transmission projects.

Each of the four electric public utilities in New Jersey own transmission infrastructure. NJBPU has regulatory jurisdiction over these electric public utilities. Therefore, it is essential that NJBPU fully exercise this regulatory jurisdiction in order to meaningfully engage the regulated utilities and regional transmission organization in this grid modernization process.

PJM, the regional transmission organization regulated by FERC and of which New Jersey is a member, has the responsibility of transmission infrastructure planning to manage the future growth of the electric transmission system and to ensure the continued reliability and economic efficiency of the transmission grid. During its planning cycle, PJM studies and establishes transmission infrastructure projects that must be built to maintain reliability standards. The electric public utilities are legally obligated to construct them for a federally authorized rate of return.

However, PJM also accepts into its planning cycle projects proposed by the electric public utilities themselves as necessary for reliability (known technically as Form 715 Criteria projects), as well as non-criteria based upgrades known as Supplemental Projects. Neither Form 715 nor Supplemental Projects are subject to PJM's approval; nor are they usually subject to competition. Recent decisions from FERC may require greater competition and NJBPU must meaningfully engage in those dockets.

New Jersey stands out in the PJM region because NJBPU has not formerly reviewed the necessity of transmission projects before they are constructed. In other states, this authority permits regulatory bodies to review the costs and benefits of new transmission projects, including the potential that such projects could be offset by NWS instead or through other, less expensive, means. Further, NJBPU's limited exercise of jurisdiction reduces its ability to reject transmission upgrades funded by New Jersey ratepayers that predominantly benefit out-of-state consumers. Although NJBPU has tools to evaluate transmission projects, they do not fully address this issue. Where NJBPU only addresses further transmission asset development through the PJM stakeholder process, NJBPU is then only left to litigate at FERC. NJBPU routinely engages, and will continue to engage, at the federal and regional level on these matters, but must do more.

When possible, NJBPU should direct the electric public utilities to study whether the existing transmission system can be used more efficiently through the use of new technologies. Dynamic line ratings, variable capacitance and inductance, and battery storage can each cost-effectively

As New Jersey pursues its clean energy objectives and advances grid modernization, NJBPU must have the ability to exercise its regulatory jurisdiction to the fullest extent to ensure that projects are necessary and the rates paid by ratepayers are just and reasonable.

increase the effective capacity of existing transmission lines. When these advanced transmission technologies are cost effective, NJBPU should require utilities to deploy them in place of or in addition to new transmission.

Fully exercising NJBPU's existing regulatory jurisdiction or, alternatively, expanding regulatory jurisdiction with new legislation if necessary, will enable NJBPU to manage the rising transmission costs, evaluate the necessity of projects, and actively engage in transmission planning. As New Jersey pursues its clean energy objectives and advances grid modernization, NJBPU must have the ability to exercise its regulatory jurisdiction to the fullest extent to ensure that projects are necessary and the rates paid by ratepayers are just and reasonable.

Goal 5.2.2: Advocate for Return on Equity reform.

As discussed above, transmission projects are subject to a return on equity authorized by FERC. Unlike traditional rate base/rate of return ratemaking practiced by NJBPU and other state public utility commissions to establish new rates for electric service, FERC utilizes the formula ratemaking approach to set transmission rates with a predetermined ROE in the calculation of revenue requirements for authorized transmission investments. FERC does not engage in further prudency review once the formula is set. Unlike standard rates, charges passed on to ratepayers through formula rates are not subject to the typical rate case type litigation. NJBPU has the authority to participate in regulatory proceedings at FERC to determine rates of return on transmission projects, and may also utilize Section 206 of the Federal Power Act[34] if it believes rates are unjust and unreasonable.

One major issue facing New Jersey is the appropriate ROE that FERC provides electric transmission companies. Another is the use of "incentive adders" that FERC allows many transmission owners to collect above their base ROE. NJBPU has strongly advocated for FERC to revise its policies on determining the ROE used in setting rates charged by public utilities. FERC acknowledged that its existing rules are now 13 years old and that during this time, "the landscape for planning, developing, operating and maintaining transmission infrastructure has changed considerably."[35] Yet reform has been slow to arrive. The state strongly supports an expedited review of these out-of-date rules, and sees this issue as a critical component of addressing high electric transmission costs that hamper the competitiveness of New Jersey businesses and raise costs for state residents. NJBPU will pursue all avenues available at FERC to ensure just and reasonable ROE and protect ratepayers, including protests in tariff proceedings and formal complaints to FERC.

34 Section 206 of the Federal Power Act allows any person to file a complaint at FERC against any currently-effective utility rate. The complainant must show that the current rate is unjust and unreasonable and that their preferred rate is just and reasonable (or the Commission, once determining the rate is unjust and unreasonable, shall set the just and reasonable rate). 16 U.S.C. § 824e.

35 166 FERC ¶ 61,208 at 10

Goal 5.2.3: Advocate for federal policy changes to address inter-regional cost allocation issues.

Cost allocation of transmission lines has been an on-going concern for NJBPU since 2005, when states to the west of New Jersey challenged their obligation to pay for large transmission lines running west to east (to serve load in New Jersey and Maryland). In a 2010 Order, approving the Susquehanna-Roseland Transmission line, NJBPU acknowledged "that cost uncertainty is unavoidable and will remain unavoidable for the foreseeable future." The contentious cost allocation litigation endured for over a decade until parties eventually negotiated a cost re-allocation under the Christie Administration that took effect after Governor Murphy took office.

Cost allocation concerns for New Jersey ratepayers continued to grow after FERC's issuance of Order 1000, which was intended (among other things) to reform FERC's cost allocation approach. In the PJM region, that change in the regional approach to determining cost allocation resulted in the cost of transmission projects in Northern New Jersey being allocated to companies serving New York City. While those parties unsuccessfully litigated at FERC, they ultimately succeeded in avoiding costs through a series of contract modifications. New Jersey ratepayers have been left paying these costs and litigating the inequity issues at FERC.

To the south, the Delaware and Maryland Public Service Commissions challenged their allocation of 90% of the costs associated with a grid upgrade that would enable more electricity to flow from the Salem and Hope Creek Nuclear Plants to the Delmarva Peninsula. Notwithstanding the benefits to Delaware and Maryland, the states successfully claimed that the nuclear units drove the grid upgrades. As a result, a substantial portion of the cost of the transmission system upgrades were reallocated to New Jersey ratepayers.

These cost reallocations for ongoing, or existing, transmission projects have resulted in higher rates for New Jersey ratepayers despite benefits to other states. As a result, New Jersey ratepayers pay larger portions of projects already in progress. Federal legislation, or other federal action, that re-examines FERC's ability to reallocate costs to ratepayers after projects are built could prevent further adverse consequences for New Jersey.

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As New Jersey pursues offshore wind generation and develops transmission to bring the offshore wind generation online, equity in cost allocation becomes all the more significant. An equitable standard that applies both within the PJM region and among regions (including New York and New England) must be in place to ensure that New Jersey ratepayers do not find themselves surrounded, on all sides, by contentious cost allocation litigation.

GOAL 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**

Grid modernization will further enable customers and utilities to take advantage of technology to manage energy consumption, enhance opportunities for demand response and load shifting, and respond to price signals. Further, implementation of state goals may put utility incentives at odds with state policies and objectives. As New Jersey advances the many goals put forth in this EMP, new technologies, such as AMI and existing rate design and rate structure, will need to be evaluated.

Goal 5.3.1: Evaluate a strategic and coordinated rollout of Advanced Metering Infrastructure.

AMI is a foundational component of a modernized electric distribution grid and uses an integrated system of smart meters, communications networks, and data management systems to enable two-way communication between utilities and customers. Statewide AMI installation is a prerequisite of many additional clean energy objectives as laid out in this EMP. Potential benefits include realization of potential gains in efficiencies and cost savings, accelerated service restoration during outages, better environmental outcomes, lower operations and maintenance costs, better demand-side customer engagement, and alternative rate designs.

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AMI has many benefits, but many can only be realized if the utility both invests in the needed data handling infrastructure and creates customer programs that leverage the new AMI capabilities.

Rockland Electric Company (RECO) recently completed its rollout of AMI across its service territory and has reported positive costs and benefits. These benefits have been preliminarily confirmed by an independent analysis by Navigant Consulting, and a final NJBPU decision will be made prior to mid-2020. If positive benefits of AMI are confirmed in the forthcoming proceeding evaluating RECO's implementation, NJBPU will work with its jurisdictional utilities to accelerate the deployment of both smart meters and the related grid infrastructure in a strategic, coordinated, and efficient manner so the state can begin realizing the benefits of a connected grid while also containing costs and reducing stranded assets. The electric public utilities should submit proposals for AMI to NJBPU for approval after the Board has issued recommendations.

Importantly, the roll-out of AMI must be done on a utility-specific basis, given that each utility is starting from a different investment baseline in the AMI backbone necessary to realize the full benefits of smart meters. And while a moratorium on pre-approval of AMI costs remains in effect, there is no prohibition on utilities making the necessary investment, subject to an after-the-fact prudency review. For example, there is a concern that continuing to replace aging standard meters with new standard meters as per the utilities' regular replacement cycles will prevent ratepayers, and the grid as a whole, from realizing the benefits of AMI for years, or risk stranding the investments in newly installed standard meters that are no longer useful. Those concerns are reaffirmed here, but NJBPU stresses that utility prudence reviews are fact-specific and will consider utility-specific concerns, such as the ability of the utility to utilize smart meters and the differential in costs between smart meters and standard meters. Further, utilities are encouraged to accelerate their planning for investment in the AMI backbone, again, consistent with NJBPU's prudency policies, as they may be informed by its review of the RECO AMI pilot.

AMI has many benefits, but many can only be realized if the utility both invests in the needed data handling infrastructure and creates customer programs that leverage the new AMI capabilities. The utility must be able to store, process, and turn the large amount of AMI data into actionable information. Examples include: 1) using AMI to monitor customer voltage levels so that utilities can optimize Volt/Var equipment to meet standards and optimize efficiency, 2) monitoring the conditions on individual circuits to better understand the potential for added DERs on each circuit, 3) deploying time-of-use rates, and 4) coordinating with DER equipment to optimize its impact on the local grid. Utilities should plan to deploy expansive AMI infrastructure and programs simultaneously, so that New Jersey and its customers immediately benefit from the new capabilities.

Meeting the goals of this EMP requires that customers engage with their energy usage on a more active basis.

Finally, there is concern about changing workforce needs and the impact of technology. If AMI proves to be a prudent and necessary investment in realizing New Jersey's clean energy future, the relevant state agencies must engage and collaborate with labor unions and utilities to ease any workforce transition and assess new or complementary opportunities for workers.

Goal 5.3.2: Develop standards to ensure customers have control of and accessibility to free and standardized energy management data.

Meeting the goals of this EMP requires that customers engage with their energy usage on a more active basis. Enabling customers to control and manage their energy usage requires that these customers are provided prompt and easy access to their energy data. For this reason, it is imperative for utilities to recognize that customers must own their own data and make it available to them, or their duly-authorized representatives, such as third-party consultants, upon request.

To enable these outcomes, NJBPU must issue guidance on such concerns as data standardization, privacy, and rules governing authorization of third-party access to customer-specific data before AMI is fully implemented. The state fully anticipates that these rules could be implemented on a uniform, statewide basis, and across utilities. Importantly, customers must have free and easy access to their usage data, as well as free and easy access to share their data with third parties and the ability to promptly terminate such access.

One initial effort to free customer data has already been implemented as part of the Community Solar Energy Pilot Program. NJBPU's rules include provisions for the statewide implementation of the industry standard "Green Button Connect My Data" initiative. Specifically, the rules require the electric public utilities to "make appropriate data available through Green Button Connect My Data (Green Button), subject to appropriate privacy protections. If Green Button capabilities are not available or are insufficient, the electric public utilities will work with NJBPU staff to determine data sharing mechanisms and requirements between the electric public utilities and developers." NJBPU is currently working with the electric public utilities to determine how best to implement Green Button, or another similar solution, that will accomplish the dual objectives of increasing customers' access to their utility data, while also maintaining rigorous privacy and security standards. However, the state sees this cooperative data-sharing arrangement as illustrative of the type of process that needs to be expanded across industry data.

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Finally, the state recognizes that increased cyber attacks, and the potential that an increasingly complex grid will further expose ratepayers to such attacks, has raised significant concerns. Utilities and third-party providers must take precautions to ensure the privacy and security of data.

Goal 5.3.3: Pilot and implement modified rate design to encourage customer-controlled demand flexibility, manage electric vehicle charging, and support demand response programs.

Successfully integrating advanced technologies, bi-directional power flow and communication, increased decarbonization and electrification, and mandated energy efficiency savings will necessitate substantial evolution in New Jersey's rate design. Such considerations should include recommendations addressing appropriate compensation for DERs and maximum value for ratepayers, as mentioned earlier in Strategy 2, as well as a means of financially recognizing a project's contribution to improving grid resilience, reliability, and operations.

Revised rate design recommendations should also include mechanisms to enable time-of-use rate design or other tariffs to encourage managed demand and load shifting. Importantly, the state should leverage technology such as smart devices and smart charging systems, like EV charging, that optimize their own electricity use based on a combination of user need and price signals. Recommendations should also establish price signals for EV charging to incentivize charging during non-peak hours or when there is an abundance of renewable energy. NJBPU will open a proceeding in 2021 to establish revised rate design recommendations as they are informed by the several initiatives NJBPU is undertaking in 2020, including but not limited to AMI, NWS, and energy efficiency measures.

As discussed further in Strategy 3, and pursuant to the Clean Energy Act, utilities are mandated to take measures to reduce peak demand. Utilities should additionally pilot demand response incentive programs as a part of a suite of rate design mechanisms to address peak load reductions.

Goal 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.

NJBPU must work with the utilities to consider the changing nature of existing business models, seek alignment on state goals to reduce energy demand, and partner with customers and third-party vendors in supporting

New Jersey is embarking on a significant transition in its energy system, including aggressively pursuing energy efficiency and conservation measures, modernizing the grid, decentralizing electricity production, decarbonizing the energy system, and adding significant additional load to the grid through electrification efforts.

100% clean energy by 2050. These conversations will originate with the ongoing energy efficiency proceedings, but may warrant a separate study and proceeding.

New Jersey is embarking on a significant transition in its energy system, including aggressively pursuing energy efficiency and conservation measures, modernizing the grid, decentralizing electricity production, decarbonizing the energy system, and adding significant additional load to the grid through electrification efforts. State-regulated electric public utilities are compensated largely through growth in electricity sales, which runs counter to the state goals of reducing electricity demand. Further, pursuant to the Clean Energy Act, NJBPU is mandated to develop performance incentives related to achievement of energy efficiency goals. This presents a situation in which utilities may be doubly compensated.

As the state moves to work with utilities, customers, and third-party providers to overhaul its energy system, the state must re-examine how utilities are compensated and consider if modifications need to be made to realign utility objectives and state goals. NJBPU will continue its efforts to ensure that rates are fair and reasonable, and that they do not create an undue burden on ratepayers.

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GOAL 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**
- **5.3.4 Instruct gas utilities to identify and prioritize the replacement of pipelines leaking methane**

New Jersey is taking a measured and intentional approach to minimize reliance on natural gas in an effort to reduce methane emissions. Methane (CH_4) is the primary component of natural gas and is considered a highly-warming greenhouse gas, with 84 times the potency of CO_2 over a 20-year period;[lxx] reducing demand for methane is critical to meeting climate goals. Through the Integrated Energy Plan modeling, the Least Cost scenario showed that New Jersey should gradually reduce demand for natural gas by 75% over the next 30 years. However, modeling has also shown that gas infrastructure (i.e., plants and transmission pipelines, even if the fuel source changes) may be vital to providing reliable and dispatchable power generation in times of low renewable output.

New Jersey is committed to supporting and establishing innovative strategies to decarbonize the existing energy system. The state must therefore consider a number of issues, including how to evaluate and balance requests to expand the transmission and distribution system versus concerns about stranded assets; how to reduce and possibly eliminate rate-based subsidies for natural gas and natural gas-fired appliances and over what timeframe; how a public gas utility business model may be affected in later years, and how low throughput may affect ratepayers; and how to maintain the safety and reliability of the existing distribution system.

Goal 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.

The last decade has seen unprecedented growth of the natural gas system, due largely to the discovery of domestic shale gas and subsequent low fuel prices. New Jersey currently has more than a dozen natural gas infrastructure projects under consideration at NJDEP and NJBPU, including pipelines, power plants, and a compressor station.

New Jersey would benefit from a comprehensive assessment of the gas system and its future needs. Consistent with recent deliberations, NJBPU will commission a study to assess if and where the system is approaching capacity limits, and where the system is being underutilized. Following this analysis and recognizing the importance of stakeholder involvement as an integral part of the process, including consumers, utilities, advocacy organizations, and others, NJBPU will undertake a stakeholder proceeding. The purpose of this proceeding is to take feedback from all interested parties as part of the Board's evaluation of the analysis. Evaluation and consideration of the analysis along with the stakeholder feedback will inform future Board action on utility filings.

The topic of whether non-pipeline solutions (further discussed in Goal 5.4.2) are a reasonable and prudent alternative to expanding the system or replacing aging and underutilized pipelines should be evaluated as part of the analysis and stakeholder process. Non-pipeline solutions may prove particularly attractive for distribution pipelines. The cost of pipeline infrastructure, in particular, is borne by the ratepayers. Pipeline infrastructure has decades of anticipated useful life. Approving unnecessary infrastructure expansion would be an imprudent investment and would significantly thwart efforts to achieve climate goals. NJBPU currently has an open proceeding on this matter, Docket No. GO19070846, which will be pending when this EMP is published.

Goal 5.4.2: Instruct gas public utilities to propose and adopt non-pipeline solutions when seeking expansion or upgrade of the distribution system.

Just as the electric public utilities should consider non-wires solutions, so too should the gas public utilities consider non-pipeline solutions. Expansion of pipeline infrastructure is inconsistent with modeling that supports pathways to New Jersey's clean energy economy. NJBPU should instruct gas public utilities to propose and integrate non-pipeline solutions into their planning and operations as an alternative to distribution and capacity expansion and upgrades.

Notably, there is a crucial difference between non-wires and non-pipeline solutions. Beyond energy efficiency upgrades, non-pipeline solutions generally require fuel switching, which will affect the gas public utilities' business models. NJBPU should enable gas public utilities to propose a pilot program to identify approaches, best practices, and opportunities for making non-pipeline solutions standard practice in their infrastructure planning, investment, and operations; such a program may require flexibility in how utilities spend expense and capital funds. Further, NJBPU should work with the gas public utilities to ensure they are compensated and can possibly adapt their business models as necessary to adopt non-pipeline solutions and accommodate a future in which some gas infrastructure is maintained but underutilized. If such an underutilized gas system begins to emerge, NJBPU will have the additional responsibility of addressing and managing ratepayer impacts.

Goal 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.

NJBPU's mission in regulating utility systems is to ensure affordability, reliability, security, resiliency, flexibility, and sustainability, but it must now additionally consider the costs and risks of environmental and climate factors and pursue a clean energy future. Maintaining a business-as-usual approach will not enable New Jersey to reach its mandated climate emissions reductions. Therefore, New Jersey will support innovative solutions to decarbonize the state's energy system.

New Jersey should evaluate existing regulations, programs, and policies that favor and otherwise incentivize growth of natural gas demand and related infrastructure and determine if these policies best serve the ratepayers or residents of New Jersey; if they don't, NJBPU and other relevant New Jersey agencies and authorities should develop alternative options. As NJBPU endeavors to ensure just and prudent investments, it must examine if ratepayers are socializing and subsidizing unnecessary fossil fuel infrastructure costs, and if doing so will risk ratepayers shouldering the burden of stranded assets in the future.

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Recently enacted legislative amendments to the Global Warming Response Act direct NJDEP to promulgate regulations requiring large emitters of greenhouse gas emissions to monitor and report such emissions from their activities.

Goal 5.4.4: Instruct gas utilities to identify and prioritize the replacement of pipelines leaking methane.

Eliminating methane leaks from New Jersey's gas pipeline system is crucial to meeting the 80x50 greenhouse gas emissions reductions. Further, methane leaks present additional safety concerns.

While the state should question the need to expand the gas distribution system before approving projects subsidized by ratepayers, and should additionally consider developing a framework for when and how to decommission instead of replace gas pipelines, it must nevertheless properly and safely maintain the existing system and support infrastructure investments to maintain reliability. This will require the repair or replacement of aging and faulty pipelines as long as the system is sufficiently utilized.

Given the state of technology today, gas infrastructure, whether it is fueled with natural gas, biogas, synthetic gas, hydrogen, or some as yet undefined fuel source, could prove vital to providing dispatchable power generation in times of low renewable output, and New Jersey must therefore make investments to ensure that the existing gas transmission system is also safe, reliable, and minimizes additional climate risks. It is equally important to ensure the existing gas distribution system is also safe, reliable, and minimizes climate risks, though there are potential opportunities to adopt non-pipeline solutions to replace the function of aging and leaky pipelines, enabling their decommission rather than their replacement.

The New Jersey Clean Air Council (NJCAC) reports a key finding[36] that methane emissions from natural gas transmission and distribution line leaks account for approximately 30% of the statewide methane emissions in New Jersey. The NJCAC report further notes that the U.S. EPA acknowledges leak estimates using existing leak detection methods are much lower than when using new technologies. A 2018 peer-reviewed analysis[37] found emissions to be 60% higher than the U.S. EPA's official estimate, suggesting that the real numbers are much larger and underscoring the urgency in addressing these sources.

Recently enacted legislative amendments to the Global Warming Response Act direct NJDEP to promulgate regulations requiring large emitters of greenhouse gas emissions to monitor and report such emissions from their activities. In the next several months, NJDEP will initiate a rulemaking process to address these emission sources.

Although the U.S. EPA has a reporting requirement[38] for methane emissions, a facility is only required to comply with the requirement if it emits at least 25,000 MMT of CO_2e per year. Neither the U.S. EPA nor the state require gas distribution companies to identify distribution system leaks or ensure that they are repaired or replaced in a timely manner. New Jersey's largest utilities have taken voluntary steps to reduce methane emissions, particularly by engaging in programs to replace aging cast iron and unprotected steel mains. However, replacement is a long-term and costly exercise and there is still a great deal of work to be done to replace the aging cast iron and unprotected steel gas mains that pose the greatest risk to New Jersey's residents and the environment. Furthermore, there is some question as to whether leak detection methods and equipment could be better utilized to address leaks earlier.

NJBPU will instruct all gas public utilities to incorporate advanced leak detection technology into operations to find, quantify, and prioritize gas pipeline repair and replacement and to file repair or replacement plans (or, in the alternative, non-pipeline solutions) with NJBPU. NJCAC has specific recommendations to support and complement such directives, which may assist NJBPU staff in developing guidelines.

36 April 2019 Public Hearing Report: **http://www.state.nj.us/dep/cleanair/**

37 Alvarez et al. 2018. *Assessment of methane emissions from the U.S. Oil and Gas Supply Chain*. Science, July 13, 2018, issue 6398, pp. 186-188, DOI:10.1126/science.aar7204.

