Draft 2019 New Jersey Energy Master Plan

Policy Vision to 2050

June 10, 2019

Energy Master Plan

Draft 2019 Energy Master Plan: Policy Vision to 2050

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MAXIMIZE ENERGY EFFICIENCY AND CONSERVATION AND REDUCE PEAK DEMAND

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3.1.1 Implement the Clean Energy Act requirement that electric and gas utilities reduce consumption by at least 2% and .75%, respectively, including the establishment of clear performance indicators and evaluation, measurement and verification methods while continuing to review and develop cost recovery mechanisms for complementary, non-competitive utility-run energy efficiency and peak load reduction programs
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MODERNIZE THE GRID AND UTILITY INFRASTRUCTURE

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

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SUPPORT COMMUNITY ENERGY PLANNING AND ACTION IN LOW- AND MODERATE-INCOME AND ENVIRONMENTAL JUSTICE COMMUNITIES

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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

7.1.1 Develop a workforce needs assessment for the clean energy economy, including but not limited to support for renewable energy generation and distributed energy resources; grid modernization; energy efficiency services; transport system

electrification including the installation of electric vehicle infrastructure and potential manufacturing and assembly of electric vehicle components; and zero carbon building construction and retrofits

7.1.2 Establish a Clean Energy Job Training program to assist current New Jersey workers to pivot their skills as necessary to meet changing industry needs

7.1.3 Establish Vocational Training to establish a pipeline of well qualified, modern energy specialists

7.3 Provide innovating 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 the offshore wind economic development opportunity 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 American offshore wind industry

7.5 Establish a Carbon-Neutral New Technology Incubator to fund and support research, development, and commercialization for promising and emerging clean energy innovations

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

II. 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 Murphy's goal of 100% clean energy by 2050 and the Global Warming Response Act (GWRA) state greenhouse gas emissions reductions of 80% below 2006 levels by 2050. Despite the state's successes since 2006 in reducing its carbon emissions, this is our current reality and our challenge.

In response, New Jersey is undertaking a new Energy Master Plan (EMP) that encompasses a dramatically broader scope than previous EMPs. 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 (NJLWD), the Economic Development Authority (NJEDA), and NJ Transit – while also upholding NJPBU's mission to provide a safe, reliable, resilient and affordable energy system for the citizens of New Jersey.

The EMP defines "100% clean energy by 2050" to mean 100% carbon-neutral electricity generation and maximum electrification of the transportation and building sectors (the sectors that produce the greatest carbon emissions in our state) to meet or exceed the GWRA emissions reductions by 2050. The successful implementation of the strategies within this draft EMP will result in drastically reducing demand for fossil fuels. Making these 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 of energy system options.

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, and identify least-cost pathways to transition to clean energy. But the state must also be sensitive to potentially rising costs and aggressive in limiting these costs wherever possible. If all the goals documented within this draft EMP are implemented at the same time, the average household could see an increase in electricity costs, though there would also be a decrease in other energy costs. However, the state also has the opportunity to manage and control these costs through measures such as energy efficiency, revised rate design and ratemaking processes, and exercising more regulatory oversight over transmission projects, as well as phasing these goals in over an appropriate and reasonable timeframe.

This visionary 2019 draft 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:

1. **Strategy 1: Reduce Energy Consumption and Emissions from the Transportation Sector.** In New Jersey, the transportation sector accounts for 46% of the state's net greenhouse gas 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—co-led by NJBPU, NJDEP, and NJEDA— to focus on accelerating aspects of electric vehicle deployment. 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 benefits.

2. **Strategy 2: Accelerate Deployment of Renewable Energy and Distributed Energy Resources.** New Jersey should maximize the development of offshore wind and in-state renewable energy generation (including community solar) and the interconnection of carbon-neutral distributed energy resources (DER)[1] – on-site systems, storage, equipment or processes that are appropriately sized, modular, and decentralized – to support the economy and increase local jobs, encourage private sector investment, accelerate clean power production, and improve resiliency. This includes transitioning to a successor solar incentive program, encouraging development of renewable energy in low-and moderate-income communities, and training the local workforce.

   Other recommended solutions include mandating non-wires solutions on state-funded projects, maximizing the use of source separated organic waste for energy production, and encouraging anaerobic digestion for electricity production or natural gas pipeline injections. Relevant regulatory agencies, including NJBPU, NJDEP, and NJDCA, will work together to achieve these strategies. In order to promote carbon-neutral energy generation, NJBPU established carve-outs for in-state solar and offshore wind through 2030, but must develop a new incentive delivery system to motivate additional carbon-neutral generation using a competitive approach to stimulating competition and investment.