38 NJDEP is currently developing a GHG Reporting Rule as mandated by the Global Warming Response Act (GWRA).

STRATEGY 5

Decarbonize and Modernize New Jersey's Energy System

Goal	Description	Commitments & Timeline	Baseline	Agencies
Require utilities to establish Integrated Distribution Plans (IDPs) within one year to expand and enhance the location and amount of DER and EVs on the electric distribution system	Utilities will develop IDPs to enable the state and utilities to optimally and effectively plan for and accommodate increased electricity demand through end-use electrification and further penetration of DER (including renewable energy generation, storage, microgrids, and EV charging), and could also incorporate rollout of AMI and non-wires solutions, pending further Board orders.	NJBPU will initiate a proceeding in early 2020 to define the scope of IDPs. Plans will include modeling, prioritization, proposal of physical and operational changes to the grid to facilitate DER, bi-directional flow, AMI, and non-wires solutions. NJBPU will direct utilities to file IDPs within one year of the Board Order requiring them to do so.	N/A	NJBPU and partner agencies where applicable
Instruct utilities to propose and adopt non-wires solutions (NWS) that encourage complementary private sector investments when seeking expansion or upgrade of the distribution and transmission system or generation sources	Utilities must routinely and methodically integrate NWS into planning and operations as an alternative or complement to traditional infrastructure and capacity upgrades and expansions to defer, reduce, or eliminate otherwise necessary increases in traditional electric infrastructure investments. NJBPU may include requirements for NWS in the IDP proceeding or in other proceedings as necessary.	NJBPU will enable electric public utilities to propose pilot programs to identify approaches, best practices, and opportunities for adopting NWS as standard practice. NJBPU will solicit proposals for pilot NWS programs by mid-2020; such proposals may factor into NJBPU's IDP proceeding. After further evaluation, especially through utilities' submitted IDPs, NJBPU will develop policies and resources to facilitate adoption of NWS by the December 2021.	N/A	NJBPU and partner agencies where applicable

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STRATEGY 5

Decarbonize and Modernize New Jersey's Energy System

Goal	Description	Commitments & Timeline	Baseline	Agencies
Instruct utilities to propose and adopt non-wires solutions (NWS) that encourage complementary private sector investments when seeking expansion or upgrade of the distribution and transmission system or generation sources *(Continued)*		NJBPU will maintain ongoing review of the program, including a study of long-term effectiveness (e.g., avoided costs, reduced consumption).		
Exercise regulatory jurisdiction to review and approve the need for transmission projects	NJBPU will clarify and solidify its regulatory authority over certain transmission projects under N.J.S.A. § 52:14B-1 et. al. (NJ APA) to increase oversight and manage utility costs.	NJBPU will issue a straw proposal or regulatory policy document in mid-2020, followed by formal rulemaking by December 2020.	N/A	NJBPU
Strategic and coordinated rollout of Advanced Metering Infrastructure (AMI)	New Jersey will assess adoption of AMI, which is a foundational technology necessary to enable several EMP goals, such as demand response and time-of-use rate design.	NJBPU will conclude a proceeding to assess the efficacy of AMI installed in Rockland Electric Company's territory by May 2020. NJBPU will issue guidelines to the electric public utilities regarding AMI installation and relevant communications upgrades by June 2020 through the IDP or other proceeding.	AMI is installed in one of the four electric public utility territories as of 2019.	NJBPU

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STRATEGY 5

Decarbonize and Modernize New Jersey's Energy System

Goal	Description	Commitments & Timeline	Baseline	Agencies
Develop a planning process to quantify and analytically assess the need for future expansion of the gas system and take appropriate action	New Jersey will comprehensively assess the current capacity and future needs of the gas system and implement a planning process to inform decision-making regarding future investments that support innovative decarbonization solutions.	NJBPU has an open proceeding, Docket No. GO19070846, which will be pending when this EMP is published. NJBPU will commission a study to assess if and where the system is approaching capacity limits, and where the system is being underutilized, in 2020. NJBPU will explore innovative solutions to decarbonize the gas system, informed by the gas capacity needs assessment, in late 2020.	N/A	NJBPU and partner agencies where applicable
Instruct gas public utilities to propose and adopt non-pipeline solutions when seeking expansion or upgrade of the distribution system	Non-pipeline solutions are one innovative tool New Jersey can use to decarbonize its energy system and minimize new investments in the gas pipeline infrastructure.	NJBPU may open a proceeding in 2020 to explore how gas public utilities can adopt non-pipeline solutions and establish compensation mechanisms. This may be done in conjunction with the gas capacity planning process.	N/A	NJBPU

STRATEGY 6

Primary Goals:

6.1 Encourage municipalities to enact Community Energy Plans

6.2 Support clean power generation

6.3 Prioritize clean transportation options

6.4 Identify barriers that prevent participation in the clean energy economy

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

Encourage local governments to establish Community Energy Plans and incentivize municipalities that house predominantly low- and moderate-income (LMI)[39] or environmental justice[40] communities to establish Community Energy Plans and enact them with state support. In addition, develop programs that support affordable access to renewable energy and energy efficiency and resiliency throughout New Jersey.

The strategies and goals outlined in this document are ambitious but necessary to ensure a strong future for New Jersey. In order to implement the steps outlined in the 2019 Energy Master Plan (EMP), it is imperative that local communities find ways to move toward these goals, taking into account local preferences and changes made at the state level.

Community Energy Plans encourage communities to identify how government, businesses, and residents can best achieve the goals outlined in the EMP as they pertain to their respective municipalities, and to create a plan to encourage those actions at the local level. Community Energy Plan committees are composed of representatives from at least two government entities, the business community, community organizations, residents, and a transportation partner. The committee develops a Community Energy Plan, which is an integrated document that addresses how communities can:

39 "Low-income household" means a household with adjusted gross income at or below 200% of the federal poverty level. "Moderate-income household" means a household with a total gross annual household income in excess of 50%, but less than 80% of the median income, as determined by annual HUD income limits.

40 Environmental justice communities are communities that are disproportionately impacted by pollutants.

- make current buildings more energy efficient,
- build new construction that is energy efficient and solar-, EV-, and demand response-ready, and
- encourage and incentivize businesses and residents to invest in these changes.

Governor Murphy has made the promise of a stronger and fairer New Jersey a pillar of his administration, to lift all communities from the bottom up and to grow the middle class.[lxxi] A signature component of the Governor's economic plan is to reduce existing disparities and inequities, and to empower the workforce. In April 2018, Governor Murphy signed Executive Order No. 23, which directed NJDEP to develop guidelines on how all state departments can incorporate environmental justice into their actions.

The state has a responsibility to facilitate equal access to and representation in the clean energy economy and all the opportunities and benefits it provides. Low- and moderate-income (LMI) households spend a proportionately higher percentage of their income on energy bills than higher-income households do. Further, whether due to lack of information, opportunity, or funding, LMI communities are often unable to benefit from energy efficiency initiatives and upgrades that can reduce energy bills and improve air quality. These communities are also more vulnerable to the impacts of disasters like Superstorm Sandy, which can interrupt transportation, the electrical grid, and lifeline services.

Transportation, buildings, and electricity generation are significant sources of greenhouse gas emissions and criteria air pollutants, which negatively impact local air quality. Environmental justice and low-income communities are disproportionately impacted by air pollutants and other environmental and climate change-related hazards, as well as affected by economic disparities.

In short, the state should encourage, support, and enable LMI and environmental justice communities to assess the impacts of localized pollution, assess energy demand, build more resilient communities, and establish opportunities across all sectors to develop the innovation economy at the local level and to participate in and benefit from the clean energy economy. The state should also ensure that new and existing clean energy and bill assistance programs are widely marketed and easily accessible to LMI ratepayers and environmental justice communities. As energy bills make up a larger percentage of income for the LMI community, it is particularly important that LMI communities utilize and have easy access to programs that can reduce energy use and lower their bills. Relatedly, as also discussed in Strategy 3, the state must work with LMI and environmental justice communities and prioritize and dedicate additional funding to them to enable cost-saving measures like energy efficiency initiatives.

NJBPU will provide technical assistance and training to community organizations and individuals to ensure that they are able to successfully participate in clean energy planning.

GOAL 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

Goal 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 to low-income and environmental justice communities.

As the state moves forward in the new clean energy economy, local governments should be provided with tools to move their own communities into that same future. NJBPU launched the Community Energy Plan grant in 2019, and will continue to create additional grant opportunities in 2020. This will support local communities to create Community Energy Plans and enable communities to determine their own priorities and obstacles and develop strategies to move in concert with the 2019 EMP.

As New Jersey transitions to a clean energy economy, all state agencies, including NJBPU, NJDEP, NJDCA, NJEDA, and NJ TRANSIT, will work collaboratively with LMI and environmental justice communities to ensure that they are actively participating in opportunities to reduce energy use and implement clean energy initiatives. NJBPU will provide technical assistance and training to community organizations and individuals to ensure that they are able to successfully participate in clean energy planning. The state should encourage and support holistic and comprehensive planning throughout the community energy planning process, including non-traditional sources of energy consumption, and will deploy resourc-

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Environmental justice communities face a disproportionate number of barriers to taking advantage of the benefits of a clean energy future, but Community Energy Plans can alleviate this.

es to ensure that there is broad participation by LMI and environmental justice community members in the planning process.

As an example, Community Energy Plans can include community redevelopment mechanisms to increase public space, walkability, and bike-ability; decrease congestion and idling; and enable equitable, multi-modal transportation opportunities. These mechanisms all support the co-benefits of improving public health and quality of life, in addition to reducing pollutants. Greening public space through initiatives like community gardens, rain gardens, tree planting, and other methods of green infrastructure captures excess rainwater, reduces high temperatures (particularly through mitigation of the "heat island effect"), and improves local air quality. Comprehensive solid waste reduction plans and neighborhood or municipal composting are additional opportunities to realize energy demand reductions and related co-benefits.

Community Energy Plan committees should work with residents, businesses, and government to determine their collective needs and goals and to identify funding opportunities through the public and private sector to help effectuate those changes. Plans will be submitted to NJBPU for review, which will additionally enable NJBPU to encourage and support the committee's implementation of the goals and steer the committee to appropriate incentives.

Further, NJBPU should reach beyond energy efficiency and financing assistance and expand its newly-created Community Energy Planning grant program. The grant program provides seed money to communities to begin a Community Energy Plan. This could include enabling LMI and environmental justice communities to hire an energy services planner to work with local government, businesses, and community organizations to assess clean energy opportunities, benchmark energy demand, and determine mechanisms to reduce aggregate energy use. Environmental justice communities face a disproportionate number of barriers to taking advantage of the benefits of a clean energy future, but Community Energy Plans can alleviate this. A higher level of community outreach should be focused upon these communities, as well as additional incentive and grant opportunities.

Finally, NJDCA administers the Urban Enterprise Zone (UEZ) program and provides guidance on the Opportunity Zone program, a federal designation for distressed communities that supports the revitalization of communities through private investments and tax incentives. NJBPU is currently offering additional incentives to residential, commercial, and governmental buildings within these zones to encourage increased participation in energy efficiency programs. New Jersey has 32 UEZs and 75 Opportunity Zones, including at least one Opportunity Zone in each of the state's 21 counties.

Urban communities may also apply for Transit Village designation. Once approved, designated Transit Villages can obtain support and funding from various state agency grant and assistance programs. Community Energy Plans can enhance this collaboration by providing urban revitalization projects with guidance to ensure not just economic benefits, but to encourage projects that beneficially impact the health and quality of life of the residents.

Goal 6.1.2: Encourage communities to incorporate land use, zoning, and multimodal transportation plans into their Community Energy Plans.

As this report identifies in Goal 1.2.1, a clean energy future is not just about how New Jersey generates and uses energy; it is also about how and where residents choose to build and how people and goods move from destination to destination. Communities should look at connectivity, Complete Streets plans, and how accessible its roadways are as they pertain to all types of transportation. Not only should communities prepare for the deployment of electric vehicle (EV) charging stations, but they should also work to ensure that sidewalks and bike paths are available and accessible as an alternative to vehicle ownership or use. Communities should also evaluate where there are new mobility options for people without personal vehicles, considering community EVs, mobility on demand, and other microtransit[41] options, especially in locations that may be cut off from other public transit options.

Goal 6.1.3: Prioritize energy efficiency programs in low- and moderate-income and environmental justice communities.

Ensuring that LMI and environmental justice communities have access to energy efficiency can support multiple policy goals, such as affordable energy, job creation, improving public health, and mitigating climate change. Energy efficiency is New Jersey's lowest-cost clean energy resource. With support from the stakeholders, NJBPU should set energy efficiency savings targets and work with utilities to roll out more programs and incentives for LMI and environmental justice communities, similar to those being introduced in Fiscal Year 2020, and provide additional incentives

41 Microtransit includes IT-enabled private multi-passenger transportation services, such as Bridj, Chariot, Split, and Via, that serve passengers using dynamically generated routes, and may expect passengers to make their way to and from common pick-up or drop-off points. Vehicles can range from large SUVs to vans to shuttle buses. Because they provide transit-like service but on a smaller, more flexible scale, these new services have been referred to as microtransit. [Transit Cooperative Research Program (TCRP) Research Report 188]

to Opportunity Zones and UEZs. The widespread deployment of energy efficiency measures provides cost-effective and powerful health and economic benefits. See additional discussion in Goal 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.

GOAL 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**

Clean power generation has the potential to provide LMI and environmental justice communities with locally supplied energy. Local clean power generation also provides additional resiliency, which is particularly important in LMI and environmental justice communities that are disproportionately impacted by the effects of natural disasters. Further, fossil fuel power generators are often located in or near environmental justice communities, placing additional burdens on them in the form of disproportionally contaminated air. By supporting clean power generation, the state can eliminate these disparities and work toward Governor Murphy's promise of a stronger and fairer New Jersey.

Goal 6.2.1: Support community-led development of community solar projects.

LMI and environmental justice communities should consider rooftop and community solar in collaboration with NJBPU, NJDCA, NJDOL, NJ Department of Education (NJDOE), and other state agencies. In addition, NJBPU, NJDEP, and NJDCA will support and encourage community outreach aimed at educating LMI communities about adopting community solar as both hosts and subscribers to ensure that there is active participation in the program.

NJBPU's Community Solar Energy Pilot Program has a 40% carve-out for LMI projects, and has created an opportunity for a further 10% to be dedicated to projects serving low-income customers only. In September 2019, NJBPU received 252 applications for Year 1 of the Community Solar Energy Pilot Program, representing the potential for over 650 MW capacity. Of these, 232 applications were for LMI projects, which means that they commit to allocating at least 51% of project capacity to LMI customers. The Year 1 Application Form evaluation criteria, established to guide the selection of projects in the first year of the pilot program, recognized the importance of community planning by placing higher preference on projects designed in partnership with local communities and projects serving LMI and environmental justice customers. In December 2019, NJBPU awarded 45 community solar projects for Year 1; all were for LMI projects.

In Years 2 and 3 of the pilot program, NJBPU will work to identify areas where community engagement in LMI communities is needed. NJBPU will work with targeted communities to educate residents about the program and encourage host site applications in those LMI communities. Prior to launching the application period for Year 2 of the pilot program in the first half of 2020, NJBPU will conduct stakeholder engagement in order to continue to improve the pilot program and application process, and the program's ability to meet the needs of local communities.

As part of its community solar program, NJBPU will explore how to provide financial and technical support to LMI communities and community organizations wishing to develop a local community solar project. NJBPU will investigate opportunities to incentivize LMI participation as subscribers, which will lead to both early adoption of the program and a reduction in energy bills in these communities.

Goal 6.2.2: Incentivize maximum installation of rooftop and community solar by the local workforce.

As further discussed in Goal 2.3.3, the state should continue to develop opportunities to incentivize maximizing urban solar rooftop installations and to train the local workforce to install and maintain them, bringing new clean energy jobs to the community and enabling low-income residents to benefit from local, clean electricity generation. In addition to the workforce benefits and the generation of local clean energy, NJBPU should work with community organizations to educate residents about the potential energy savings from rooftop solar.

NJBPU and NJDEP are currently assessing solar rooftop potential in urban communities to assist in this effort.

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The energy efficiency industry aids in the creation of good, local service jobs that can't be outsourced, such as energy auditors, installers, and energy managers.

Goal 6.2.3: Develop clean energy workforce opportunities and training programs.

The state, through NJDOL, has several established training pipelines through apprenticeships, industry partnerships, vocational training, and education. NJDOL will enhance and accelerate opportunities for youth and the local workforce in LMI communities, and will supply them with the skills, training, education, and opportunities necessary to thrive in clean energy occupations.

The energy efficiency industry aids in the creation of good, local service jobs that can't be outsourced, such as energy auditors, installers, and energy managers. This effort will build upon the existing workforce development programs and initiatives that are successful across the state. New Jersey will also foster collaboration among economic, education, and workforce entities to develop new curricula and certification programs to develop necessary energy industry skill sets. Attaining industry-valued credentials is also critical in the preparation of the offshore wind and clean energy workforce development plan. Further, NJDOL should dedicate funding toward cross-field training in energy efficiency and environmental health services to reduce the number of housing units deferred from energy upgrades due to structural deficiencies or environmental health hazards and to encourage "whole house" projects. For example, energy efficiency projects that will tighten the thermal shell of a home should be paired with radon testing and possible remediation because building envelope-based efficiency improvements, by making houses more airtight, can potentially exacerbate environmental health concerns like air contaminants (see Goal 3.1.4). Workforce training is further discussed in Strategy 7: Expand the Clean Energy Innovation Economy.

6.2.4: Target distributed energy resource incentives to support local clean power generation in low- and moderate-income and environmental justice communities.

NJBPU should explore the creation of distributed energy resource (DER) incentive programs targeted at LMI and environmental justice communities. DERs include a wide variety of technologies including renewable distributed generation like energy efficiency, photovoltaic (PV), smart inverters, battery storage, demand response, and EVs that provide numerous grid and customer benefits. Programs also should consider how DERs can be combined to maximize their value to the grid and to customers, while at the same time recognizing the importance in local planning and engagement, as well as in utility distribution planning, when determining where DERs should be located to best serve the communities.

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GOAL 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**

Transportation-related air pollution is disproportionately high in urban areas. The state will work with LMI and environmental justice communities to assess and develop mechanisms to increase clean transportation options, such as: developing electric mobility programs; installing EV chargers in community hubs; offering additional incentives for new, leased, and pre-owned EVs; piloting additional NJ TRANSIT electric buses on urban routes; and increasing the deployment of other kinds of electric medium- and heavy-duty vehicles such as trucks and cargo-moving equipment in place of diesel-powered vehicles in LMI and environmental justice communities. Such measures are further described below and also in Strategy 1: Reduce Energy Consumption and Emissions from the Transportation Sector.

Early community engagement and energy planning driven by local needs will be critical for these initiatives. Community Energy Plans that are created in concert with local transportation providers and the community have the added benefit of reducing greenhouse gas emissions and other air pollutants, and can also reduce vehicle miles traveled by creating zoning and planning guidelines that encourage multi-modal transportation.

Goal 6.3.1: Prioritize replacement of fossil-fueled public transportation fleets with electric fleets, with a focus on environmental justice communities.

Electric transit fleets provide residents in environmental justice communities with access to clean and efficient transportation. Electric buses reduce both greenhouse gas and other harmful air pollutant emissions, resulting in cleaner air for the community. Transitioning fossil-fuel transit fleets to electric will ease the disproportionate burden of air pollution these communities face.

In February, 2019 NJDEP announced the availability of $8 million to purchase eight new electric transit buses, allocated from the Volkswagen Mitigation Trust. The buses will be operated by NJ TRANSIT along routes in Camden and will serve as an electric bus pilot program for the state.[lxxii] NJ TRANSIT should utilize insights from this pilot to develop strategies for the further implementation of electric buses in transit fleets throughout New Jersey, as discussed in Goal 1.1.7. NJ TRANSIT will prioritize the electrification of its bus fleet in LMI and environmental justice communities.

Goal 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.

As discussed in Goal 1.3.1, reducing emissions from the transportation sector in LMI and environmental justice communities should be a high priority for the state because these communities have also been disproportionately burdened by harmful air pollutants from ports, airports, and transit hubs. Reducing transportation emissions will significantly decrease New Jersey's overall greenhouse gas emissions and will improve the air quality in some of the state's most polluted communities.

In June 2019, the administration announced an additional $16 million from the Volkswagen settlement fund to deploy electric trucks and equipment in urban areas, including port trucks, garbage trucks, school buses, delivery and drayage trucks, and airport ground support equipment.[lxxiii] The administration will continue to prioritize use of Volkswagen funds for similar zero emission projects in environmental justice communities.

Volkswagen settlement funds, as well as those resulting from New Jersey's renewed participation in the Regional Greenhouse Gas Initiative, should also be used to help deploy electrified medium-duty vehicles in and around these communities, and for uses such as private jitneys and last-mile package delivery. The total cost of ownership (i.e., both upfront capital costs and ongoing operating costs) for electric and diesel-power medium-duty trucks are converging more rapidly than they are for heavy-duty trucks, indicating opportunities to accelerate the deployment of electric versions of these vehicles.

Goal 6.3.3: Build or incentivize electric vehicle charging infrastructure and incentivize adoption of electric vehicles in low-income communities.

As discussed in Strategy 1, proper charging infrastructure must be built in order for the benefits of electric buses, trucks, and cars to be realized.

Shared mobility strategies such as car-sharing, ridesharing, and scooter- and bike-sharing have been shown to have environmental, social, and transportation-related benefits, especially when it provides first and last mile solutions to connect residents with public transportation.

LMI and environmental justice communities stand to benefit greatly as zero-emission vehicles continue to replace diesel- and gasoline-fueled vehicles. Sufficient investment in charging infrastructure in these areas will speed the transition to a zero emission transportation future.

Sufficient public charging infrastructure also makes these communities more attractive to car-sharing and ride-hailing companies looking to expand their EV programs, and it creates the opportunity for possible future partnerships. These partnerships, such as Lyft's Express Drive Rental Program, could benefit communities by providing increased access to clean transportation services and sources of income. Programs like these allow for EV technology to be utilized more equally across all communities, increasing the overall number of clean vehicles on the road. Zoning policies and land use incentives will be explored in an effort to spread out EV charging infrastructure across communities, especially those in LMI and environmental justice areas. NJBPU will also look at where to spend ratepayer dollars most strategically when incentivizing EV charging infrastructure, prioritizing these funds where private investment is less likely.

As outlined in Goal 1.1.3, NJBPU should look to provide additional incentives to LMI communities for the purchase of EVs. In the past, EV incentives have gone primarily to new vehicles, which have made them inaccessible to most of the LMI community. Instead, creating incentives geared toward LMI community members to lease new or purchase pre-owned EVs would make the vehicles significantly more accessible.

Goal 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.

Shared mobility strategies such as car-sharing, ridesharing, and scooter- and bike-sharing have been shown to have environmental, social, and transportation-related benefits, especially when it provides first and last mile solutions to connect residents with public transportation. By encouraging residents to use shared modes of transportation, these services can reduce personal vehicle use and vehicle miles traveled.[lxxiv] Additionally, in LMI and environmental justice communities, private vehicle ownership is not always available or affordable for citizens; these programs offer increased transportation options. Shared mobility can also bridge the gap in existing public transit networks, thereby increasing access to mass transit. In aggregate, these programs can benefit LMI and environmental justice communities by reducing pollution and traffic congestion and by expanding access to affordable transportation.

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There are a number of successful electric car-sharing platforms currently in use in cities across the world. If designed properly, they can benefit LMI and environmental justice communities by providing clean, low-cost transportation options. Creating car-sharing programs with low-income membership options and adequate station and charge point locations in LMI and environmental justice communities should be a priority when designing such programs for the state.

Both NJBPU and NJDEP have begun work on creating pilot electric car share programs in urban areas to specifically address LMI and environmental justice communities. NJBPU won a competitive grant from the U.S. Department of Energy to study electric car-sharing opportunities for LMI communities. The anticipated lessons learned from this study should support the establishment of pilot programs in the near future to enable equitable access to electric transportation. NJDEP is also developing a pilot EV car share program in Trenton using It Pay$ to Plug In funding, allowing those lessons-learned to be implemented.

The state will also explore the implementation of bike lanes and sidewalks in communities across New Jersey, as detailed in Goal 1.2.1. Prioritizing connections between residential neighborhoods and commerce areas are of the upmost importance, especially in LMI and environmental justice communities. In LMI communities, the state must pay attention to the need for community EVs and must identify micro-transit opportunities to address community needs. Where current public transportation is focused on getting residents to a large hub (i.e., downtowns, Manhattan, Philadelphia, malls), community EVs and micro-transit may be cleaner alternatives to provide LMI residents with necessary transportation to grocery stores or employers located elsewhere.

GOAL 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

Agencies must ensure that LMI and environmental justice communities are fully represented in the processes that will determine the implementation of the EMP policies and that their voices inform program design and implementation, as well as community outreach and engagement approaches.

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The state should work to identify and eliminate barriers to participation in existing low-income energy efficiency programs and should develop opportunities for enhanced energy efficiency incentives for low-income customers and for affordable multi-family housing.

The state and utilities currently administer several programs that aim to make energy bills more affordable and provide long-term solutions to LMI households:

- The Comfort Partners Program, though New Jersey's Clean Energy Program (NJCEP), aims to improve long-term energy affordability by providing free energy audits, energy education, and the direct installation of energy savings measures to income-qualified residents at no cost. In 2017, nearly 20% of NJCEP energy efficiency expenditures were spent through the Comfort Partners Program. Since its inception in 2001, Comfort Partners has served over 113,750 low-income households.
- NJDCA administers the federally-funded Weatherization Assistance Program, which assists elderly, handicapped, and low-income persons in weatherizing their homes, improving heating system efficiency, and conserving energy. Similar to Comfort Partners, this program provides the direct installation of weatherization upgrades and significantly lowers customers' energy bills over the long term, as well as makes their homes more comfortable.
- NJBPU funds several energy assistance programs including: the Universal Service Fund for low-income households, administered by NJDCA; the Lifeline Program which is for the elderly and disabled, administered by NJ Department of Human Services; and the Payment Assistance for Gas and Electric (PAGE) Program for LMI households. NJDCA also administers the federally funded Low-Income Energy Assistance Program (LIHEAP), which shares an application with Universal Service Fund and the Weatherization Assistance Program.
- NJBPU administers the Winter Termination Program, which protects certain customer categories from gas or electric shut-off between November 15 and March 15.
- NJBPU's Multifamily Program is an energy efficiency incentive program for all eligible multi-family residential facilities applying for incentives through NJCEP. NJCEP determines the size of the incentives using the needs and scope of each project. It aims to provide savings to all residents within the buildings, not only those who qualify for LMI programs, and encourages a whole building approach in environmental justice and LMI communities.

NJBPU will work with other state agencies to increase collaboration on programs that may impact similar customers, including the Weatherization Assistance Program and the Comfort Partners Program.

Goal 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.

In addition to expanding the above initiatives, the state should ensure that existing programs are accessible to eligible customers and provide support for eliminating external barriers to customer participation. NJBPU and NJDCA currently have a memorandum of understanding for collaboration between Comfort Partners and the Weatherization Assistance Program, so as to ensure that qualifying customers are more easily served by both programs. NJBPU and other state agencies should continue to promote coordination efforts, in order to facilitate LMI access to all existing clean energy programs.

NJBPU will work with other state agencies to increase collaboration on programs that may impact similar customers, including the Weatherization Assistance Program and the Comfort Partners Program. The state will work with stakeholders to identify market barriers and develop a strategy and action plan to overcome persistent, systematic issues. The strategies will address the need for targeted marketing to LMI and environmental justice communities describing existing programs available to New Jersey ratepayers, including outreach materials in multiple languages and community-based social marketing campaigns. The action plan will include engaging with local organizations and hosting community meetings in locations and at times that are convenient to residents.

NJBPU should also evaluate opportunities to develop or enhance programs targeted to all LMI customers to ensure that all customers who face disproportionately high energy burdens have access to long-term energy savings measures. NJBPU should consider increased incentives and incentive structures, such as “pay as you save” models, alternative program delivery models, such as “direct install,” and methods to collaborate with trusted community organizations. As further discussed in Strategy 3.1.4, the state should consider establishing a clearinghouse for energy-related assistance programs that would reduce barriers to qualifying customers and also ease access to other programs that could address structural building deficiencies that negatively impact energy efficiency measures.

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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

Goal	Description	Commitments & Timeline	Baseline	Agencies
Develop a comprehensive Community Energy Plan program in concert with local community groups	Community Energy Plans enable municipalities and interested local parties to manage, plan for, and future proof their energy needs.	NJBPU will increase awards for counties and cities and add awards for NJBPU-related implementation in mid-2020. NJBPU will build a toolkit in mid-2020 for identifying partner agency grant programs that may be applicable.	NJBPU established the Community Energy Planning grant program in 2019.	NJBPU, NJDCA, and other state agencies as necessary
Prioritize energy efficiency programs in low- and moderate-income and environmental justice communities	Prioritizing energy efficiency in low- and moderate-income and environmental justice communities will reduce utility bills and improve public health.	NJBPU will create enhanced incentives for low- and moderate-income communities in early 2020. NJBPU will explore continuing to offer enhanced UEZ and Opportunity Zone incentives in 2021. NJBPU will consider enhanced incentives for completed Community Energy Plans in 2021 and 2022. NJDCA will continue to inform local municipalities about additional incentives to buildings within UEZs and OZs to encourage increased participation in energy efficiency programs.	NJBPU offers enhanced incentives for UEZs and Opportunity Zones. Comfort Partners eligibility was expanded to 250% of federal poverty rate.	NJBPU, NJDCA, and other state agencies as necessary

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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

Goal	Description	Commitments & Timeline	Baseline	Agencies
Identify clean energy workforce opportunities and incentivize installation of projects by the local workforce	NJDOL will perform a clean energy workforce needs assessment by December 2021. NJDOL will collaborate with project developers, educational institutions, training organizations, and employers to create curricula and career pathways and expand its workforce development programs into the Clean Energy sector in late 2021. NJEDA will establish collaborative state partnerships in 2020 with NJDOL, NJDOE, NJBPU, NJDEP, and NJDCA to support workforce development. NJDOL will ensure that solar providers are aware of the on the job training grants for hiring local employees through state and regional meetings. NJBPU is entering the first year of its Community Solar Energy Pilot Program, which awards applications with additional points for creating and investing in the local workforce.	NJDOL currently offers programs to encourage hiring of local workforce, but they are not specific to the clean energy sector.	N/A	NJDOL, NJEDA, NJBPU

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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

Goal	Description	Commitments & Timeline	Baseline	Agencies
Prioritize clean transportation options in low- and moderate-income and environmental justice 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. 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.	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, possibly using Volkswagen or 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.	$8 million in VW funds has been allocated to NJ TRANSIT for the purchase and operation of 8 electric transit buses in Camden. $1.975 million in VW funds has been allocated to Student Transportation of America to purchase 5 electric school buses for operation in Trenton.	NJDEP, NJEDA, NJBPU, NJ TRANSIT, NJDCA, NJDOT

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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

Goal	Description	Commitments & Timeline	Baseline	Agencies
Prioritize clean transportation options in low- and moderate-income and environmental justice communities *(Continued)*		NJDOT will work with advocates and consultants to target Local Bicycle and Pedestrian Planning Assistance in environmental justice and low- and moderate-income communities. NJ TRANSIT's battery electric bus pilot project in Camden will commence in 2020. In addition, 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.		

STRATEGY 7

Primary Goals:

7.1
Grow world-class R&D and supply chain clusters for clean energy sub-sectors

7.2
Establish clean energy workforce training programs

7.3
Provide innovative financing for clean energy projects and tech

7.4
Capitalize on offshore wind economic opportunities

7.5
Establish a Clean Energy New Technology Innovation Center and other resources

7.6
Explore establishing a Clean Buildings Hub

Expand the Clean Energy Innovation Economy

Support the growth of in-state clean energy industries through workforce training, clean energy finance solutions, and investing in innovative research and development programs.

New Jersey has established a strong foundation for the clean energy economy. Today, nearly 52,000 New Jerseyans are employed in the energy efficiency, clean vehicles,[42] biofuels, storage, and renewable energy industries, located in every county across the state.[lxxv] The state must build upon this foundation and expand the clean energy economy to its full potential.

In addition to clean energy, the ambitious renewable energy goals set in recent legislation have the power to bring significant economic benefits to the state. Capturing growth in clean energy industries will advance Governor Murphy's goal of a stronger and fairer New Jersey[43] by increasing opportunities for quality employment. Solar installers and wind turbine service technicians are currently the two fastest growing occupations in the nation;[lxxvi] in 2018 the solar industry alone employed nearly 9,000 New Jerseyans.[lxxvii, lxxviii] Expanding these and other clean energy industries will create jobs and grow the economy, while ensuring that the state meets its climate goals.

42 "Clean vehicles" refers to electric, hybrid electric, plug-in hybrid, hydrogen and fuel cell and natural gas vehicles.

43 For more information about the Governor's vision for an inclusive, innovation-driven New Jersey, see "The State of Innovation: Building a Stronger and Fairer Economy in New Jersey," October 2018, available at **https://www.njeda.com/pdfs/StrongerAndFairerNewJerseyEconomyReport.aspx**.

The clean energy industry presents a new opportunity for the state to continue its history of innovation.

New Jersey's innovation economy has a long and storied history. LCD technology, the transistor, radar, and digital cellular are just a few examples of the state's great innovations. The clean energy industry presents a new opportunity for the state to continue this history of innovation. The state must continue to make investments to bring cutting-edge clean energy research and development to New Jersey.

GOAL 7.1 GROW WORLD-CLASS RESEARCH AND DEVELOPMENT AND SUPPLY CHAIN CLUSTERS FOR HIGH-GROWTH CLEAN ENERGY SUB-SECTORS.

Across the U.S., there are more than 3.2 million clean energy jobs[44]—nearly three times more than the fossil fuel industry.[lxxix] Linked to this job growth is an equally large expansion in clean energy investment. Some financial institutions predict that nearly $1 trillion of private capital could flow into the clean energy economy by 2030.[lxxx] Given this explosion of opportunity, New Jersey must move to capture more than its fair share of the future clean energy economy.

In considering clean energy focus areas, New Jersey should not only look for opportunities to develop and implement projects within its own borders. It should also invest in developing clean energy knowledge, services, and products that can be exported to other regions around the country and around the world. To do this, New Jersey should identify clean energy economy sub-sectors where the state can take a leadership position in research and development and attract supply chain businesses to create dynamic new clean energy industry clusters. For example, New Jersey can look to lead in the technical development of new utility-scale battery storage solutions and then look to attract the hardware manufacturers and software developers needed to commercialize and bring those technologies to market. By focusing on building knowledge, services, and products that can be sold to other markets, New Jersey's clean energy economy can bring an influx of investment and jobs that will support many other sectors in our state's economy.

44 The U.S. Bureau of Labor Statistics technically defines "green jobs" to include: (a) jobs in businesses that produce goods or provide services that benefit the environment or conserve natural resources; and (b) jobs in which workers' duties involve making their establishment's production processes more environmentally friendly or use fewer natural resources (**https://www.bls.gov/green/home.htm**). More specifically, New Jersey has considered the clean energy economy, and, relatedly, clean energy jobs, to encompass the sectors of energy efficiency, renewable energy, energy storage, clean vehicles, and related engineering, manufacturing, services, financing, and infrastructure.

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GOAL 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**

A modern, educated workforce will be required to fill the new job opportunities created by New Jersey's growing clean energy economy. This economy includes the development of new industries such as offshore wind, the ramp-up of research and development in sub-sectors such as battery storage, and the expansion of existing sectors such as solar (rooftop and community) and energy efficiency. As these areas expand over the coming years, declining industries will be simultaneously shedding workers, and skill gaps will emerge. It is critical that state agencies work together with business leaders, educational institutions, and communities to develop programs that both train new workers and support those transitioning. Such programs are critical in providing New Jersey's workforce with the necessary skills to thrive in a 21st century economy.

Developing a local population of trained energy professionals will ensure that there is a sufficient workforce to support the expansion of New Jersey's clean energy economy and that the economic benefits of this expansion stay within the state. This training presents a valuable opportunity to support workers in stagnating industries by transitioning them to ones with greater future growth potential. Currently, 30.5% of the state's clean energy jobs are in trades and manufacturing.[lxxxi] A competitive local workforce will also attract outside industry investment, advancing New Jersey's goal of becoming a hub for clean energy manufacturing and innovation.

States across the country, including New York,[lxxxii] Massachusetts,[lxxxiii] and California,[lxxxiv] have made commitments to developing their clean energy workforces. They have made investments to develop training curricula for schools and labor organizations, implement on-the-job training and internship programs, as well as establish funding commitments for future

workforce development activities. New Jersey similarly has several active training programs, as well as a strong history of investing in its workforce, and will collaborate with these states and others to share best practices as it empowers its workforce and youth to thrive in a clean energy future.

Goal 7.2.1: Develop a workforce needs assessment for the clean energy economy.

As New Jersey embarks on a transition to a clean energy economy, several sectors will see opportunities for growth and will need a workforce that can meet the needs of emerging, maturing, changing, and expanding industries.

The Department of Labor and Workforce Development's (NJDOL) Office of Research Information (ORI)[45] will develop a needs assessment for the clean energy economy, including but not limited to support for renewable energy generation and distributed energy resources (DER); grid modernization; energy efficiency services; transport system electrification, including electric vehicle (EV) infrastructure installation and potential EV component manufacturing and assembly; and zero carbon building construction and retrofits. The needs assessment will be developed within one year of the contract award.

Initially, in coordination with stakeholders including NJBPU, NJEDA, and industry, ORI will define the parameters of the clean energy workforce needs assessment. The assessment will provide long-term employment projections for relevant clean energy industries and occupations and identify occupations that require similar skills so that incumbent and unemployed workers can be retrained for jobs in the clean energy economy. Together with the qualitative analyses described later, this will allow ORI to assess the alignment between current workforce development offerings and the needs of the clean energy economy.

Once the parameters of the clean energy economy workforce needs assessment are defined, ORI will engage in data collection and analysis. Using various methods, including research, surveys, and focus groups, ORI will collect information about the positive and negative elements that build or detract from a clean energy economy. The assessment will include a literature review on topics including factors associated with site selection, market drivers and inhibitors (e.g., availability of a supply chain) in clean energy economy industries, as well as a review of existing statewide

45 ORI will work with the listed agencies to develop the parameters of the economy, fine-tune the research questions, invite competitive bids from qualified firms to conduct the study, and oversee the study's implementation through completion.

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Transitioning workers from declining industries into the new clean energy economy is critical to support New Jersey's growth and equity ambitions.

interactions between industry and workforce development professionals. To gain further insights into New Jersey's clean energy workforce needs, the assessment will conduct interviews and focus groups with employers, labor and trade associations, and experts from both in and out of state. Employing this diverse methodology will reveal trends and help develop an accurate understanding of what currently exists and what is missing.

The third phase of the needs assessment is the final product, which includes a summary of findings and recommendations. The findings will detail which elements and forces should be cultivated and which negative elements should be managed, reduced, or eliminated. Ultimately, this final product will offer recommendations on actions necessary to cultivate workforce development for New Jersey's clean energy sector. This would include training for new and incumbent workers, strategies for engaging employers and industry, and how to gather the resources for implementation. To facilitate implementation, focus groups that review the report's implications will be conducted with workforce professionals and educational institutions.

Goal 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.

Transitioning workers from declining industries into the new clean energy economy is critical to support New Jersey's growth and equity ambitions. Led by NJDOL, the state will investigate a range of potential programs to help retrain and reskill New Jersey's workforce for clean energy jobs.

For example, NJDOL has established pipelines for training via its County Apprentice Coordinators, the Pre-Apprenticeship in Career Education (PACE) program, and the Growing Apprenticeship in Nontraditional Sectors (GAINS) program. NJDOL's Industry Partnerships initiative is another example of an innovative program to match labor demand with training programs. Through this program, NJDOL will offer opportunities for its training partners and New Jersey businesses to retrain state residents for clean energy occupations.

New Jersey Industry Partnerships are regional partnerships of business leaders from a targeted industry who work together with workforce development, economic development, education, community-based organizations, and other public partners to address the shared workforce and competitiveness needs of the sector.

New Jersey is exploring options to establish a New Jersey Green Bank to help increase the amount of public and private capital flowing to important clean energy projects and innovations.

- **For business leaders**, Industry Partnerships serve as a place to efficiently and effectively collaborate with industry peers and public partners to tackle common issues that impact the sector's competitiveness—the need for a skilled workforce, infrastructure improvements, supply chain coordination, and others.
- **For public partners**, Industry Partnerships serve as a way of gaining high-quality information on industry needs and act as a shared table where workforce developers, educators, and economic developers can develop responsive solutions to industry needs together, aligning and leveraging multiple programs and funding streams.
- **For communities**, Industry Partnerships harness the passions of committed business leaders and focus the resources of public partners to build stronger education and training systems, strengthen regional economies, and connect people to jobs.

Goal 7.2.3: Establish vocational training to establish a pipeline of well-qualified, modern energy specialists.

NJDOL has historically partnered with the state's vocational schools through its County Apprenticeship program as well as its Youth Transitions to Work (YTTW) program. The YTTW program's focus is to introduce high school juniors and seniors to apprenticeships. In addition, NJDOL's PACE program will drive economic development through skills and educational attainment and create pathways to better paying careers and advanced credentials. PACE has designated the energy sector as a pathway to a long-term career. NJDOL will look to improve existing training programs and establish new ones with the insights learned from the workforce needs assessment.

GOAL 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**

Goal 7.3.1: Establish a New Jersey Green Bank.

New Jersey is exploring options to establish a New Jersey Green Bank to help increase the amount of public and private capital flowing to important clean energy projects and innovations. Expanding opportunities for innovative and low-cost financing and leveraging public dollars to grow private sector investment is vital to achieving the goals set forth throughout the Energy Master Plan (EMP). Using public funds to attract and leverage private capital, lower interest rates, provide gap financing, and advance other financial mechanisms will enable the clean energy economy to grow faster and farther and with less impact to ratepayers and taxpayers.

A Green Bank, or similar funding mechanism established by the state, could help New Jersey deliver on its clean energy market potential by providing public financing for clean energy deployment as well as driving necessary private investment for these projects. Green Banks have been shown to attract outside capital by encouraging private investors to enter the clean energy market at scale. Further, a Green Bank could develop financing mechanisms to ensure participatory access to New Jersey's clean energy initiatives among all income levels. It could also help New Jersey achieve its goals of broadening participation in the state's energy efficiency programs and achieving a 40% carve-out for community solar projects that serve at least 51% LMI customers.

New York and Connecticut offer successful examples of state Green Banks for New Jersey to follow. State Green Banks have been able to leverage approximately $3 to $4 of private investment per public dollar invested.[lxxxv] As an example, since its creation in 2011 through state legislation, Connecticut's Green Bank has used $186 million in public capital to leverage $755 million in private investment.[lxxxvi] In addition, state governments have recently played a central role in establishing and capitalizing Green Banks that then operate as private, non-profit organizations independent of government control.

As a preliminary step in the creation of a Green Bank, the New Jersey Economic Development Authority (NJEDA) developed an assessment both of the market need and potential for a state Green Bank. NJEDA will next work with both external stakeholders such as lenders, energy efficiency contractors, and solar project developers, as well as internal government stakeholders such as NJBPU and the iBank, to develop a recommendation for how the bank should be organized and capitalized, and what its initial suite of offerings should be. This preliminary stage should be completed by mid-year 2020. During the second half of the year, an organization and capitalization plan should be finalized; any necessary governmental authorizations (whether statutory, regulatory, or otherwise) should be obtained; initial organization staffing should be undertaken; and an initial suite of two or three program and product offerings should be identified and created.

Green Bank financial support for private lending can take either or both of two principal forms. First, a bank can offer credit exposure reduction mechanisms intended to de-risk the lending, including loan guarantees, loan loss reserves, and co-lending arrangements. Second, the bank can engage in the purchase, warehousing, and securitization of private loans—enhancing liquidity for banks, establishing broader markets for the applicable loan product, and, over time, improving loan terms for borrowers. Green Banks in other states have also used a bidding process to award particular lenders a "preferred" relationship under which the Bank serves as their marketing channel and, potentially, provides financial enhancements that reduce the loans' risk profile, in exchange for committing to a specific volume of lending on the most competitive terms.

The Green Bank should also support lenders, borrowers, and project developers by stimulating private lending through non-financial measures such as training; marketing, outreach, and referral support; matching borrowers with available project incentive grants; and driving the use of standardized forms of agreement for particular types of loans to help lower per-loan transaction costs. In addition, the state Green Bank should also assume responsibility for the sponsorship and administration of the state's Commercial Property Assessed Clean Energy Program, further defined in the next goal, which is anticipated to be enacted into law early in 2020.

Goal 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.

New Jersey is exploring new and creative financing methods to ensure that clean energy investments are made with fiscal prudence and that all customers have the ability and opportunity to participate in the clean energy economy. For example, on-bill financing is already offered by two of the state's natural gas utilities and has been effective in improving the repayment profile for clean energy loans. The state, utilities, and third-party providers should work together to make on-bill financing an option for all customers. Similarly, NJBPU should work with utilities, third-party providers, and other industry actors to develop mechanisms to provide rebates at the point of sale. This lessens administrative overhead and lowers barriers to entry for those who otherwise wouldn't be able to afford waiting for a rebate check.

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Around the country, the security enhancement that C-PACE provides has made private lenders willing to extend the terms of their clean energy loans to as long as 25 years.

Commercial Property Assessed Clean Energy (C-PACE) lending is another program that can facilitate greater private lender funding, and on relatively better terms. C-PACE, which is currently authorized in approximately three dozen states and has been launched in approximately 20 states, does this by treating the obligation to repay a clean energy-related loan in the same fashion as a property tax assessment. In this scheme, municipalities are responsible for billing and collecting loan payments, while the loan repayment obligations are attached to the applicable property, just as with property tax obligations.