   We must also model scenarios and pathways to achieve 100% clean, carbon-neutral electricity generation by 2050 with an emphasis on least-cost options. NJBPU will explore ways to open currently restricted electric distribution companies' circuits that are currently restricted from accepting new requests for interconnection of DER. Solutions to be explored include strategic adoption of energy storage, energy efficiency, smart inverters, and other distribution system protective equipment. The relevant agencies will also 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.

3. **Strategy 3: Maximize Energy Efficiency and Conservation, and Reduce Peak Demand.** We must strengthen efforts toward promoting energy efficiency and managing and reducing peak load, including clear energy-reduction goal setting and accountability, through financial incentives or consequences for utilities that do not meet those targets, reducing wasted energy through improvements in building thermal envelopes, appliance efficiency, energy benchmarking,

[1] 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.

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. We must enforce the requirement that electric and gas utilities reduce consumption by at least 2% and 0.75%, respectively, expand New Jersey's Clean Energy Program (NJCEP), and adopt equitable clean energy and energy efficiency financing mechanisms. The state should also strengthen building and energy codes and appliance standards.

4. **Strategy 4: Reduce Energy Use and Emissions from the Building Sector.** Buildings are responsible for a combined 61.7% 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. We must 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-unit dwelling and commercial construction. We must also develop a transition plan to a fully electrified building sector, including appliances like electrified heat pumps and hot water heaters.

5. **Strategy 5: Modernize the Grid and Utility Infrastructure.** We must plan for, finance, and implement distribution system upgrades that will be required to handle increased electrification and integration of DERs, support bi-directional grid power flow, assess integration of voltage optimization (or Volt/Var Control), and actively engage in transmission planning and siting. This will require utilities to establish Integrated Distribution Plans (IDPs) to allow for the anticipated growth of DERs and EVs on the electric distribution system. Utilities will act as the "air traffic controllers" in this new distributed marketplace, and should propose and adopt tariffs to implement a distributed marketplace that encourages non-wires solutions using private sector investment. Such programs are particularly important to compare the cost of non-wires alternatives to an expansion or upgrade of the distribution and transmission system and additional generation resources. 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. Finally we must instruct gas utilities to prioritize the replacement of pipelines leaking methane.

6. **Strategy 6: Support Community Energy Planning and Action in Low- and Moderate-Income and Environmental Justice Communities.** The state has a responsibility to facilitate equal access to and representation of the clean energy economy and all the opportunities and benefits it provides. We 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. We 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, equitable access to renewable energy and energy efficiency.

7. **Strategy 7: Expand the Clean Energy Innovation Economy.** New Jersey will expand upon its existing 52,000 clean energy jobs to bring cutting-edge clean energy research and development to New Jersey. We must support the growth of in-state clean energy industries through

workforce training programs, clean energy finance solutions, and investing 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 to establish a pipeline of well qualified, modern energy specialists.

We must also explore the establishment of a New Jersey Green Bank that would leverage public dollars to grow private sector investment and 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, we must capitalize on the offshore wind economic development opportunities by establishing a WIND Institute. We also recommend establishing a Carbon-Neutral 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, 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 our clean energy future.

The EMP is a living document that will guide New Jersey through the next 30 years. Given this, it acknowledges that there are impending technologies that are not yet available or discovered, and allows enough flexibility to use today's tools but also incorporate tomorrow's advances.

This Draft 2019 EMP focuses on strategies and goals to reach Governor Murphy's 100% clean energy mandates. NJBPU is concurrently developing an Integrated Energy Plan study that will model several scenarios reflecting the draft EMP's strategies. It will identify the most strategic and least-cost pathways to achieve New Jersey's 2050 goals of 100% clean energy and 80% emissions reduction. The findings from the Integrated Energy Plan and the many other studies NJBPU is or has conducted in the last 18 months will be incorporated into the final EMP.

The Final 2019 EMP will incorporate the findings of the Integrated Energy Plan as well as several other studies, and will include specific and targeted dates and metrics, which are not yet reflected in this draft, 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.

III. 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*

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.[1]

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 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 2019, one of the last three remaining coal-fired power plants officially ceased operations in May, and the fuel source has been all but eliminated from our 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 Air Act and the New Jersey Air Pollution Control Act. In 2005 NJDEP classified carbon dioxide (CO_2) as an air contaminant,[2] 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 our 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 25.7 million metric tons (MMTs) of carbon dioxide equivalent (CO_2e) by 2050 (80x50).[2] New Jersey 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 102.7 MMTs of CO_2e, down from 128 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 we reach the 2050 target limit.