Around the country, the security enhancement that C-PACE provides has made private lenders willing to extend the terms of their clean energy loans to as long as 25 years. This longer repayment period enables many projects funded through C-PACE to be cash flow positive from the outset. Legislation is currently pending that would designate NJEDA to serve as the state government sponsor for a statewide C-PACE program that would utilize a standardized program platform. Experience in other states suggests that, if well executed, such a program can be very effective in implementing C-PACE in a cost-efficient manner where borrowers can benefit from strong competition for business among lenders (and other local financing providers such as country improvement authorities). It can also help to speed adoption of C-PACE around the state, since these programs require individual governmental units with property taxing authority (in the case of New Jersey, the municipalities) to adopt ordinances opting into the program. New Jersey can learn from the experiences of the more than two dozen states that have already enacted C-PACE and thereby move quickly to launch its program following legislative enactment.

GOAL 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.

The growing offshore wind industry on the U.S. East Coast is now projected to generate almost 24 GW of clean, cost-effective power in seven states by 2035, representing more than $85 billion in capital investment over the next decade.

The launch of this new industry on the East Coast has created a once-in-a-generation economic development opportunity for New Jersey.

The WIND Institute aims to create the state clearinghouse for education, research, innovation, and workforce training for the future of wind energy.

The New Jersey Offshore Wind Interagency Taskforce, in alignment with Governor Murphy's overall economic development vision, has approached implementation of Executive Order No. 8 — which provided the target of 3,500 MW of offshore wind by 2030 — as an opportunity for New Jersey to lead and serve as a national hub for offshore wind. The subsequent procurement schedule to roll out the initial 1,100 MW, which was awarded to Ørsted in June 2019, with additional solicitations anticipated in 2020 and 2022, created a level of market certainty that has garnered the attention of international offshore wind companies. The November 2019 issuance of Governor Murphy's Executive Order No. 92, which increased New Jersey's offshore wind target to 7,500 MW by 2035, has further bolstered industry support. These companies are considering strategic investments as this new industry is launched on the East Coast.

The approach of NJBPU's 1,100 MW solicitation, which is the largest single-state solicitation in the nation, has been to position New Jersey as a state that solves for "value" and not just price. For example, the first solicitation considered both price and environmental impact, while also factoring how potential developers of this clean energy resource would commit to serving as a local economic driver.

A few of the efforts underway to ensure New Jersey capitalizes on this opportunity and serves as a hub of offshore wind include: the release of a new Offshore Wind Tax Credit Program targeted at attracting the largest anchor supply chain companies; the launch of a New Jersey Offshore Wind Supply Chain Registry in partnership with the premiere offshore wind industry organization; the launch of a technical assistance program to support New Jersey-based companies to get the certifications and build the competencies they need to sell into the supply chain; and the creation of a Wind Innovation & New Development (WIND) Institute.

The WIND Institute aims to create the state clearinghouse for education, research, innovation, and workforce training for the future of wind energy. The Institute will ensure coordination across state government and allow government agencies (e.g., NJDEP, NJBPU, NJEDA, NJDOL, OSHE, NJDOE), private corporations, research institutions, utility providers, and labor unions to come together to advance New Jersey's leadership in the offshore wind industry. Governor Murphy established a Council to develop and implement a plan to launch the WIND Institute, with formal recommendations to be issued in early 2020. The Institute will continually require industry input related to curriculum development, requisite competencies, credentials, and certifications.

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GOAL 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.

Often one of the critical steps to creating a thriving innovation ecosystem is the establishment of physical spaces that brings together companies, funders, and service providers. New Jersey already has several successful examples of such collaborative technology centers and incubators, including NJEDA's New Jersey Bioscience Center in North Brunswick, the Rutgers EcoComplex in Bordentown, and the National Aviation Research and Technology Park in Atlantic County. Governor Murphy has also announced plans for a major new innovation-oriented development called The Hub in New Brunswick. This project is focused on supporting research and start-ups at the intersection of technology and life sciences. A similar center focused on "Clean Energy Technologies" could be launched to support innovation in the clean energy economy.

New Jersey already has numerous businesses engaged in research, development, and commercialization of new and innovative clean energy-related technologies. While some of this work is undertaken within large and well-established companies, much of it occurs in the context of small and early-stage ventures that are operating on their own. The growth of these early-stage businesses often suffers from a shortage of capital, lack of business expertise, or lack of access to the potential customers who can utilize their technology innovations most productively. Resources to support these ventures exist in various institutions across the state, but often start-ups have a hard time accessing them. A Clean Energy Technology Center could help expand and coordinate access to these resources and thereby support the success of start-ups focused on clean energy technology innovation.

In addition, the launch of a physical space focused on clean energy innovation could serve as a "capital" for clean energy cluster development, increasing the visibility and momentum of this sector. Support programs could also be offered through the center to help fund early-stage proof-of-concept and commercialization research.

Often such projects are launched on a collaborative basis, and the state should consider developing an incubator or accelerator through strategic partnerships with well-established corporations, early stage investors, and New Jersey's exceptional research universities.

NJEDA has issued a Request for Ideas in order to receive input from the public on how the state can best prioritize implementation steps needed to strengthen New Jersey's clean tech innovation ecosystem. In addition, NJEDA is hosting a series of listening sessions with representatives of the various stakeholder groups in the clean tech ecosystem, including early stage companies; investors; large corporations active in clean tech innovation; real estate developers; and academic institutions. NJEDA is aiming to launch programs that support innovation in the clean energy sector during the first half of 2020.

In addition to needing access to a stronger array of research and development assets organized through one or more incubators and other facilities, many early-stage clean tech companies also have a lack of business expertise in areas such as financing, marketing, and business planning. The state should consider assisting companies in developing this kind of expertise by supporting program development and mentor networks to enable the companies to accelerate their business development.

GOAL 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.

Increasing the energy efficiency of current and future physical infrastructure in New Jersey is critical to achieving the state's clean energy ambitions. One of the challenges to fully realizing this opportunity is ensuring that investments are being made in energy efficiency technology development and workforce development. The growth of building electrification and energy efficiency is dependent upon a community of builders, trades professionals, installers, energy managers, real estate agents, and customers who are knowledgeable about the different technologies available to them. Lack of awareness, education, training, and accessibility of recently developed and emerging-market technologies and appliances creates barriers to both the implementation of building efficiency measures and building electrification.

Currently, professionals and customers are sometimes unaware of the costs and benefits associated with electrification and energy efficiency technologies. This makes builders unlikely to implement them in their construction and customers unlikely to ask about them for their homes or businesses. Increased awareness of these technologies can lead to greater implementation in the state's building sector and growth of New Jersey's energy efficiency market.

Educating brokers on energy efficiency allows them to inform their clients and incorporate the concept into the leasing process.

It is important that the state's builders, contractors, engineers, and architects are educated and trained on up-to-date efficiency measures. As efficiency technologies evolve, it is becoming increasingly necessary for those carrying out the work to have specialized knowledge. The growth in New Jersey's building efficiency could be limited by the availability of a skilled workforce, so proper investments in worker training are necessary.

Training and educational opportunities also exist outside of the construction industry. The Consortium for Building Energy Innovation has identified the unique position of commercial real estate brokers to promote building efficiency.[lxxxvii] Educating brokers on energy efficiency allows them to inform their clients and incorporate the concept into the leasing process. A Clean Buildings Hub could develop these strategies and others, ensuring that New Jersey's market for building energy efficiency grows and that there is a trained workforce capable of performing the work.

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STRATEGY 7

Expand the Clean Energy Innovation Economy

Goal	Description	Commitments & Timeline	Baseline	Agencies
Complete a workforce needs assessment for the clean energy economy and develop a clean energy jobs training program to fulfill the workforce needs	A Clean Energy Workforce Needs Assessment and Job Training Program will enable the state to align current workforce development offerings with the needs of the clean energy economy; provide long-term employment projections for relevant clean energy industries and occupations; and identify occupations that require similar skills so that incumbent and unemployed workers can be retrained as necessary for jobs in the clean energy economy.	NJDOL will award a contract to complete a workforce needs assessment in 2020; the assessment will be due one year after the contract is awarded. NJDOL will establish a clean energy jobs training program to fulfill workforce needs within one year of completion of the clean energy workforce needs assessment, as well as in real-time response to employers' clean energy sector job opportunities.	N/A	NJDOL
Explore a New Jersey Green Bank	New Jersey is exploring the development of a Green Bank to help increase the amount of public and private capital flowing to important clean energy projects and innovations, thereby enabling the clean energy economy to grow faster and farther and with less impact to ratepayers and taxpayers.	NJEDA will develop the necessary assessments and stakeholder process by mid-2020.	N/A	NJEDA

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STRATEGY 7

Expand the Clean Energy Innovation Economy

Goal	Description	Commitments & Timeline	Baseline	Agencies
Explore establishing a Clean Energy New Technology Innovation Center and other state-level facilities and resources	New Jersey's Clean Energy New Technology Innovation Center will support clean energy research and innovation in the state and provide NJ-based expertise to support early-stage clean tech companies in the areas of financing, marketing and business planning.	NJEDA will solicit feedback from stakeholders on innovation in the clean energy sector during Q1 of 2020. NJEDA will establish a program to develop a roster of NJ-based experts expected in 2020.	N/A	NJEDA
Establish the Wind Innovation and New Development (WIND) Institute and support the growing economic opportunities and supply chain of offshore wind development	The WIND Institute aims to create the state clearinghouse for education, research, innovation, and workforce training for the future of wind energy. The Institute will ensure coordination across state government and allow government agencies, private corporations, research institutions, utility providers, and labor unions to advance New Jersey's leadership in the offshore wind industry.	Formal recommendations for the development and launch of the WIND Institute will be issued in early 2020.	Governor Murphy established a Council for the WIND Institute in August 2019 to develop and implement a plan to create a regional hub for the state's offshore wind industry.	NJDEP, NJBPU, NJEDA, NJDOL, OSHE, NJDOE

SECTION 7

CONCLUSION

As the guiding light of Governor Murphy's energy policy agenda, the EMP outlines the strategic vision for the state's role in the development, use, distribution, and management of energy in New Jersey over the next 30 years.

As delineated above, the increased urgency around climate change led the state to take an innovative, systematic, and inter-agency approach that, for the first time, holistically considers the complete energy system in New Jersey, including electricity generation, transportation, and buildings, and their associated greenhouse gas emissions.

The seven overarching strategies outlined in the EMP — Reducing Energy Consumption and Emissions from the Transportation Sector; Accelerating Deployment of Renewable Energy and Distributed Energy Resources; Maximizing Energy Efficiency and Conservation and Reducing Peak Demand; Reducing Energy Consumption and Emissions from the Building Sector; Decarbonizing and Modernizing New Jersey's Energy System; Supporting Community Energy Planning and Action with an Emphasis on Encouraging and Supporting Participation By Low- and Moderate-Income and Environmental Justice Communities; and Expanding the Clean Energy Innovation Economy — provide the framework upon which New Jersey will achieve 100% clean energy by 2050. The targeted goals and implementation mechanisms within these strategies, as well as the Integrated Energy Plan modeling and analyses and other studies the state has conducted, provide a roadmap to achieve state goals.

In pursuing a clean energy future, the state will drive an innovation economy that invests in people and communities to create good-paying jobs, foster a diverse ecosystem, improve government efficiencies, and support New Jersey's low- and moderate-income and environmental justice communities when it comes to participating in and benefitting from the clean energy transition.

There is scientific consensus that the world must act now to mitigate the devastating impacts of climate change and New Jersey is heeding the call. Ultimately, the state is on the brink of a monumental transformation in energy policy, generation, use, distribution, and conservation that will propel New Jersey into a clean energy future and grow the economy, reduce energy use, mitigate the impacts of climate change, improve the health of our communities, and make New Jersey stronger and fairer for generations to come.

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ACE	Atlantic City Electric Company
ACEEE	American Council for an Energy-Efficient Economy
AMI	Advanced Metering Infrastructure
BGS	Basic Generation Service
BOEM	Bureau of Ocean Energy Management
C&I	Commercial and Industrial
CBA	Cost-Benefit Analysis
CEA	Clean Energy Act
CHP	Combined Heat and Power
CMAQ	Congestion Mitigation and Air Quality
CO	Carbon Monoxide
CO_2	Carbon Dioxide
C-PACE	Commercial Property Assessed Clean Energy
DER	Distributed Energy Resources
DG	Distributed Generation
DOE	Department of Energy
DR	Demand Response
ECC	Energy Conservation Code
EDECA	Electric Discount and Energy Competition Act
EE	Energy Efficiency
EMP	Energy Master Plan
ETG	Elizabethtown Gas
EV	Electric Vehicle
EY	Energy Year
FERC	Federal Energy Regulatory Commission
GW	Gigawatt
GWh	Gigawatt Hour
GWRA	Global Warming Response Act
HVAC	Heating, Ventilation and Air Conditioning
IDP	Integrated Distribution Plan
IEP	Integrated Energy Plan
JCP&L	Jersey Central Power & Light Company
kW	Kilowatt
LED	Light-Emitting Diode
LMI	Low- and moderate-income
MBUF	Mileage Based User Fee
MOU	Memorandum of Understanding
MW	Megawatt
MWh	Megawatt Hour
NJBPU	New Jersey Board of Public Utilities
NJCEP	New Jersey Clean Energy Program
NJDCA	New Jersey Department of Community Affairs
NJDEP	New Jersey Department of Environmental Protection
NJDOT	New Jersey Department of Transportation
NJEDA	New Jersey Economic Development Authority
NJNG	New Jersey Natural Gas

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NJDOL	New Jersey Department of Labor and Workforce Development
NOI	Notices of Inquiry
NOx	Nitrogen Oxides
NREL	National Renewable Energy Laboratory
NWS	Non-Wires Solutions
OREC	Offshore Wind Renewable Energy Certificate
OSW	Offshore Wind
O&M	Operations and Maintenance
OWEDA	Offshore Wind Economic Development Act
PSE&G	Public Service Electric and Gas
PACE	Property Assessed Clean Energy
PV	Photovoltaic
R&D	Research & Development
REC	Renewable Energy Credits
RECO	Rockland Electric Company
RGGI	Regional Greenhouse Gas Initiative
RNC	Residential New Construction
ROE	Return on Equity
RPS	Renewable Portfolio Standard
RTO	Regional Transmission Organization
SJG	South Jersey Gas
SJPC	South Jersey Port Corporation
SO_2	Sulfur Dioxide
SREC	Solar Renewable Energy Certificate
TCI	Transportation and Climate Initiative
TOU	Time Of Use
TPS	Third-Party Supplier
UCC	Uniform Construction Code
UEZ	Urban Enterprise Zone
VMT	Vehicle Miles Traveled
WIND	Wind Innovation & New Development
ZEV	Zero-emission Vehicle

GLOSSARY

Advanced Metering Infrastructure (AMI or Smart Meters)
An integrated system of smart meters, communications networks, and data management systems that enables two-way communication between utilities and customers.

Alternative Fuel Vehicles (AFV)
A vehicle that runs on a fuel other than traditional petroleum fuels.

Appliance Standards
The minimum efficiency requirements for appliances. Depending on the appliance, these standards are set at the state or federal levels.

Basic Generation Service (BGS)
The electric public utilities obtain wholesale power supplies to serve customers who do not shop for their own power through an annual procurement process that is approved by the NJBPU Board.

Battery Electric Vehicle (BEV)
An electric vehicle that uses rechargeable batteries and an electric motor for propulsion.

Biofuels
Fuels made from biomass materials.

Biopower
The conversion of organic materials into heat and electricity.

British Thermal Unit (BTU)
A BTU is a standard measure of energy and provides a basis to compare energy sources and uses.

Capacity
The maximum amount of electricity a generator can produce, measured in megawatts (MW).

Class I Renewable Energy
Class I renewables in New Jersey are defined at N.J.S.A. 48:3-51 and include solar, wind, biomass, tidal, wave, fuel cell, and geothermal technologies, and hydropower facilities less than 3 MW.

Class II Renewable Energy
Class II renewables in New Jersey are defined at N.J.S.A. 48:3-51 and include resource recovery (i.e., waste-to-energy plants) and hydropower facilities greater than 3 MW.

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GLOSSARY

Clean Energy Act (CEA)
A New Jersey law passed in 2018 that mandated several changes to the state's energy system, including the Renewable Portfolio Standard, renewable energy procurements and programs, and energy efficiency.

Clean Firm
Dispatchable electricity generation with zero net greenhouse gas emissions. Clean firm resources can include long-duration energy storage, turbines fueled using biogas and/or synthetic gas, and hydrogen-powered generators.

Combined Heat and Power (CHP)
CHP plants, also referred to as cogeneration, provide electric and thermal energy, thus obtaining high overall efficiency from the fuel.

Community Energy Plans
A Community Energy Plan is a way for a community to work toward a better environment for all residents by using the state's Energy Master Plan (EMP) as a guide to develop goals and strategies to increase clean energy production, reduce energy use, develop sustainable strategies and reduce emissions.

Complete Streets
Streets designed and operated to enable safe use and support mobility for all users. Those include people of all ages and abilities, regardless of whether they are traveling as drivers, pedestrians, bicyclists, or public transportation riders.

Compressed Natural Gas (CNG)
Natural gas can be stored under pressure in specialized tanks to substitute for gasoline or other fuels. Although its combustion does produce greenhouse gases, it is a more environmentally clean alternative to diesel fuel or gasoline and much less expensive.

DC Fast Charging
DC fast chargers convert AC power to DC power within the EV charging station and deliver DC power directly to the vehicle's battery. These chargers are faster than level 1 or level 2 charging, and are predominantly utilized for quick charging sessions on long trips.

Decarbonization
The process of reducing and eliminating carbon emissions from the economy.

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GLOSSARY (CONT.)

Demand Response
Measures that consumers take to minimize their demand for energy. It includes curtailment of energy or the use of on-site generation of electricity at critical times.

Distributed Energy Resources (DER)
Small-scale electricity production that is on-site or close to the primary user and is interconnected to the utility distribution system.

District Energy System
Systems that provide energy from a centralized location rather than multiple localized facilities. District energy systems tend to be more efficient and less polluting than multiple local energy generation systems.

Electric Discount and Energy Competition Act (EDECA)
New Jersey's Electric Discount and Energy Competition Act deregulated the state's electricity industry.

Electric Vehicle (EV)
A vehicle that uses one or more electric motors for propulsion. Typically, these vehicles, such as battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs), are charged through an external source of electric power and are typically referred to as EVs. FCEVs also use electric motors but are fueled with electricity produced internally with hydrogen instead of a battery and refuel at a hydrogen station (similar to today's gas stations) instead of plugging into an outlet or an EV charging station.

Electric Vehicle Charging Infrastructure
Electric vehicle service equipment used to supply electric energy to recharge electric vehicles.

Electric Public Utility
Atlantic City Electric (ACE), Jersey Central Power & Light (JCP&L), Public Service Electric & Gas Company (PSE&G), and Rockland Electric Company (RECO).

Electrification
The action or process of transitioning from a machine or system traditionally powered with a fuel such as natural gas, oil, propane, or gasoline to be powered with electricity. An example is replacing or converting a building heating system powered by natural gas with a system powered by electricity.

Energy Efficiency (EE)
Reducing wasted energy, or using less electricity, to perform the same task. For example, a high-efficiency appliance will use less energy than a low-efficiency appliance. Alternatively, adding insulation to exterior walls will reduce building heat loss.

Energy Storage
The capturing and storing of energy for future use. Energy can be stored through electrochemical (batteries), thermal, and mechanical means, as well as through pumped hydropower and hydrogen. Depending on the technology used, energy storage can used be for a long or short duration.

Energy Year
The twelve-month period from June 1 through May 31.

Environmental Justice (EJ)
An environmental justice community is a community that is disproportionately impacted by pollutants.

Federal Energy Regulatory Commission (FERC)
FERC has jurisdiction over the interstate sale and transmission of electricity and natural gas, and regulates PJM.

First Mile / Last Mile
The means of travel an individual uses from the initial place of departure to public transportation, and from public transportation to the final destination.

Fossil Fuel
A carbon-based fuel such as coal or gas, formed in the geological past from the remains of living organisms.

Fuel Cell
A fuel cell is an electrochemical cell that converts the chemical energy of a fuel into electricity.

Fuel Cell Electric Vehicle (FCEV)
A vehicle that uses a fuel cell to generate electricity for power as its primary method of propulsion and does not use a plug to recharge.

Gas Public Utilities
Elizabethtown Gas (ETG), New Jersey Natural Gas (NJNG), Public Service Electric and Gas (PSE&G), and South Jersey Gas (SJG).

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GLOSSARY (CONT.)

Gigawatt
A Gigawatt (GW) is a unit of electrical capacity equal to 1,000,000,000 watts.

Gigawatt-hour (GWh)
1 GWh is a unit of electrical energy equal to 1,000 MWh or 1 million kWh.

Global Warming Response Act (GWRA or 80x50)
The Global Warming Response Act of 2007 requires New Jersey to reduce its greenhouse gas emissions 80% below 2006 levels by 2050 (80x50).

Green Bank
A public or non-profit bank designed to increase the amount of public and private capital flowing to important clean energy projects and innovations.

Integrated Distribution Plan
A comprehensive plan that leverages existing tools from distribution system planning and enables electric public utilities to model demand growth and assess and recommend physical, market, and operational changes to the electric grid to ensure safe, reliable, and affordable services and to create streamlined and equally accessible integration of DERs.

Integrated Energy Plan (IEP)
A study commissioned by NJBPU in 2019 that models several energy future scenarios for New Jersey to determine the least-cost pathway to accomplish the state's goals of reaching 100% clean energy by 2050.

kilowatt (kW)
A kW is a unit of electrical capacity equal to 1,000 watts. It is estimated that a typical residential home (without electric heating) can have a peak load as high as 8 kW.

kilowatt-hour (kWh)
A kWh is a unit of electrical energy equal to 1,000 watt-hours. According to the DOE, the average New Jersey residential home consumes almost 700 kWh/month.

Light-duty Vehicle
Refers to passenger vehicles that weigh less than 8,500 lbs., including but not limited to, hatchbacks, sedans, crossovers, sport utility vehicles, pick-up trucks, coupes, and convertibles, which have four wheels and possess an electric motor for propulsion.

Low- and Moderate-Income (LMI)
"Low-income household" means a household with adjusted gross income at or below 200% of the Federal poverty level. "Moderate-income household" means a household with a total gross annual household income in excess of 50%, but less than 80% of the median income, as determined by annual U.S. HUD income limits.

Medium- and Heavy-Duty Vehicle (MHDV)
A medium- or heavy-duty vehicle weighs more than 8501 lbs. These vehicles are typically commercial in nature and perform duties related to the movement of goods and people.

Megawatt (MW)
A MW is a unit of electrical capacity equal to 1,000 kilowatts or 1,000,000 watts.

Megawatt-day
A unit of energy, especially electrical energy, equal to the work done by one Megawatt acting for one day.

Megawatt-hour (MWh)
A MWh is a unit of electrical energy equal to 1,000 kWh.

Microgrid
A microgrid is a group of interconnected loads and distributed energy resources (DERs) within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid. A microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or island-mode.

Micro-Transit
Includes IT-enabled private multi-passenger transportation services, such as Bridj, Chariot, Split, and Via, that serve passengers using dynamically generated routes, and may expect passengers to make their way to and from common pick-up or drop-off points. Vehicles can range from large SUVs to vans to shuttle buses. Because they provide transit-like service but on a smaller, more flexible scale, these new services have been referred to as micro-transit.