Figure 1, below, 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 124 million MMT, and these strategies were achieved while reducing overall energy costs.

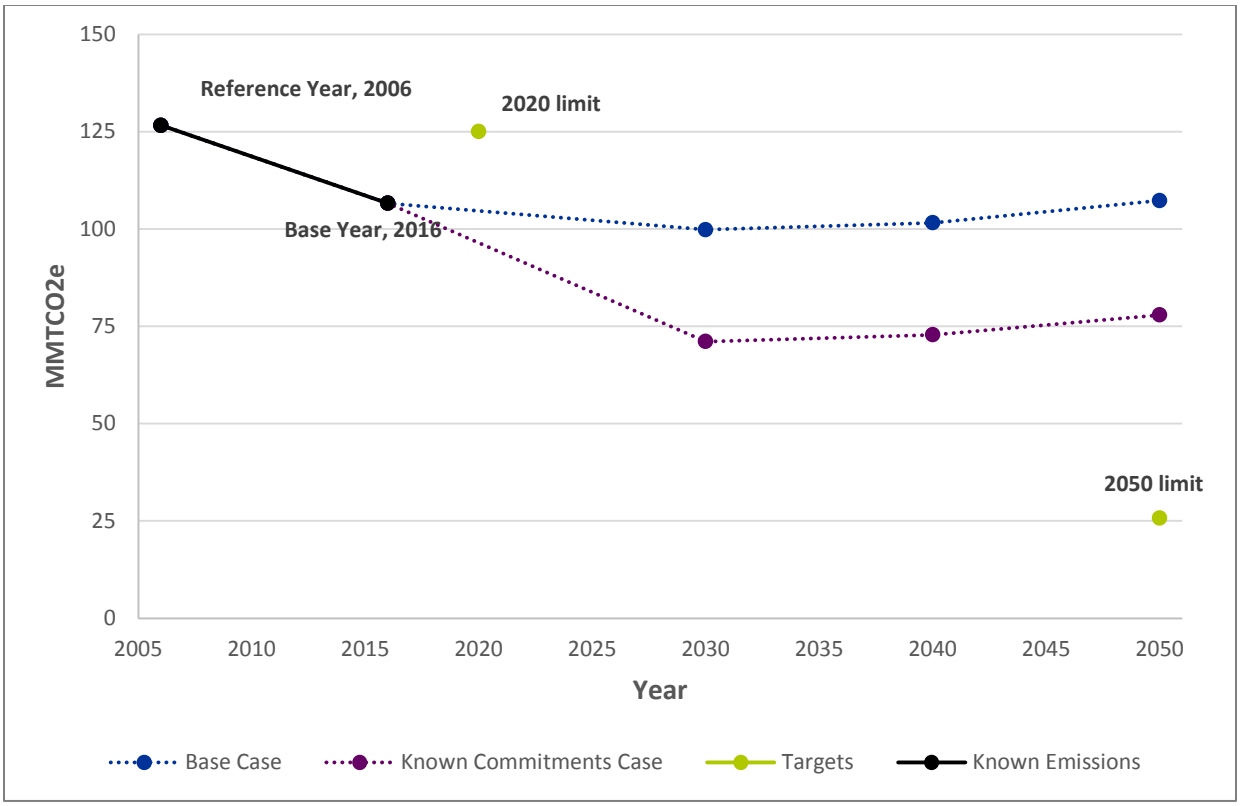
Figure 1 also shows two projected pathways from 2016 through 2050, including the upper "base case" projection assuming "business as usual", and the lower "known commitments case" projection assuming achievement of Governor Murphy's energy mandates, including the Clean Energy Act, through 2030.

Modeling indicates that in the "base case," New Jersey is not on track to meet its 80x50 targets, but 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. However,

[2] 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.