Nameplate Capacity
Nameplate capacity is the intended technical full-load sustained output of a electric generating unit as indicated on a nameplate that is physically attached to the generating resource and is expressed in MW or kW.

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GLOSSARY (CONT.)

Net Zero Carbon
The World Green Building Council defines "net zero carbon" as when the amount of carbon dioxide emissions released on an annual basis is zero or negative. The Council's definition for a net zero carbon building is a highly energy efficient building that is fully powered from on-site and/or off-site renewable energy sources and offsets.

New Jersey Board of Public Utilities (NJBPU or Board)
NJBPU regulates the electric public utilities and gas public utilities, participates in the PJM planning process, and advocates for New Jersey's interests before FERC. NJBPU sets utility rates and reliability standards, oversees the BGS procurement process, administers the Clean Energy Program, and approves ratepayer-supported utility programs.

New Jersey's Clean Energy Program (NJCEP)
New Jersey's Clean Energy Program is a statewide program that offers financial incentives, programs and services for New Jersey residents, business owners, and local governments.

New Jersey Department of Community Affairs (NJDCA)
The New Jersey Department of Community Affairs is a state agency created to provide administrative guidance, financial support, and technical assistance to local governments, community development organizations, businesses, and individuals to improve the quality of life in New Jersey.

New Jersey Department of Environmental Protection (NJDEP)
NJDEP is responsible for protecting the quality of New Jersey's air, water, land, and natural and historic resources. It issues permits for air pollution control, water pollution control, land use, and the management of other environmental impacts.

New Jersey Department of Labor and Workforce Development (NJDOL)
NJDOL helps broaden the skills of the state's world-class workforce through the statewide One-Stop Career Center system; provides vital income security to workers who are unemployed or unable to work due to illness, accident, or injury; equitably enforces New Jersey's labor laws and standards; analyzes the state's labor market and demographic information; helps individuals with disabilities succeed in the workplace; promotes labor management harmony; and protects the health and safety of workers on the job.

New Jersey Department of Transportation (NJDOT)
The primary mission of NJDOT is to provide a safe, reliable, and efficient multi-modal transportation network that serves the mobility needs of residents, commerce, and visitors in a manner that promotes economic development and insures environmental responsibility.

New Jersey Department of the Treasury (Treasury)
The mission of the Department of the Treasury is to formulate and manage the state's budget, generate and collect revenues, disburse the appropriations used to operate New Jersey state government, manage the state's physical and financial assets, and provide statewide support services to state and local government agencies as well as the citizens of New Jersey.

New Jersey Economic Development Authority (NJEDA)
NJEDA is an independent state agency that provides financial assistance to qualified companies for the purposes of maintaining and expanding employment opportunities in the state and increasing tax ratables in underserved communities.

New Jersey Motor Vehicle Commission (NJMVC)
NJMVC serves the people of New Jersey by promoting motor vehicle safety, earning the public trust through the integrity of their documents and services, and delivers exceptional service.

NJ TRANSIT
NJ TRANSIT is New Jersey's public transportation corporation. Its mission is to provide safe, reliable, convenient and cost-effective transit service with a skilled team of employees, dedicated to their customers' needs and committed to excellence.

Non-wires solutions
An umbrella term for projects or investments that may defer or replace electric distribution or transmission upgrades by reducing load.

Operations and Maintenance Costs (O&M)
The costs associated with the operations and maintenance of a component, resource, or facility.

Peak Demand
The highest electrical power demand that has occurred over a specified time period.

PJM
PJM is the regional transmission organization responsible for planning and operating the electric transmission grid across thirteen Mid-Atlantic and Midwestern states and the District of Columbia. PJM is also the independent system operator that administers the wholesale power markets in its territory to assure bulk system reliability.

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GLOSSARY (CONT.)

Plug-In Hybrid Electric Vehicle (PHEV)
Refers to a hybrid electric vehicle that uses rechargeable batteries that can be plugged into an external source of electric power, but still possess an internal combustion engine for propulsion.

Renewable Portfolio Standard (RPS)
An RPS is a state requirement that mandates the increased production of energy from renewable energy sources, such as wind, solar, biomass, and geothermal, to meet a specified goal. Twenty-nine states and the District of Columbia have RPS requirements.

Renewable Energy
Energy from a source that is naturally replenishing on a human time-scale or not depleted when used. Examples include solar, on-shore and off-shore wind, wave, tidal, geothermal, and hydropower.

Renewable Energy Credit (REC)
A certificate representing the environmental benefits or attributes of one megawatt-hour of generation from a generating facility that produces Class I or Class II renewable energy, with the exclusion of generating facilities that earn a solar renewable energy certificate or an offshore wind renewable energy certificate.

Regional Greenhouse Gas Initiative (RGGI)
The Regional Greenhouse Gas Initiative (RGGI) is the first mandatory market-based program in the United States to reduce greenhouse gas emissions. RGGI is a cooperative effort among several states in the Northeast and Mid-Atlantic regions to cap and reduce CO2 emissions from the power sector.

Regional Transmission Organization (RTO)
A Regional Transmission Organization, e.g. PJM, is an entity responsible for planning and operating regional electric transmission grids.

Rooftop Solar
Type of solar generating facility that is sited on the roof of a building or structure.

Solar PV (solar)
Technology that utilizes solar radiation to generate electricity by means of solar photovoltaic panels.

Solar Thermal
Energy systems that utilize rooftop panels to provide water heating for residential, commercial and industrial buildings.

Solar Renewable Energy Certificate (SREC)
An SREC is a tradable certificate that represents the clean energy benefits of electricity generated from a solar energy system. An SREC is generated after 1000 kWhs are produced by the solar system. SREC quantities are established by New Jersey's RPS, and SREC prices are established by the competitive market, up to the solar alternative compliance payment (SACP) ceiling.

Therm (t)
A unit of heat energy equal to 100,000 BTUs or approximately 100 cubic feet of natural gas. It is a measure of natural gas used converted from volume to energy at the meter.

Third-Party Supplier (TPS)
A NJBPU-registered company that sells electricity or natural gas supplies directly to an energy user. This entity includes, but is not limited to, marketers, aggregators, and brokers.

Utility-Scale Solar
Large-scale solar generating facility which feeds directly into the electric grid.

Value Stack
The practice of enabling a single energy resource to receive multiple different streams of revenue corresponding to different services, or "use cases," provided by the resource.

Vehicle Miles Traveled (VMT)
The primary metric to assess vehicle travel is to measure vehicle miles traveled (VMT), where one vehicle traveling one mile equals one VMT.

Volt/Var Control
A set of technologies that manage and "right-size" the voltage received by end-users so as to minimize wasted electricity.

Zero Emission Vehicle (ZEV)
A vehicle that emits no tailpipe pollutants from the onboard source of power, such as particulates, hydrocarbons, carbon monoxide, ozone, lead, and various oxides of nitrogen. According to the Multi-State ZEV MOU to which New Jersey is a signatory, ZEVs include battery-electric vehicles (BEVs), plug-in hybrid electric vehicles (PHEVs), and hydrogen fuel cell electric vehicles (FCEVs).

APPENDIX A:
Integrated Energy Plan: Scenario Results and Cost Estimates

Integrated Energy Plan Scenario Results

The following sections detail the purpose, implementation, and findings of the nine Integrated Energy Plan scenarios.

In a business-as-usual case that assumes no recent energy policies, New Jersey's energy system remains much as it is today, and as a result, emissions in 2050 are much higher than the state's targets.

Reference 1: Business as usual

Purpose: The business-as-usual 'Reference 1' plays an important role in the analysis by serving as a baseline against which other scenarios can be easily compared. Reference 1 shows the least-cost investments, and their associated costs and emissions impacts, that New Jersey would make without striving to achieve emissions reductions or implement recent clean energy policies.

Implementation: In Reference 1, the only clean energy policies that are included are the 2021 22.5% Renewable Portfolio Standard and the SREC program that resulted in the yearly addition of 400 MW of solar through 2030. The vehicle fleet in the state remained powered by gasoline and diesel. Buildings retained their use of natural gas and delivered fossil fuels (e.g., oil, propane).

Key Findings:

1. **Emissions remain high:** In the reference scenario, emissions remain close to 80 MMT of carbon dioxide per year through 2050, and New Jersey does not come close to meeting either of its targets (Figure A). Gasoline emissions fall only slightly, due to increased vehicle fuel efficiency. Natural gas emissions fall slightly as solar and PJM wind are added as least-cost electricity generation resources.
2. **New Jersey's electricity mix remains similar to today's, though solar and wind increase due to their low cost.** New Jersey continues to rely on nuclear power and in-state natural gas. Solar, imported PJM wind, and offshore wind are added due to their low cost (Figure B).
3. **New Jersey energy costs decrease as a share of the state's economy.** In the reference case, New Jersey's energy costs decrease from just over 4% to about 3% of New Jersey's GSP, due to the continuing trend of decoupling economic growth from energy use.

FIGURE A.

Emissions reductions in Reference 1 scenario as compared to the Least Cost scenario

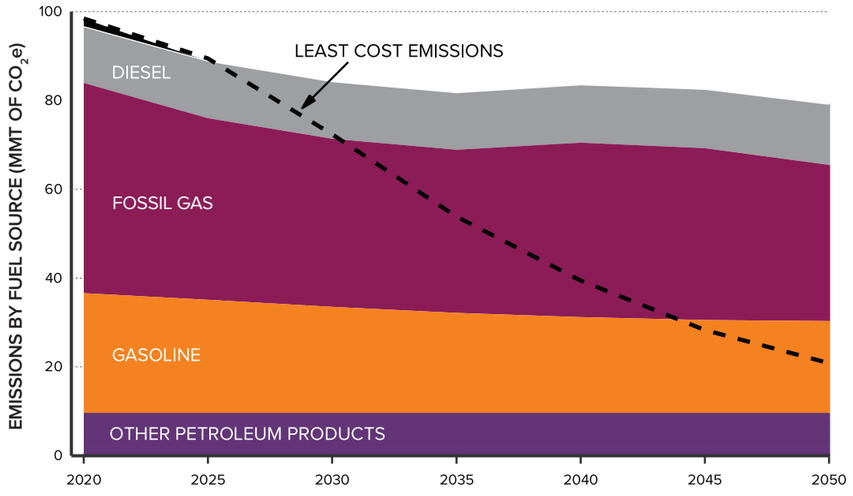

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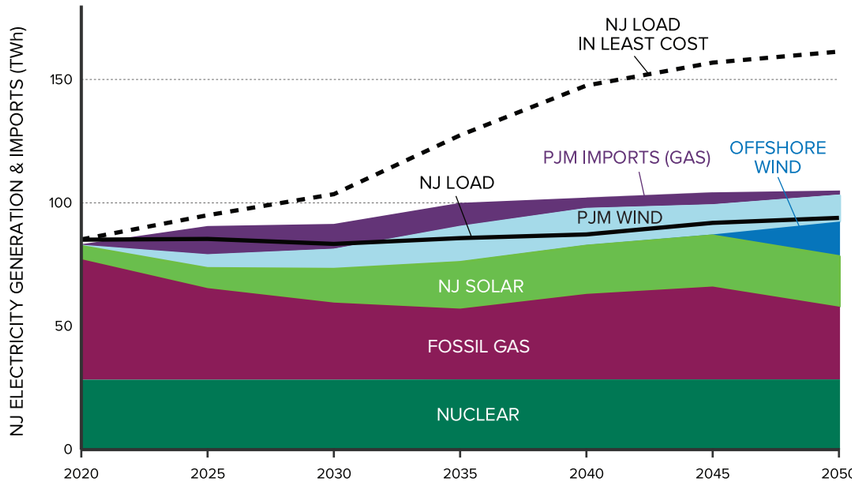
FIGURE B.

Electricity generation in the Reference 1 scenario

Note that electricity exports are not shown, which is why generation and imports do not sum to New Jersey load.



Recently passed energy policies will drive a near-term decline in New Jersey's carbon emissions, but fall well short of those needed to put the state on a path to meet its 2050 emissions reduction and clean energy targets.

Reference 2: Existing clean energy policies, with the exception of emissions targets.

Purpose: Reference 2 examines the impact and cost of implementing the Clean Energy Act of 2018 and the ZEV MOU, but excludes the 80x50 emissions reduction and 100% clean energy targets.

Implementation: Reference 2 includes recent polices for electric vehicle adoption, efficiency programs, storage carve-outs, offshore wind carve-outs, and an increase in the RPS, but does not require the state to meet its emission reduction targets.

Findings:

1. **Emissions remain high:** Reference 2 emissions are marginally lower than in Reference 1 but still exceed 75 MMT through 2050 and do not approach New Jersey's emissions reduction goals (Figure C).

2. **Additional costs and fuel savings are small:** The cost difference between References 1 and 2 are approximately $1.5 billion per year in 2030 and $0.6 billion per year in 2050 (Figure D). There are some small additional costs for efficient appliances, electric vehicles, and renewables. However, these costs are nearly offset by fuel savings. Most of the new and avoided costs result from the electricity sector where efficiency, offshore wind, and storage costs displace natural gas.

FIGURE C.

Emissions trajectory in Reference 2

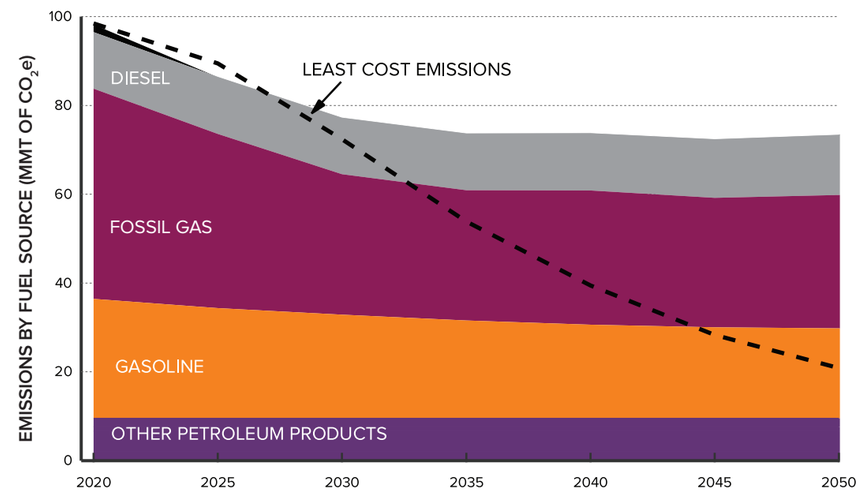
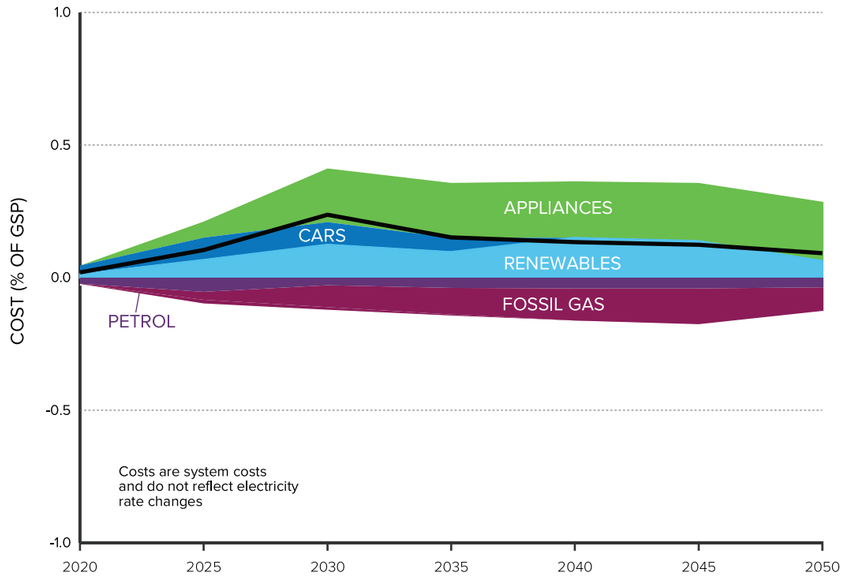


FIGURE D.

Breakout of costs in Reference 2 case

Note: See the Least Cost scenario below for a description of how to interpret this chart.



Least Cost Scenario

Purpose: The Least Cost scenario combines aggressive building and transportation electrification with few limitations on energy generation. The intent of the Least Cost scenario is to set a baseline for meeting New Jersey's emissions targets and to allow the other Integrated Energy Plan scenarios (Variations 1 through 6) to test the impacts of different assumptions, constraints, and other uncertainties.

Implementation: The Least Cost scenario assumes aggressive transportation and building electrification, allowing these two sectors, which combined account for the majority of New Jersey's current emissions, to be largely electrified and powered by 100% clean electricity by 2050. This scenario does not place further supply-side constraints beyond the carve-outs in existing policy. Specifically, the scenario assumes:

- **Transportation electrification:** Electric vehicles make up an increasing share of light-duty vehicles (LDV, i.e., passenger cars). New LDV purchases are entirely electric in 2035 so that 100% of LDV fleet is electric by 2050, because the model assumes 15-year vehicle lifespans. Medium- and heavy-duty vehicles are also mostly electrified, though some diesel vehicles remain.
- **Building electrification:** In 2030, buildings are increasingly retrofitted with electric appliances so that the building stock throughout the state is 90% electric by 2050.
- **Out-of-state renewables:** New Jersey is able to purchase renewable resources tied to PJM (through power purchase agreements). Renewable imports cannot exceed ~7 GW transmission infrastructure into New Jersey without further transmission system investment. In this scenario, new transmission investments were limited to an additional 7 GW.
- **Energy efficiency:** Appliances are replaced with the most efficient models available, as part of the stock rollover model.
- **Nuclear:** The nuclear fleet remains active through their permits and then retained if it is determined economic to do so.
- **In-state natural gas generation:** No limits are placed on natural gas generation other than the requirement to meet New Jersey's emissions limits. Natural gas power plants are assumed to have a maximum 50-year life. Gas plants can utilize synthetic or biogas (at corresponding higher fuel prices than fossil gas) to produce carbon-neutral electricity.
- **Solar:** Solar is added at a rate of at least 400 MW per year through 2030 due to the new solar program. Additional solar can be added if it is economic to do so.
- **Storage:** At least 2 GW of storage is added by 2030.
- **Offshore wind:** At least 3.5 GW of offshore wind is added by 2030.
- **Grid upgrades:** Integrated Energy Plan modeling accounts for the incremental costs of transmission and distribution upgrades due to electrification by scaling up current grid expenses.

The Least Cost scenario that meets New Jersey's 2050 targets relies on electric vehicles, building electrification, and renewable energy deployment at scale. In this scenario, the state meets its 2050 emission reduction goals, and the costs of needed investments are more than offset by avoided fuel costs, avoided air pollution, and other emission reduction benefits.

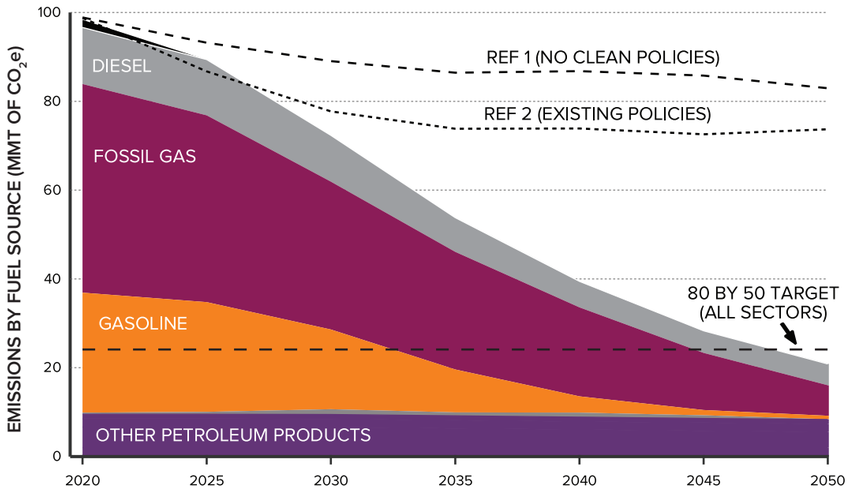
Findings:

1. **New Jersey can meet its emissions goals:** Greenhouse gas emissions fall in all sectors (Figure E). Buildings and transportation electrify, nearly eliminating gasoline use and significantly reducing natural gas use. Renewables generate most of New Jersey's electricity, including large contributions from in-state solar, offshore wind, and PJM-connected onshore wind, with intermittent generation balanced by storage, nuclear, and clean firm resources by 2050.

FIGURE E.

Energy emissions reductions by fuel source in the Least Cost scenario

The dashed and dotted lines show total energy emissions in the Reference 1 and Reference 2 scenarios.



2. **The incremental costs to meet New Jersey's emissions targets are small compared to overall energy system spending.** Overall annual energy system spending is $2.2 billion per year higher than in Reference 1 by 2050, but is still low compared to historical trends. Additionally, the direct healthcare cost savings associated with reduced air pollution and societal benefits associated with climate change mitigation further offset the incremental costs, accruing net benefits (Figure F). Additional costs for efficient electric appliances, electric vehicles, grid improvements, and renewable electricity generation are largely offset by reduced costs for fossil fuels (Figure G).

FIGURE F.

Incremental energy system costs, avoided fuel costs, clean air health benefits

Including emissions reduction benefits in the Least Cost scenario.

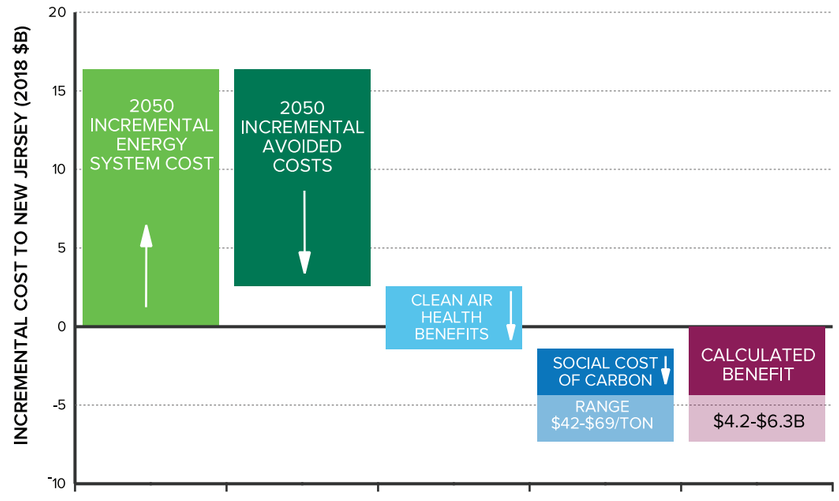


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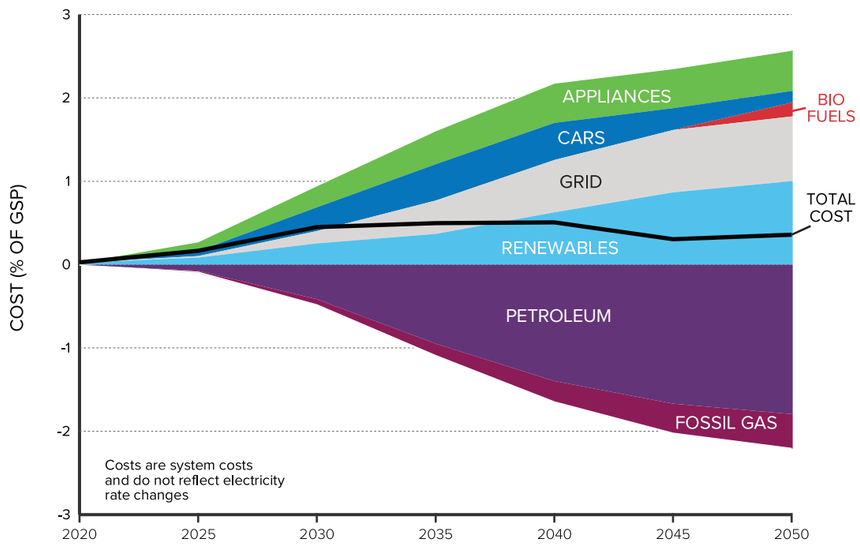
FIGURE G.