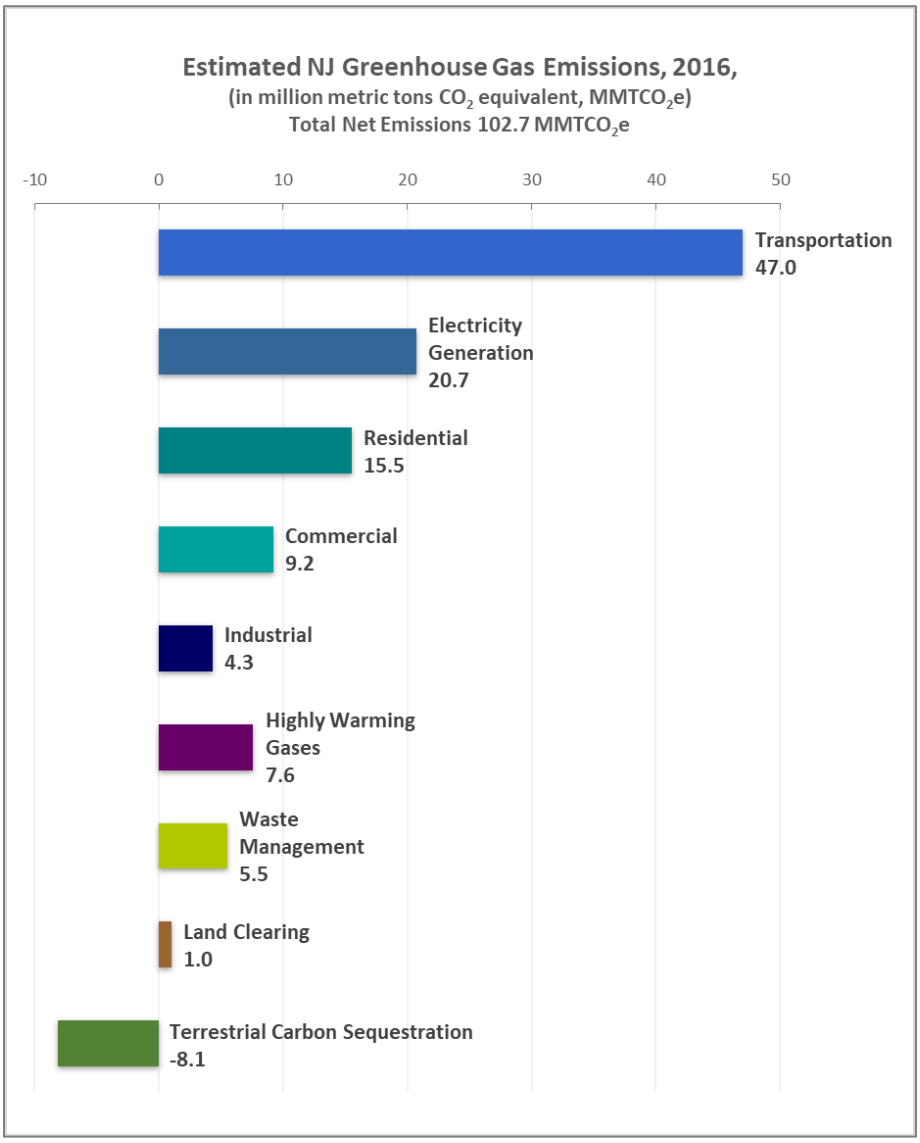
greenhouse gas emissions would begin rising again if New Jersey does not continue to take aggressive action beyond the 2030 mandates.

Figure 1: New Jersey's Greenhouse Gas Reduction Targets Including Clean Energy Act Mandates



Eighty-seven percent of the state's total greenhouse gas emissions are generated from New Jersey's energy production and consumption (Figure 2), electricity demand is anticipated to increase, and the state's highest energy consumption and largest emissions stem from the transportation and building sectors.

Figure 2: Estimated NJ Greenhouse Gas Emissions in MMT CO_2e, 2016



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 our way of life.

This moment demands a comprehensive EMP that will, for the first time, go well beyond electricity generation and that explores policies to:

- decarbonize and electrify the transportation and building sectors;
- maximize energy efficiency and conservation;
- modernize the grid and utility infrastructure; and
- expand the clean energy innovation economy and support community energy planning and action in low-and moderate-income communities.

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. When we invest in people and communities while advancing clean energy, we create good-paying jobs and a diverse ecosystem, and improve government efficiencies.

In the past 18 months alone the Murphy administration has taken unprecedented action on clean energy. 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 will be published in June 2019, and following an affirmative vote by the RGGI states, the state will begin participating in the RGGI auctions in the first quarter of 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.

Less than three months later, 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. Stakeholder discussions to develop a strategic plan to effectively reduce greenhouse gas emissions with the RGGI auction proceeds will begin in the coming months, and will focus on communities that have been disproportionately impacted by pollution.

The following month, on May 23, 2018, Governor Murphy signed into law the Clean Energy Act of 2018 (P.L. 2018, c.17). It 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 and air quality, and therefore 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.

The Murphy administration's energy commitments to date include:

- Increasing the Renewable Portfolio Standard to 50% by 2030
- Generating 3,500 MW of offshore wind by 2030
- 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[3]
- Putting 330,000 Zero Emission Vehicles on the road by 2025 through the State Zero-Emission Vehicles Memorandum of Understanding (MOU)

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 cost caps of 9% through EY 2021 and 7% thereafter, to protect ratepayers. In November 2018, New Jersey's solar industry surpassed 100,000 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 the agency 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 (LMI) customers, one of the highest goals in the nation and the first-of-its-kind in New Jersey. The Community Solar Pilot Program 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.