Incremental and avoided costs in the Least Cost scenario

See call-out box for description of this and similar charts.



3. **Final energy demand decreases, while electricity demand increases.** Due to efficiency and electrification, total energy demand decreases, as shown in Figure H. Electrification of the building and transportation sectors increases total electricity demand and shifts peak demand to winter months (Figure I).

4. **New in-state renewables provide a majority of New Jersey's electricity.** As shown in Figure J, New Jersey solar and offshore wind are deployed at high rates and contribute the majority of electricity generation by 2050. Out-of-state, PJM-connected wind and solar make important contributions to the state's electricity supply by complementing in-state resources. To accommodate PJM-connected renewables, the model builds an additional 2 GW of transmission (less than the maximum allowed 7 GW of additional transmission). The nuclear fleet is retained past current licenses, as carbon-free energy is valuable for meeting the 100% clean energy standard in 2050.

FIGURE H.

Final energy demand in the Least Cost scenario

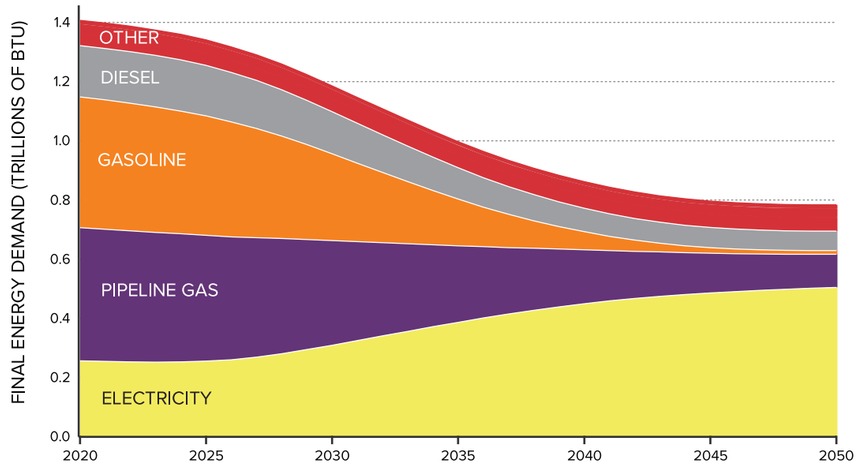


FIGURE I.

Changes to monthly electricity demand in the Least Cost scenario

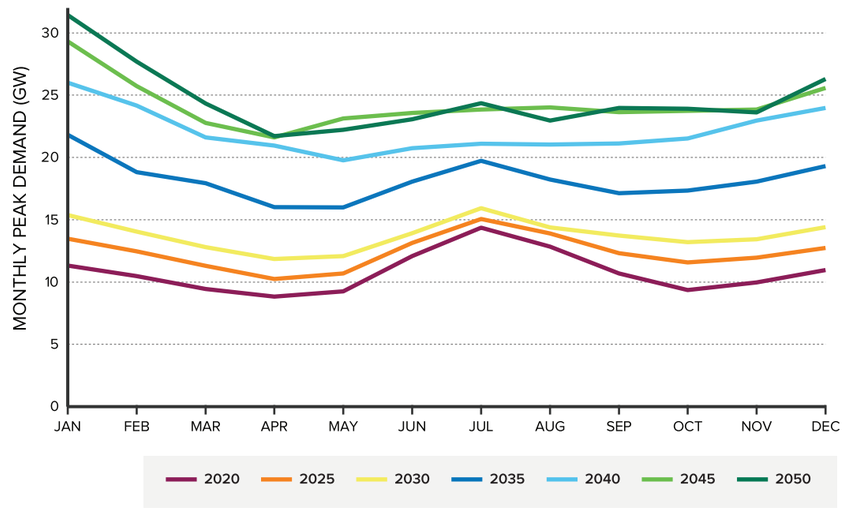


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FIGURE J.

Gas-fired generation decreases through 2050

While dispatchable capacity increases to provide reliability.

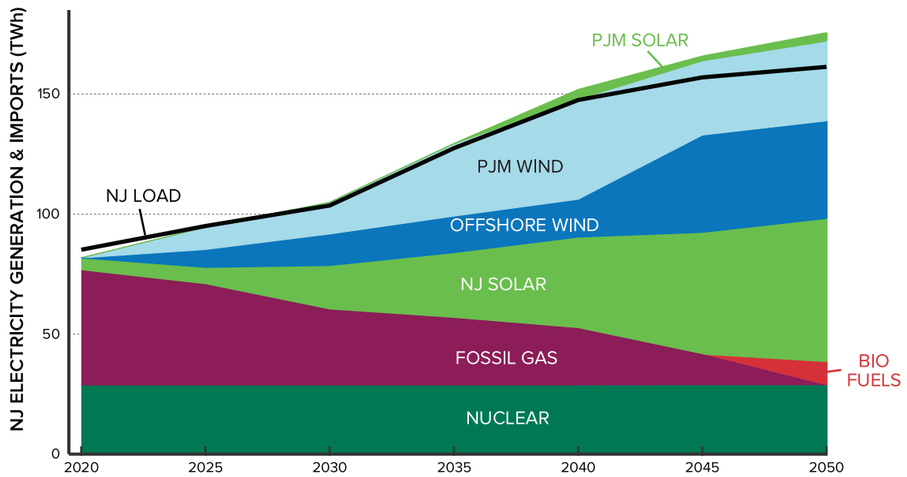
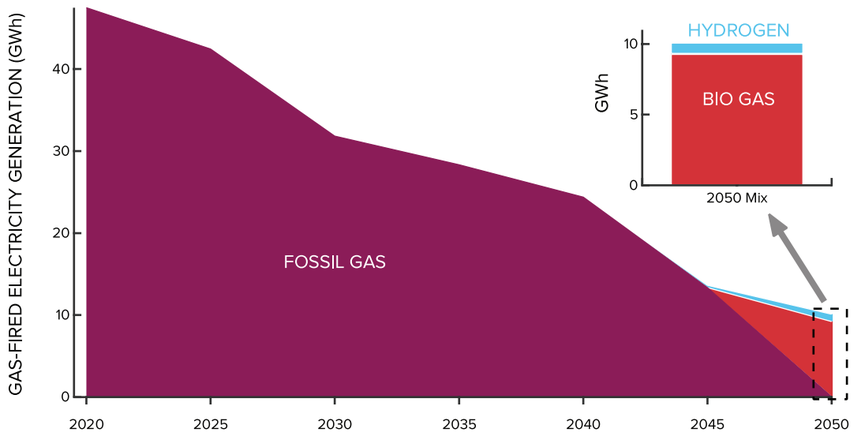


FIGURE K.

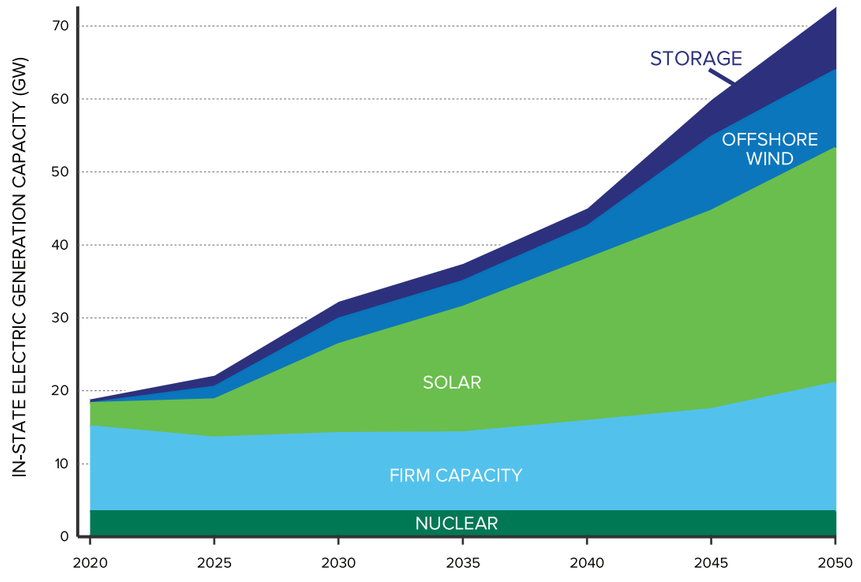
Gas-fired dispatchable electricity generation in the Least Cost scenario



5. **Gas-fired generation decreases through 2050, while dispatchable capacity increases to provide reliability.** As shown in Figure K, the use of gas-fueled turbines to generate electricity decreases from 48 TWh in 2020 to 10 TWh in 2050, even as total electricity use increases by more than 100%. While Figure K shows that the total energy required from dispatchable sources continually decreases, Figure L shows that the firm capacity required to provide reliability when solar and wind are unavailable for extended periods increases after 2035. This added capacity would run very infrequently, but would occasionally be needed to reliably meet New Jersey's energy demands. A number of technologies could provide this reliability, including long duration storage, gas generators fueled by hydrogen or synthetic methane, or hydrogen-powered generation. With the cost projections used in the analysis, the most economic reliability option that the Integrated Energy Plan identified is gas turbines fueled by a mix of hydrogen and biogas produced from energy-specific crops.

FIGURE L.

In-state electricity generation capacity in Least Cost scenario



Interpreting Scenario Cost Charts

The cost breakdown for each scenario is shown using a common format, as seen in Figure G. Each positive wedge (above the x-axis) indicates costs higher than those in the Reference 1 scenario. Each negative wedge (below the x-axis) represents savings due to reduced fossil fuel costs compared to Reference 1. Costs are presented as a percentage of New Jersey's Gross State Product, and include full energy system costs including vehicle and appliance purchases, fuel costs, and electricity costs. Each wedge includes a different category of the state's energy system costs:

- **"Appliances"** represents additional costs for electric or more efficient building appliances, medium- and heavy-duty vehicles.
- **"Cars"** represents incremental higher purchase prices for electric vehicles over the cost of internal combustion engine vehicles.
- **"Grid"** represents the additional cost to upgrade the electricity transmission and distribution system to support increased electricity demand.
- **"Renewables"** represents the additional costs to deploy renewable electricity generation (solar and wind) and battery storage.
- **"Biofuels"** represents the additional costs to use biofuels in place of fossil fuels.
- **"Petroleum"** represents the savings due to reduced gasoline and diesel fuel use.
- **"Fossil Gas"** represents the savings due to reduced natural gas use.

The net cost for each year is the difference between the incremental costs (the wedges above the x-axis) and the incremental savings (the wedges below the x-axis). The net costs by year are shown as a black line. For each variation, we include the Least Cost scenario's net cost as a dashed line for comparison.

Note that each of the variations modeled below meets the 2050 GWRA goals, but use different assumptions that offer different degrees of flexibility to achieve further emissions reductions beyond what is currently legislated. Increasing the amount or pace of emissions reductions in Variations 3 and 6, in particular, would result in much higher costs because of their respective reliance on limited carbon-neutral **fuel options.**

Variation 1: Eastern United States decarbonizes with New Jersey

Purpose: The Integrated Energy Plan team developed Variation 1 to test the impact and cost when both New Jersey and the Eastern Interconnect all work to meet 80% emissions reductions as well as 100% clean energy by 2050. In this scenario, it is easier for the region to share its geographic diversity but there is also more demand for onshore wind.

Implementation: Variation 1 extends New Jersey's goals to the entire Eastern Interconnect. It applies an economy-wide emissions constraint requiring all states in PJM—not just New Jersey—to achieve the 80% by 2050 emissions reduction goal and 100% carbon-neutral electricity generation.

Findings: The Integrated Energy Plan finds three main physical implications for New Jersey's system as a result of enforcing PJM-wide state action on decarbonization:

1. **Increased region-wide demand for renewables:** States implementing decarbonization policies across the Eastern Interconnection have the effect of increasing demand for renewable generation in the region and therefore creating more competition for sourcing lower-cost, high-quality renewables.

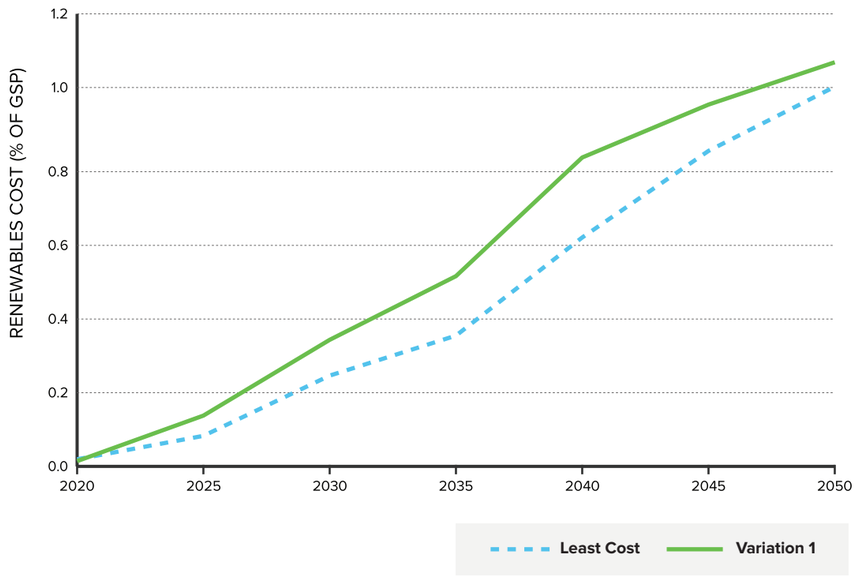
2. **Increased competition affects New Jersey:** As in the Least Cost scenario, in Variation 1, New Jersey can import out-of-state renewables to meet its decarbonization goals. Unlike the Least Cost scenario, no accounting mechanisms are required to determine when and how much electricity importing is allowed because the entire region decarbonizes together. With the increased demand for clean electricity, Variation 1 exhausts the best wind resources in PJM. While adequate wind remains, it is marginally more expensive. Figure M illustrates the increase in renewable energy costs for New Jersey in this scenario.

3. **Greater benefits of region-wide decarbonization:** With the entire Eastern Interconnect reducing emissions, the environmental, economic, and health benefits of decarbonization are shared region-wide. These benefits are not captured when looking at the cost-benefit outcome for New Jersey alone.

In a scenario where states in the entire PJM region pursue GWRA and 100% clean energy goals, New Jersey faces higher-cost renewable energy imports due to competition from other states, and develops additional in-state resources.

FIGURE M.

Cost of renewable generation in Variation 1 and the Least Cost scenario



Cost implications: Costs to New Jersey in this scenario increase by $0.8 billion per year in 2050 compared to the Least Cost scenario due to region-wide competition for the lowest-cost resources (Figure N). This figure does not include additional air quality and climate change mitigation benefits to New Jersey associated with region-wide decarbonization.

Variation 2: Reduced regional cooperation

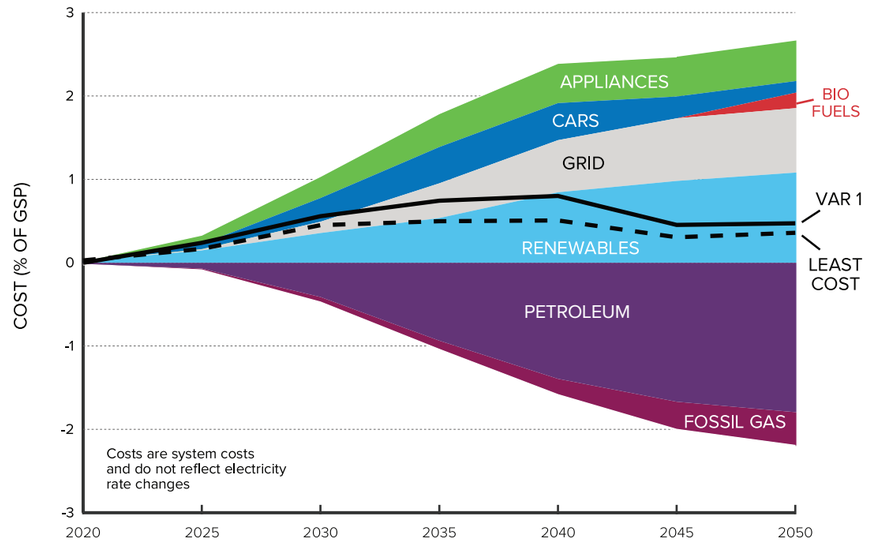
Purpose: The Integrated Energy Plan team developed the Variation 2 scenario to test the impact and cost of New Jersey meeting 2050 GWRA and 100% clean energy goals without allowing for any clean electricity imports from out-of-state. Stakeholders suggested this scenario as a way to test how New Jersey might adapt if regional cooperation on clean energy resources proved difficult or impossible.

Implementation: Variation 2 assumes that New Jersey loses the ability to build clean energy generation capacity out-of-state and import the resulting clean electricity. The model prevents build-out of new transmission, maintains the currently available 7 GW of transmission capacity, and precludes the ability

FIGURE N.

Incremental and avoided costs in Variation 1

Note: not including public health and climate change mitigation cost benefits.



In a scenario in which New Jersey must meet all electricity needs with generation located within the state, resource diversity would be limited, requiring additional investment in in-state renewables, storage, and firm capacity to ensure reliability and meet 2050 goals.

to procure out-of-state resources. The 2050 GWRA and 100% clean energy goals are therefore met through investment in new resources within New Jersey's borders (Figure O).

Findings: The Integrated Energy Plan finds three main physical implications for New Jersey's system as a result of excluding out-of-state imports:

1. **Offshore wind capacity increases:** To compensate for a lack of access to out-of-state renewable resources in this scenario, the model must build additional renewable resources in-state that are higher cost than imported, onshore wind. As a result, offshore wind generation capacity in 2050 is approximately 20.7 GW in 2050 in Variation 2, compared to 10.7 GW in the Least Cost scenario.

2. **Increase storage and firm capacity for reliability:** The lower diversity in generation resources in this scenario requires an increase in energy storage and firm capacity for balancing. In 2050, energy storage and firm capacity are approximately 10.9 GW and 20.1 GW, respectively, compared to corresponding values in the Least Cost scenario of 8.7 GW of storage and 17.6 GW of firm capacity.

3. **Increased biofuel requirement:** Reduced resource diversity in Variation 2 and the resulting increase of firm capacity for reliability also requires doubling the amount of biofuel used for electricity generation in 2050, compared to Least Cost scenario levels.

FIGURE O.

Comparison of in-state storage, offshore wind, and firm capacity in Least Cost scenario and in Variation 2

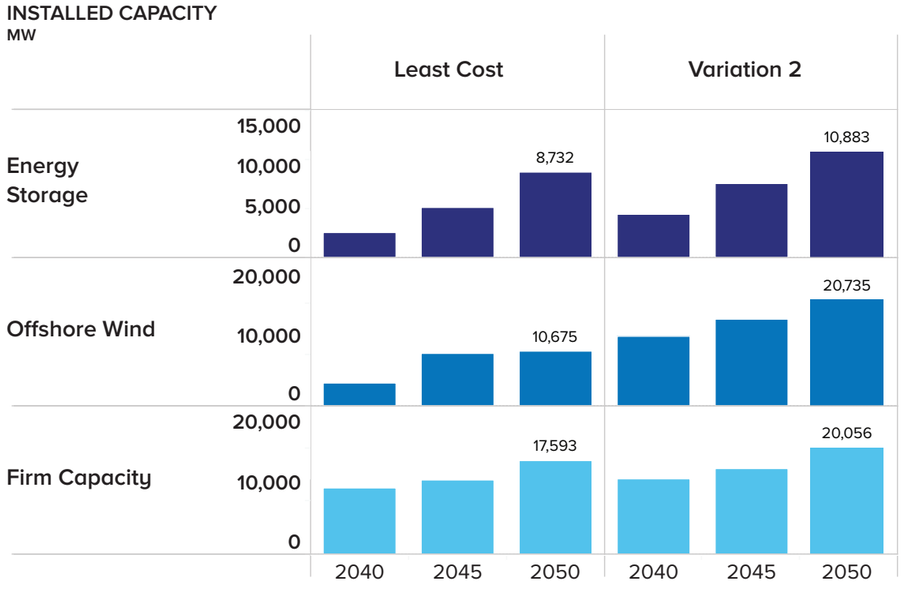
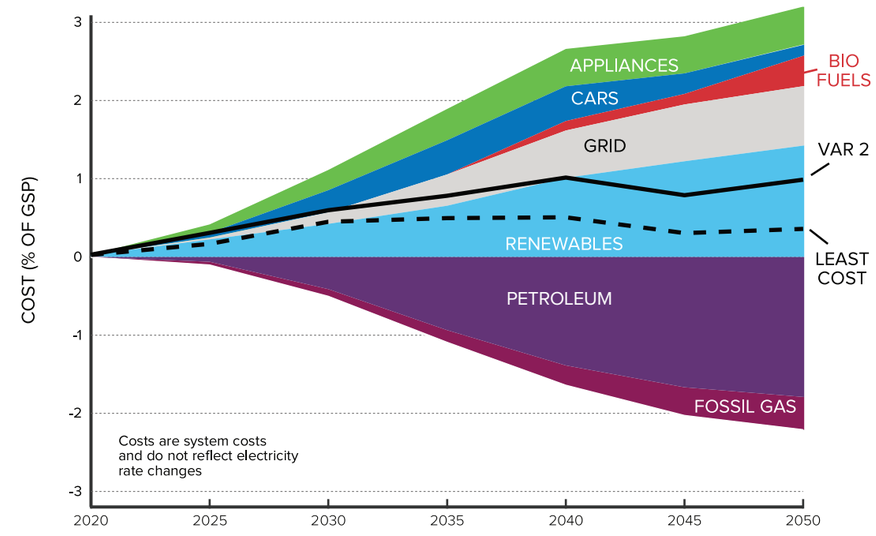


FIGURE P.

Marginal investment and avoided fuel costs in Variation 2

Note: See Least Cost scenario for details on the components of this chart.



Cost implications: The Integrated Energy Plan found that a lack of access to low-cost, out-of-state renewables that complement in-state energy generation would increase annual costs by $1.5 billion in 2030 and by $4.9 billion in 2050, compared to the Least Cost scenario (Figure P). Incremental costs are driven by offshore wind, storage, and firm capacity investments.

Variation 3: Retain fuel use in buildings

Purpose: This scenario tests the impacts and costs of meeting New Jersey's climate and energy targets without any building electrification efforts. Stakeholders requested that the Integrated Energy Plan model a scenario without electrification to assess whether alternative strategies for meeting 2050 GWRA goals (e.g., renewable natural gas delivered to buildings) might be more cost-effective than retrofitting buildings with heat pumps.

If New Jersey buildings do not electrify, in order to meet the 2050 GWRA emissions target the state would need to purchase higher amounts of relatively expensive, biologically-based fuels from out-of-state to power the buildings sector.

Implementation: In Variation 3, the Integrated Energy Plan team omitted the adoption of electric space and water heating in buildings. The model then optimized New Jersey's energy supply mix to deliver building fuels while still meeting 2050 GWRA and 100% clean energy goals.

Findings: The Integrated Energy Plan finds four main physical implications for New Jersey's energy system:

1. **Total final energy demand increases:** Heat pumps are approximately 3 times as efficient for space and water heating than direct combustion of either natural gas or other delivered fuels. As a result, 2050 final energy demand in this scenario is approximately 20% higher than in the Least Cost scenario; demand for delivered electricity falls by 90 billion BTU, but increased demand for natural gas for building heating increases by 260 billion BTU (Figure Q).

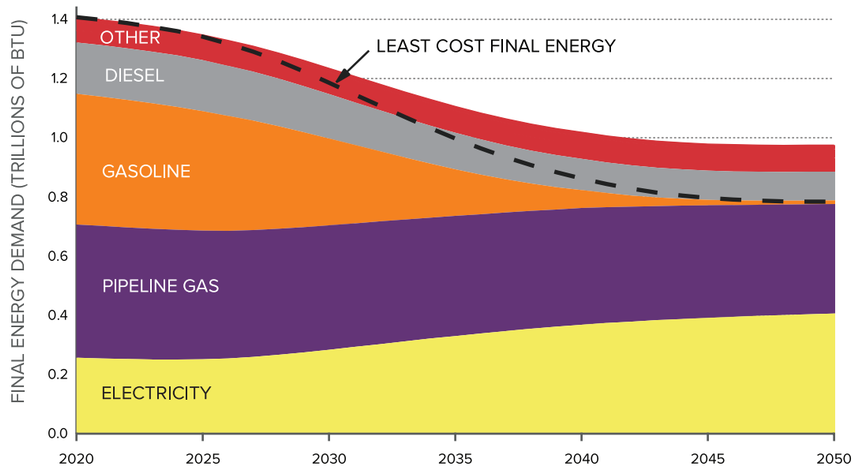
2. **Increased biofuel requirement:** To meet the 2050 GWRA goal while retaining fuel use in buildings, the model is forced to include carbon-neutral gas in the mix delivered to buildings. This results in increased biofuels costs (red wedge in Figure R) between 2040 and 2050 compared to the Least Cost case.

3. **Reduced need for electricity supply and delivery investment, but reduced savings on fossil gas:** The reduction in electricity demand compared to the Least Cost scenario lowers the need for generation and grid investments (light blue and gray wedges in Figure R). Appliance costs actually increase because buildings must invest in both air conditioners and furnaces, while air-source heat pumps in the Least Cost scenario provide both heating and cooling. Reduced electricity demand also reduces the need for additional dispatchable capacity in 2050 compared to the Least Cost scenario, and dispatchable capacity declines from approximately 17 GW to 8 GW.

4. **Limited flexibility for further emissions reductions:** This scenario relies on the direct combustion of relatively expensive biofuels to meet 2050 GWRA targets. Any increase in desired scale or pace of emissions reductions from the energy sector (e.g., through additional policy mandates, or under a scenario where non-energy sector emissions do not decline as far or as rapidly as necessary) would require additional use of these relatively scarce and high-cost resources and add significantly to system-level costs. In contrast, the Least Cost scenario allows New Jersey to decarbonize faster and further because it uses electricity to power a larger portion of end-use demands with carbon-neutral power.

FIGURE Q.

Final energy demand in Variation 3

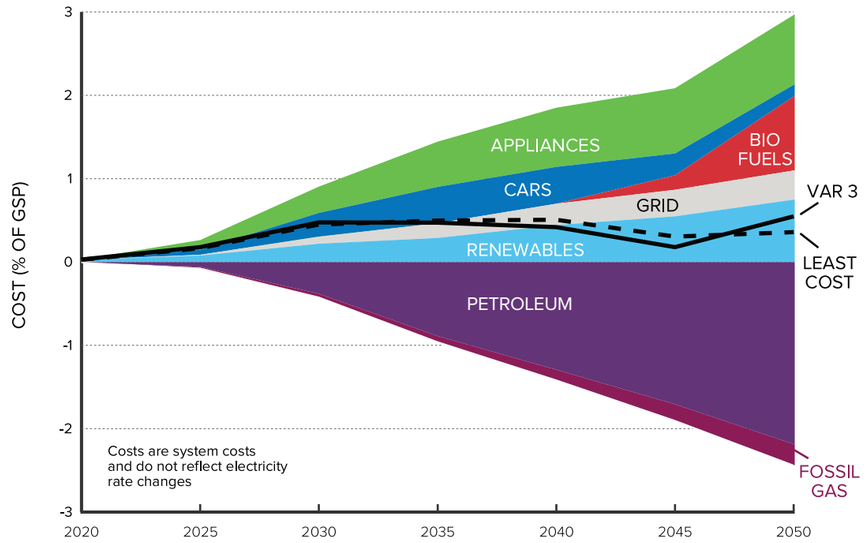


Cost implications: Through 2045, Variation 3 is similar in cost to the Least Cost scenario (Figure R). However, as emissions constraints tighten near 2050, increased biofuel use causes this scenario to cost $1.1 billion per year more than the Least Cost scenario, and as noted above, further emissions reductions would drive much higher costs because there are a limited number of carbon-neutral fuel options.

FIGURE R.

Marginal investment and avoided fuel costs in Variation 3

Note: See Least Cost scenario for details on the components of this chart.



Variation 4: Technology cost reductions

Purpose: Historically, price forecasts for clean energy have tended to be overly conservative, underestimating how fast the realized costs of these technologies would actually decline. This scenario investigates this trend by making less conservative forecasts for the price of solar generation, wind generation, and energy storage.

Implementation: In this scenario, future costs for solar PV, offshore wind, and energy storage technologies for New Jersey are assumed to be lower than in all other scenarios. Technology price data is sourced from NREL ATB 2019 Low forecasts. Storage prices are from International Renewable Energy Agency (IRENA) Low forecasts.

Summary of scenario findings: The Integrated Energy Plan finds two main physical implications for New Jersey's system as a result of faster cost reductions for solar, wind, and storage:

1. **Increased energy storage:** Owing to the relatively more favorable price of storage, Variation 4 shows increased deployment of energy storage in New Jersey compared to the Least Cost scenario. Energy storage capacity is approximately 11.6 GW by 2050 compared to approximately 8.7 GW in the Least Cost scenario.

2. **Reduced gas capacity need:** With renewable generation and energy storage being relatively less expensive, the need for gas capacity is reduced. In Variation 4, gas capacity by 2050 is approximately 17.0 GW, a slight decrease from the Least Cost scenario gas capacity of approximately 17.6 GW in 2050.

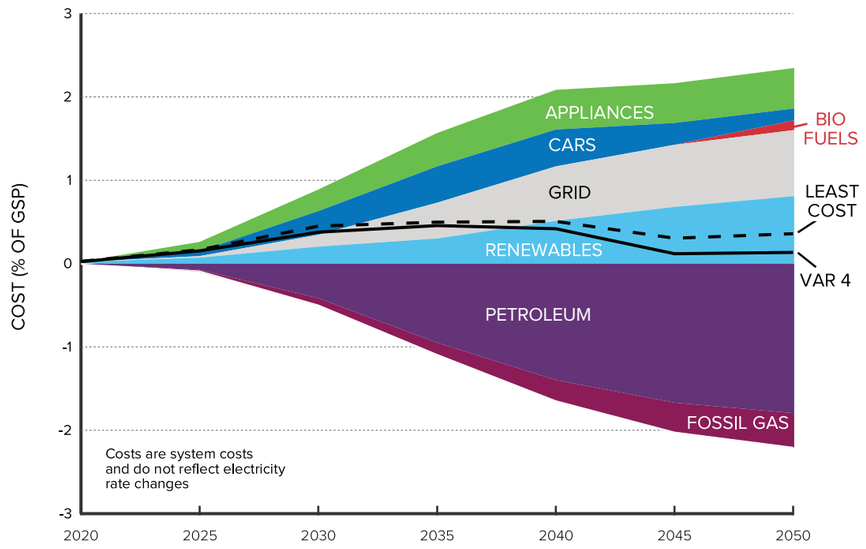
In a scenario in which cost declines for renewable and storage technologies continue at a pace closer to historical levels than the base-case assumptions used elsewhere in the Integrated Energy Plan, New Jersey's energy system could evolve to meet 2050 GWRA and 100% clean energy targets at a cost near parity with business-as-usual.

Cost implications: The Integrated Energy Plan found that accelerated cost reductions for wind, solar, and energy storage would reduce the overall cost of system decarbonization (Figure S). New Jersey's energy system in Variation 4 is $0.5 billion per year less expensive than the Least Cost case in 2030. Relative cost decreases further to $1.4 billion per year less expensive than the Least Cost scenario in 2050, or approximately $0.7 billion per year more expensive than the business-as-usual case in Reference 1.

FIGURE S.

Marginal investment and avoided fuel costs in Variation 4

Note: See Least cost case for details on the components of this chart.



In a scenario in which all incremental investment in electricity generating capacity in New Jersey goes to renewable resources, the need to balance electricity demand and supply in a grid dominated by renewable energy leads to significant storage requirements and high costs in 2050.

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Variation 5: Nuclear retirement and no new gas power plants

Purpose: This scenario estimates the impact and cost for New Jersey to avoid any new gas-powered electricity generation through 2050 and to require the nuclear fleet to retire. The Integrated Energy Plan team constructed this scenario based on stakeholder comments that indicated an interest in testing a scenario closer to "100% renewables" than the Least Cost scenario's inclusion of carbon-neutral generation.

Implementation: In Variation 5, the Integrated Energy Plan does not allow new gas plant investments and requires the existing nuclear fleet to retire when unit licenses expire. Existing gas generators are allowed to continue operating until the end of an assumed 50-year life.

Findings: The Integrated Energy Plan finds three main physical implications for New Jersey's system as a result of nuclear retirement and no new gas power plants built:

FIGURE T.

Energy storage, offshore wind, and firm electricity generation capacity in the Least Cost and Variation 5 scenarios

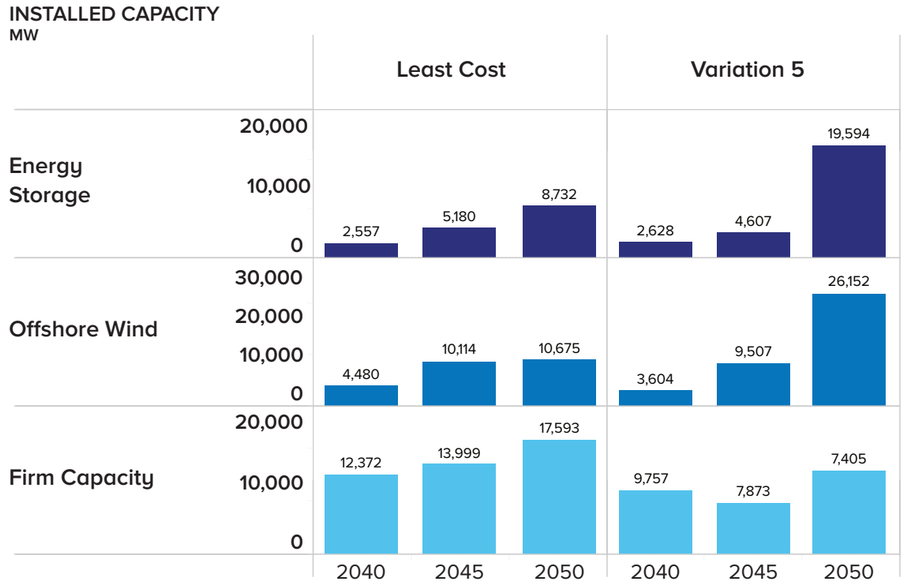
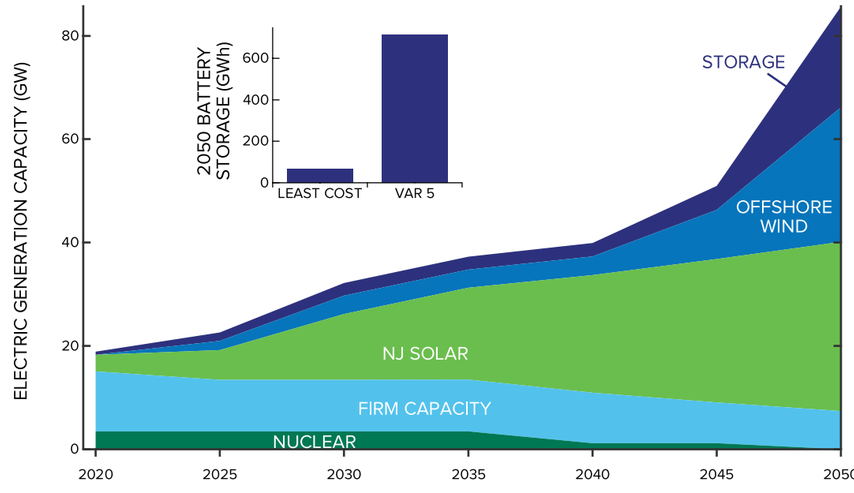


FIGURE U.

In-state electricity generation capacity in Variation 5

Note: Inset shows 2050 battery storage energy capacity (duration) for the Least Cost and Variation 5 scenarios.



1. **Increased offshore wind and energy storage build:** To meet electricity demand as existing gas and nuclear plants retire, Variation 5 increases offshore wind and energy storage capacity (Figure T). The greatest increase occurs between 2045 and 2050, when nuclear and many gas plants have retired, with only 7.4 GW of gas capacity still active in 2050. Energy storage reaches approximately 19.6 GW by 2050, up from 4.6 GW in 2045, while offshore wind capacity in 2050 grows to 26.2 GW, from 9.5 GW in 2045.

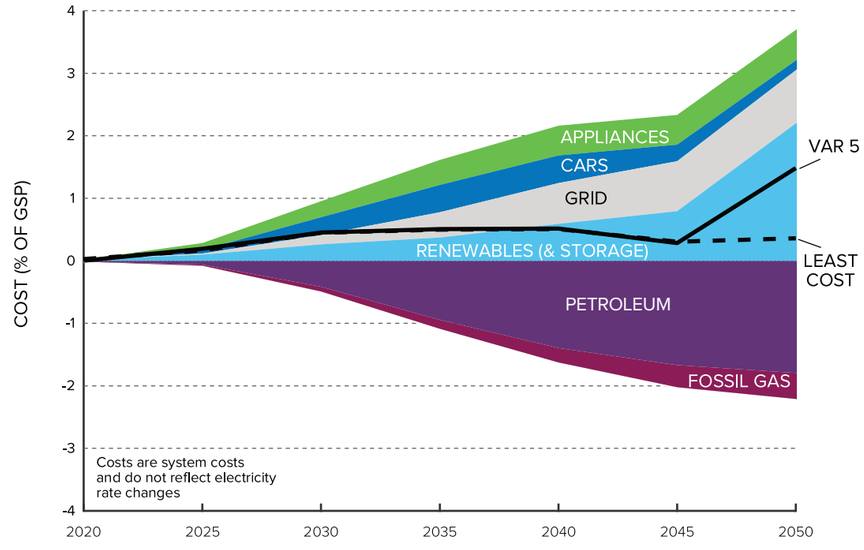
2. **Increased average storage duration:** The constraints imposed on dispatchable generation in Variation 5 require increased battery energy capacity (both power and duration) to maintain system reliability. The average energy storage duration in 2050 is 36 hours, compared to 8 hours in the Least Cost scenario where adequate nuclear and dispatchable generation (fueled by biogas) can provide energy during the rare extended periods when wind and solar are unavailable (Figure U).

3. **Increased intertie capacity:** The need to ensure system reliability also drives an increase in energy imports from out-of-state. In Variation 5, gas imports for reliability occur prior to 2050 and nuclear energy is replaced with additional out-of-state renewables in order to meet 2050 GWRA and 100% clean energy goals.

Cost implications: Variation 5 is similar in cost to the Least Cost scenario through 2045 (Figure V). After 2045, when the system no longer has enough dispatchable generation to retain reliability, the model chooses long duration battery storage to provide reliability. While the modeled lithium-ion storage plays a useful role in hourly and daily balancing, it is not cost-effective to provide reliability over the long durations required during rare events when wind and solar are unavailable for extended periods. Additional storage increases the costs an additional $7 billion per year in 2050 compared to the Least Cost scenario.

FIGURE V.

Marginal investment and avoided fuel costs in Variation 5



Variation 6: Reduced transportation electrification

Purpose: Variation 6 explores how New Jersey would meet the 2050 GWRA and 100% clean energy goals, and at what cost, if it kept fossil fuels in vehicles rather than electrify a greater share of New Jersey's vehicle fleet. Stakeholders expressed an interest in understanding the tradeoffs between vehicle electrification costs and the costs of other, alternative decarbonization strategies (e.g., biofuels) that could be used to meet 2050 GWRA targets.

Implementation: Variation 6 slows and reduces light-duty vehicle electrification so that it misses the 2025 ZEV MOU target and is only 50% electrified by 2050, in comparison to 100% electrification in the Least Cost scenario. Additionally, there is zero electrification assumed for medium- and heavy-duty vehicles. In this scenario carbon-neutral biofuels replace liquid fossil fuels to meet GWRA targets.

Summary of findings: The Integrated Energy Plan finds two main physical implications for New Jersey's energy system as a result of reduced electrification of transportation:

1. **Additional biofuels used for vehicles:** Due to reduced vehicle electrification, Variation 6 shows higher fossil fuel consumption in all years between 2020 and 2050 than the Least Cost scenario. In order meet to 2050 GWRA and 100% clean energy goals in this context of reduced vehicle electrification, biofuels must replace fossil fuels in liquid fuel vehicle consumption (Figure W).

2. **Limited flexibility for further emissions reductions:** This scenario relies on direct combustion of fuels in vehicles. As in Variation 3, the continued reliance on fuel combustion creates a poor foundation for further opportunities to reduce emissions in the future. In contrast, the Least Cost scenario preserves an ability to decarbonize faster or further due to its use of electricity to power a higher share of end-use demands with carbon-neutral power.

Cost implications: The Integrated Energy Plan found that in the near-term, lower rates of vehicle electrification would reduce society-wide costs by $0.1 billion annually in 2030 due to higher upfront costs for EVs and charging infrastructure versus traditional vehicles, but also found that in 2050, this scenario would require higher consumption of expensive biofuels to meet climate targets and would increase costs by $4.4 billion in 2050 (Figure X). Importantly, retaining gas-powered vehicles (even if they are partially powered with biofuels) would largely negate the health and clean air benefits found in the Least Cost scenario due to vehicle electrification.

In a scenario in which vehicles largely remain fueled with gasoline and diesel, New Jersey must use relatively expensive biofuels to comply with 2050 GWRA targets, driving up energy system costs.

FIGURE W.

Transportation fuel composition in Least Cost and Variation 6 scenarios

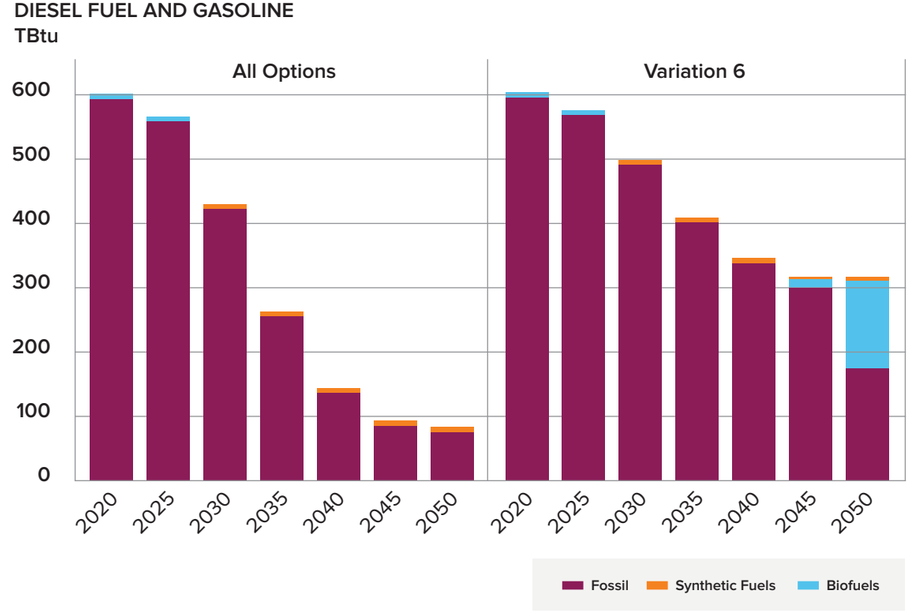


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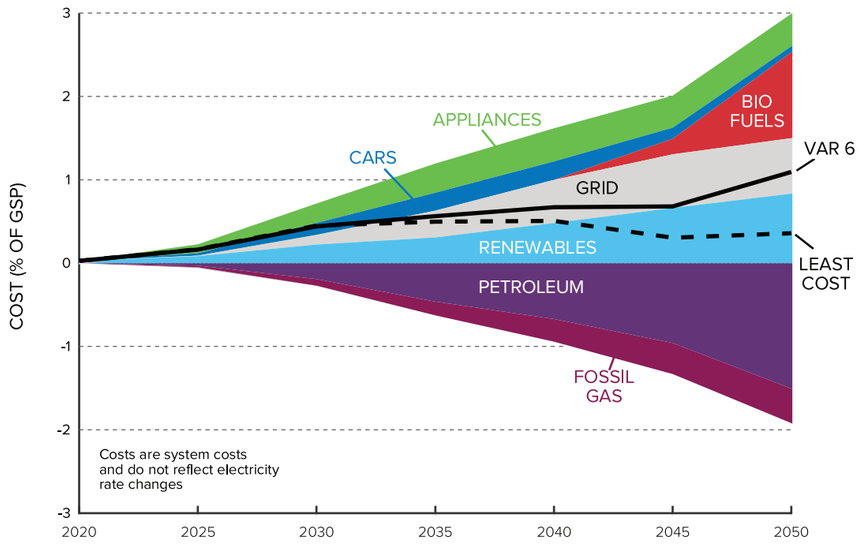
FIGURE X.

Incremental investment and avoided fuel costs in Variation 6



Integrated Energy Plan Scenario Cost Estimates

Summary of scenario costs

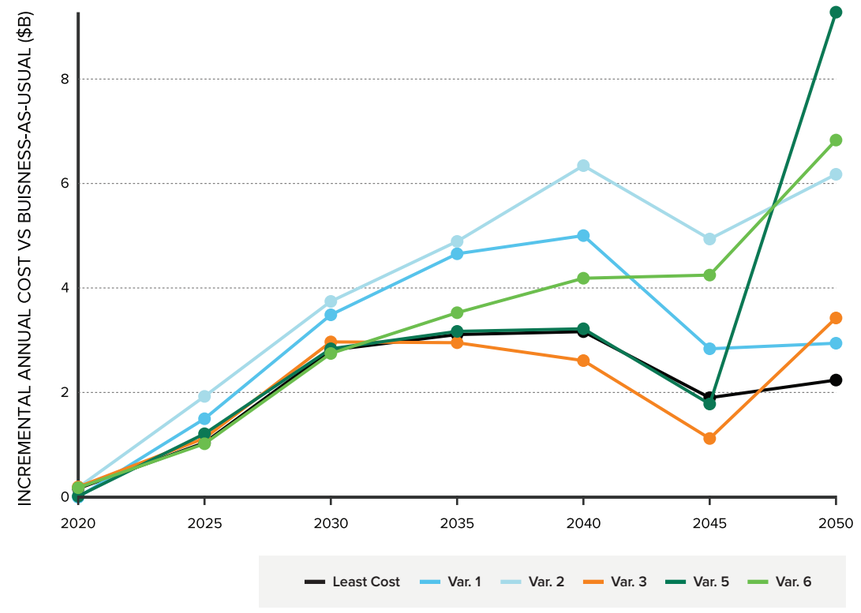
Figure Y summarizes the differences in annual energy system costs across each of the Integrated Energy Plan scenarios. The figure shows the annual net costs of the Least Cost scenario and each variation compared to the business-as-usual Reference 1 scenario.[1] As defined earlier, net costs reflect changes compared to the Reference 1 scenario in investments in demand- and supply-side equipment, operations costs, and avoided fuel costs.

Variations 3 and 6, which restrict end-use electrification, track close to or slightly below the costs of the Least Cost scenario before rising through 2050 as the cost of biofuels for direct combustion exceeds any sources of savings. Variation 2, which investigates the impact of reduced regional coordination, implies limited resource diversity and thus

FIGURE Y.

Incremental scenario costs, as compared to the business-as-usual Reference 1 scenario

Note: Costs are shown in 2018 dollars and reflect total energy system costs, not ratepayer impacts.



[1] Variation 4 is not included because it uses different cost assumptions than the other scenarios, and would therefore be an inconsistent comparison.

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higher costs each year, while Variation 1 shows the effects of regional competition for low-cost renewables and shows a smaller cost increase each year. Variation 5, which relies heavily on renewables and storage to meet long-duration reliability needs, tracks at or below the Least Cost scenario until 2045, at which point reliability needs require increasing investment in long-duration storage resources that are relatively more expensive than reliance on biogas-fueled turbines for rare balancing needs.

Each of the scenarios in which New Jersey achieves its clean energy goals, including the Least Cost scenario, come at a positive incremental annual cost over the business-as-usual reference case in each year between 2020 and 2050. However, these incremental costs are relatively small both in terms of New Jersey's overall economy as well as in the context of total energy system spending.

Table A shows how the Least Cost scenario's $2.8 and $2.2 billion/year in incremental costs in 2030 and 2050, respectively, account for 0.2-0.3% of gross state product (GSP), or a total energy cost increase of 7-10% compared to the business-as-usual Reference 1 scenario. And, as noted above, these net costs, dominated by investment in in-state resources, do not capture the health benefits associated with reduced air pollution and societal benefits of reduced carbon emissions that would come with meeting New Jersey's 2050 targets. Further, they are not reflective of state economic development strategies and goals to invest in people and infrastructure and enable this clean energy transition. Notably, the incremental cost differential between the Least Cost scenario and Reference 1 is lower in 2050 than in 2030 for several reasons, including the maturation of clean energy technology cost curves and the inherent efficiency of end-use electrification.

TABLE A.

Integrated Energy Plan scenario energy system spending and incremental costs

Costs ($2018 billion/year)	2030	2050
New Jersey gross state product (GSP)	$787	$1,138
Total energy spending: Reference 1	$28.0	$30.2
Total energy spending: Least Cost scenario	$30.8	$32.4
Incremental costs: Least Cost scenario	$2.8	$2.2
Incremental costs as percent of Reference 1 costs	10%	7%
Incremental costs as percent of GSP	0.3%	0.2%

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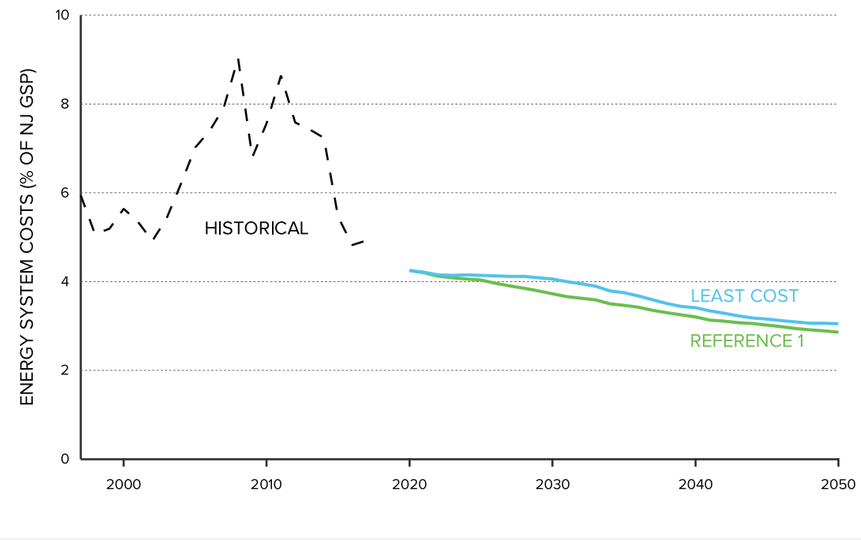
FIGURE Z.

Historical and projected costs for Reference 1 and the Least Cost scenario



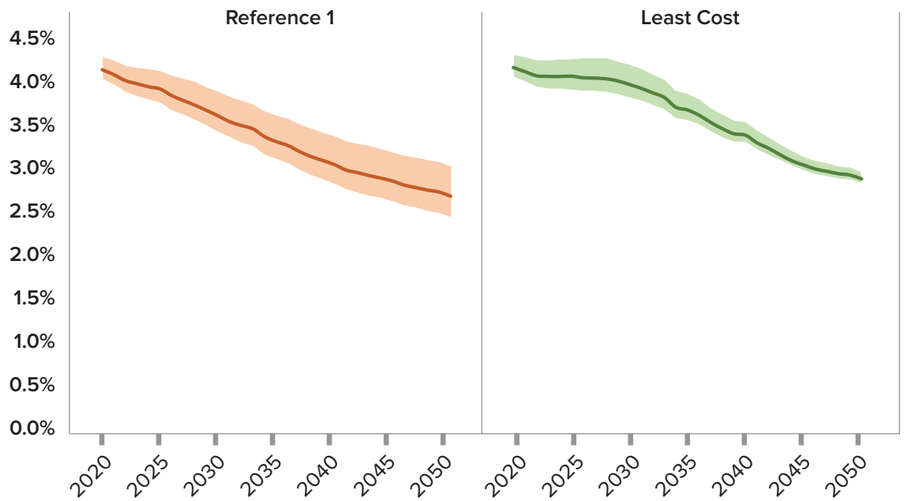
Cost volatility and uncertainty

Figure Z shows the historical energy system costs and projected costs for Reference 1 and the Least Cost scenario, represented as a fraction of New Jersey's GSP. The Integrated Energy Plan analysis finds in all cases that absolute energy costs rise over time, but at a significantly slower rate than the economy the system supports, due to the continuing trend of economic growth decoupling from energy consumption and costs. As a result, energy costs as a share of GSP decline in every Integrated Energy Plan scenario.

Figure Z demonstrates that historical energy system costs have been volatile. This volatility has resulted from fossil fuel price fluctuations, particularly oil. The Integrated Energy Plan analysis assumes fossil fuel prices based on Annual Energy Outlook (AEO) forecasts, without the price shocks observed in the historical period. To demonstrate the sensitivity of different scenarios to fossil fuel price uncertainty, Figure AA shows the impact of choosing the 'high' and 'low' fossil fuel price projections in EIA's AEO. The Least Cost scenario shows significantly less sensitivity to fossil fuel costs, because it is much less reliant on fossil fuels, and thus decreases price risks for New Jersey customers. Notably, the fossil fuel price variations assumed in Figure AA are much smaller than the geopolitically-driven volatility shown in Figure Z.

FIGURE AA.

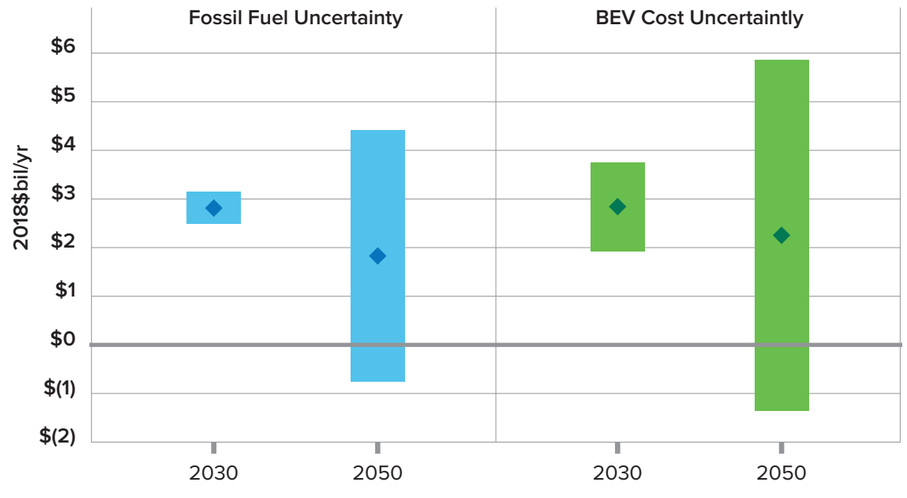
Impact of AEO 'high' and 'low' fossil fuel price projections on New Jersey energy system costs in Reference 1 and Least Cost scenarios, as percent of GSP.



In addition to sensitivity to uncertain fuel prices, the estimated costs for the Least Cost scenario are also sensitive to assumptions about the cost trajectories of clean energy technologies that are still fairly early in their development. Figure BB shows the range of 2050 cost impacts for fossil fuel and EV price variations. For the Least Cost scenario, the sensitivity of system costs to a ±10% change in EV prices is higher than the sensitivity to oil prices varying by +10%/-12% in 2050 and fossil gas prices varying by +70%/-30%. Notably, if EVs come down in price faster than predicted by the AEO, as has commonly occurred for emerging clean energy technologies, the Least Cost scenario would likely fall below the zero line, indicating that it would be less expensive than Reference 1.

FIGURE BB.

System cost uncertainty in 2050 for Least Cost scenario due to fossil fuel and EV price uncertainties



Conclusion

In summary, the Integrated Energy Plan analysis finds that New Jersey can meet both its GWRA emissions reduction targets and 100% clean energy goals with little added cost, and likely net savings when health benefits and climate change mitigation benefits are taken into account. While modeling shows that numerous approaches can meet the state's goals with differing cost implications, the combination of aggressive renewables deployment, transportation electrification, building electrification, and regional cooperation represent the most prudent, least-cost strategies common across a robust range of sensitivities. Further, these strategies can promote near-term flexibility in meeting long-term targets, by allowing the state to adapt strategies to changing technologies, market conditions, and potential requirements or incentives to decarbonize faster or further than existing policy targets. The Integrated Energy Plan lays the analytical groundwork for near-term action to support long-term policy priorities, even as it acknowledges the uncertainty of technology and resource costs decades into the future. As New Jersey implements EMP strategies over the coming years, the Integrated Energy Plan can be revisited and updated to provide new insights in response to emerging technology and market conditions. In this way, the Integrated Energy Plan can continue to serve as a living roadmap for the state to prioritize actions that can meet policy goals at least cost and greatest benefit to New Jersey.

2019 NEW JERSEY
ENERGY MASTER PLAN
Pathway to 2050

APPENDIX B:
Data and Analyses Guiding the Transition to a Clean Energy Future

The State of New Jersey is embarking on a monumental transition to a clean energy economy and must do so in a way that supports economic growth, benefits all customers equitably, and works with existing industry partners to give them the clarity and forecasting they need to adjust business models for future success. Further, the state must assess the possible pathways and opportunities to achieve 100% clean energy and maintain an affordable, flexible, reliable, resilient, and secure energy system.

To provide rigorous data and analysis in support of future policy directives, NJBPU has implemented several studies to provide necessary granularity, context, forecasting, and policy options to inform decision-making. They include:

- Integrated Energy Plan
- Energy Efficiency Market Potential Study
- Energy Storage Analysis
- Solar Energy Transition Plan
- Optimal Voltage Study
- Offshore Wind Strategic Plan
- Microgrids Feasibility Study
- Alternative Fuel Vehicles Study

Some of these studies are required by the Clean Energy Act of 2018; others NJBPU initiated to inform decisions of consequence. The studies were, are, or will be conducted by a wide array of experts including outside consultants, utilities, and universities. By reaching out to experts in the field and engaging with stakeholders throughout the development of these studies, NJBPU can utilize outside knowledge, experience, and expertise to devise the best possible solutions to current challenges and opportunities.

Integrated Energy Plan

The Integrated Energy Plan is the largest and most ambitious plan that NJBPU has undertaken and was conducted by the Rocky Mountain Institute (RMI) in consultation with Evolved Energy Research (Evolved). Founded in 1982, RMI has consistently been a visionary leader in its field and has worked with public utility commissions around the nation on issues such as energy strategy and grid modernization. Evolved similarly has a breadth of experience and knowledge and provides complex technical analyses of energy systems.

As discussed throughout this EMP, NJBPU and NJDEP worked with RMI and Evolved to utilize advanced modeling, a regional approach, and an interactive stakeholder process to develop several demand-side scenarios based upon different policy options to inform the benefits, costs, and trade-offs associated with each policy approach.

These scenarios provided the scientific rigor and data analysis necessary for the state to determine how best to approach reaching its 100% clean energy and 80x50 goals in an equitable and affordable manner while maintaining reliability, resiliency, flexibility, and security.

The Integrated Energy Plan was developed throughout 2019 and its findings have been incorporated into this Final EMP. The Technical Appendix is available on NJBPU's website.[1]

Energy Efficiency Market Potential Study

The easiest way to reduce the cost of energy is to not use it. Of all the initiatives New Jersey is embarking on in the clean energy transition, reducing the state's energy footprint through energy efficiency measures is the first, most affordable, and most accessible action. Energy efficiency is the most controllable and empowering aspect of the clean energy transition for customers and will be a key objective in reaching the state's 100% clean energy goal. This is because energy efficiency reduces costs by decreasing the amount of power demanded by customers as well as by delaying or obviating the need for certain distribution grid upgrades to accommodate greater load.

NJBPU contracted with Optimal Energy, Inc. (Optimal) to conduct the Energy Efficiency Market Potential Study.[2] Optimal performed a study of statewide electric and gas savings potential, allowing for the integration of impacts and potential interactions of electric efficiency measures, gas efficiency measures, and demand response. The tasks in devising this study were divided into: technology penetration; industry practices; market potential; infrastructure; and barriers. After performing an economic potential analysis that outlined the theoretical cost-potential available, they formulated a pragmatic, actionable estimate of potential that can be achieved given actual conditions. Optimal also developed energy savings and peak reduction targets. Combined with the aforementioned analysis, these will equip NJBPU to best implement energy efficiency measures in conjunction with the state's regulated utilities. Consistent with the Clean Energy Act, the Board approved this study in May 2019.

Energy Storage Analysis

Energy storage is a rapidly maturing technology and a key component of a clean energy future. Unlike conventional energy generation that runs continuously, renewable energy resources produce energy intermittently. Energy storage is a way of capturing excess energy when the sun is shining and the wind is blowing, and providing that energy back to the grid when renewable generation ceases. Energy storage also provides ancillary services, such as regulating grid frequency. Finally, storage systems can shave peak load by providing energy back to the grid during peak demand. Integrating storage into the energy system and further advancing the technology is critical to providing clean, reliable, and resilient energy going forward.

[1] https://nj.gov/emp/pdf/New_Jersey_2019_IEP_Technical_Appendix.pdf

[2] https://njcleanenergy.com/main/public-reports-and-library/market-analysis-protocols/market-analysis-baseline-studies/market-po

NJBPU contracted the Center for Advanced Infrastructure and Transportation at Rutgers University to perform the energy storage analysis. Consistent with the Clean Energy Act, the final Energy Storage Analysis report[3] was released in June 2019.

Solar Energy Transition Plan

The existing Solar Renewable Energy Certificate (SREC) market will close upon achievement of in-state solar energy supplying 5.1% of kilowatt hours sold; NJBPU anticipates this will occur in 2020. As mandated by the Clean Energy Act of 2018, NJBPU is working to revamp the incentive program for photovoltaic (PV) technologies to accommodate today's market conditions and cost concerns and secure a clean energy future. Importantly, the current SREC program catapulted New Jersey to a national leader in installed solar capacity, but the costs associated with the program are also among the highest in the nation.

NJBPU is currently working with Cadmus Group and Sustainable Energy Advantage to formulate a solar transition study. The team is presenting NJBPU with decades of collective experience in state-level solar policy design and has a breadth of experience in cost-effectiveness studies and modeling the economics of solar incentives. The process includes a robust stakeholder process to ensure thorough participation and engagement among a diverse set of stakeholders. Cadmus Group is developing proposed megawatt targets and incentive payment cap methodology to properly align the program. The study will ultimately result in a plan that will secure the future of New Jersey's solar industry. Per the Clean Energy Act, the final Solar Energy Transition report is due in May 2020.[4]

Optimal Voltage Study

As required by the Clean Energy Act, in May 2019 the Board ordered the electric public utilities to engage in a comprehensive and robust analysis of optimal voltage. Understanding and implementing an optimal voltage will allow the utilities to conserve energy by properly and uniquely scaling the amount of voltage used on different aspects of their respective distribution systems to reduce energy supply while maintaining service quality. Based upon the results of the study, the Board will be able to determine the best course of action going forward with respect to optimal voltage. This study is due in early 2020.

Offshore Wind Strategic Plan

Offshore wind is a highly promising opportunity for New Jersey to produce in-state renewable energy, create ongoing jobs, and grow the economy. Offshore wind is already a mature industry in countries like Germany, Denmark, and the United Kingdom, and New Jersey is leading its fellow states along the Eastern Seaboard to bring the market to the U.S. and develop a home-grown supply chain.

In June 2019 NJBPU awarded the solicitation for the first 1,100 MW of offshore wind, and plans to install 7,500 MW by 2035.[5] To support NJBPU's efforts to grow the offshore wind industry, NJBPU has retained Ramboll US Corporation to provide a roadmap for the responsible development of 7,500 MW of offshore wind generation. The Offshore Wind Strategic Plan development process includes working with stakeholders, including the offshore wind industry, commercial and recreational fishing industries, environmental groups, and others to help inform the plan. Upon release, the Offshore Wind Strategic Plan will provide a roadmap for achieving the state's offshore wind goals.

Microgrids Feasibility Study

A microgrid is a subset of the electric utility grid. Microgrids, for example, may be used to electrically connect clusters of critical facilities, such as police, fire, and hospitals to onsite power generation systems. Microgrids are "hardened" to make them resilient against power outages, and they can function connected to or independently from the larger distribution grid.

Microgrids can range in size from a single residence or building to a campus or to a municipality. They enable that entity to control and manage energy for critical needs, manage peak demand, and provide resiliency and back-up power if the larger grid goes down. Further, microgrids can provide flexibility to the macrogrid by islanding (i.e., functioning independently) or contributing load when necessary.

In 2017-2018, NJBPU provided incentives for funding Town Center Distributed Energy Resource (TCDER) Microgrid feasibility studies in 13 municipalities or counties, including Trenton, to determine if critical facilities can be connected into a microgrid to provide power and essential services in the event of a power outage.[6] In June 2019, NJBPU approved a $4 million budget for a second phase incentive program for the detailed design of the TCDER Microgrids. In December 2019, NJBPU issued a straw proposal and conducted a stakeholder meeting for the Phase II Program. The TCDER Feasibility Study program participants will be eligible to participate in the detailed design incentive program. In 2020, NJBPU expects to solicit competitive applications from the TCDER Feasibility Study participants, evaluate applications, and issue detailed design grants.

Separately, NJBPU is also participating in meetings with the Department of the Treasury to examine the feasibility of a Statehouse Complex microgrid project, and whether the Statehouse Complex and Trenton microgrid projects could be combined.

Additionally, NJBPU, in partnership with the New Jersey Institute of Technology and Rutgers University, received a $300,000 grant from the

Offshore wind is a highly promising opportunity for New Jersey to produce in-state renewable energy, create ongoing jobs, and grow the economy.

[3] https://www.bpu.state.nj.us/bpu/pdf/commercial/New%20Jersey%20ESA%20Final%20Report%2005-23-2019.pdf

[4] https://njcleanenergy.com/renewable-energy/program-updates-and-background-information/solar-proceedings

[5] https://njcleanenergy.com/nj-offshore-wind

[6] https://www.nj.gov/bpu/commercial/microgrid.html

U.S. DOE for a microgrid financing study which will produce a financing tool for microgrid developers.

Alternative Fuel Vehicles Study

The transportation industry accounts for 46% of New Jersey's net greenhouse gas emissions. Considering that New Jersey's electricity generation sector produces fewer emissions than the average U.S. state, owing to its high utilization of natural gas and nuclear energy and a growing renewable energy industry, incentivizing customers to switch from conventional gas- or diesel-fueled vehicles to EVs powered by non- or low-emitting electricity generation will produce significant gains in lowering the state's emissions and criteria air pollutants.

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 the State of 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 funding mechanisms, and create the plan.

Recently, NJBPU announced the Clean Fleet Electric Vehicle Incentive Program to support local governments as they transition to clean energy. The $210,000 program, which is funded primarily through a federal grant from the U.S. Department of Energy, will incentivize the purchase of electric vehicles (EVs) or charging stations by allowing local governments to purchase EVs at the State Purchasing Contract price and simultaneously apply for grant funds.

In addition, on April 3, 2018, Governor Murphy announced that New Jersey would be joining other leading states in signing the State Zero-Emission Vehicles Programs Memorandum of Understanding (MOU). Through the MOU, New Jersey pledged to work collaboratively with other states to support the deployment of zero-emission vehicles (ZEV). This included a goal of 330,000 EVs on New Jersey roads by 2025.

On June 3, 2019, Governor Murphy announced the Partnership to Plug-In, which provides a specific set of tasks for state agencies to deploy several critical aspects of electrification. NJBPU is to consider how to dedicate funds from the Clean Energy Program and Regional Greenhouse Gas Initiative (RGGI), to the extent authorized by the law and regulation, to establish an incentive program to incentivize the sale and ownership electric vehicles and charging infrastructure in New Jersey. Also in June 2019, $30 million was dedicated in the Clean Energy Fund for NJBPU to establish a program to support the purchase and use of zero-emissions vehicles.

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