In December 2018, four months after the Clean Energy Act was signed into law, NJBPU approved rules for the Offshore Wind Energy Certificates (ORECs) funding mechanism and also opened the nation's largest single-state solicitation to date for 1,100 MW of offshore wind. Three offshore wind project developers submitted bids in December 2018, and NJBPU anticipates making an award in June 2019. NJBPU is developing an Offshore Wind Strategic Plan to inform additional solicitations to meet the 3,500 MW goal, as well as any solicitations beyond the initial 3,500 MW target (see Appendix A). Governor Murphy has also asked NJBPU to open additional solicitations in 2020 and 2022.

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 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

[3] "Low-income household" means a household with adjusted gross income at or below 200 percent 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.

distributed energy resources (DER).[4] Following issuance of a report summarizing these findings, anticipated to be released in June, NJBPU will establish a process and mechanisms to achieve our energy storage goals.

NJBPU will continue advocating at the federal and regional levels to incorporate environmental externalities and considerations into wholesale market outcomes and to guide the development of regional market rules within the regional transmission organization, the PJM Interconnection (PJM), that promote, not hinder, New Jersey's energy ambitions. NJBPU will also endeavor to collaborate with PJM to ensure that transmission planning and interconnection rules are compatible with renewable DERs. Finally, given the state's commitment to affordability, NJBPU will continue to advocate that costs associated with transmission, interconnection, or other grid upgrades are allocated on a just, reasonable, and nondiscriminatory basis among states regionally and inter-regionally.

For the first time, NJBPU is establishing plans for regulated utilities to achieve minimum energy savings of 2% of electric sales and 0.75% of natural gas sales, an increase of three to four times the current targets. 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, we need more aggressive strategies to increase EV adoption. New Jersey ranked second among states in the northeast for EV sales in 2018,[3] 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.[4]

In the past fifteen months the administration has made significant progress on electric vehicles (EVs). In April 2018, Governor Murphy added New Jersey as a signatory to the State Zero-Emission Vehicles Program MOU, committing the state to support the deployment of 330,000 zero emission vehicles by 2025. The following December, New Jersey committed to the Transportation and Climate Initiative (TCI), a consortium of Northeast and Mid-Atlantic states working to design a regional low-carbon transportation policy. Most recently, the administration announced in June 2019 the Partnership to Plug-In, a statewide partnership to support the growth of EVs. Further, the state has dispersed or ear-marked a collective $34.2 million of New Jersey's settlement with the federal Volkswagen lawsuit to be

[4] 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.

spent on electric buses in the City of Camden, heavy-duty electric vehicles in urban areas, and on electric-vehicle charging stations throughout the state.

Governor Murphy's bold and 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 (NJLWD) 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 EMP 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 25.7 MMT of CO_2e by 2050, which is 80% of New Jersey's emissions relative to 2006 levels, otherwise known as "80x50."

The goals of the EMP and GWRA Report are inextricably linked. NJBPU and NJDEP are partnering to develop a unified, synchronous plan to transition New Jersey to a clean energy economy. For the first time, NJBPU and NJDEP are working together and leading other agencies across state government in collaborating on three successive phases to map out this transition:

- Phase 1: 2019 Draft Energy Master Plan: Policy Vision to 2050 (June 2019)
- Phase 2: 2019 Final Energy Master Plan: Implementation Roadmap (December 2019)
- Phase 3: Global Warming Response Act Plan to 2050 (June 2020)

The 2019 EMP is the first report of the Murphy administration to holistically consider the complete energy system in New Jersey, including electricity generation, transportation, and buildings, along with

their associated greenhouse gas emissions. This document, the "2019 Draft Energy Master Plan: Policy Vision to 2050" illuminates preferred objectives, strategies, and supporting policies to achieve 100% clean energy by 2050.

This draft EMP for the first time defines 100% clean energy and provides an overview of the seven key strategies on which New Jersey will focus to achieve 100% clean energy by 2050. This draft report is focused on state goals and strategies, and will request specific feedback to help inform the final targets and milestones that will be announced in the "2019 Final Energy Master Plan: Implementation Roadmap."

The final EMP will serve both as a long-term, detailed blueprint and a near-term action plan for New Jersey's energy system. It will expand upon the goals and strategies and lay out a series of policy mechanisms, options and target deadlines by which to achieve them in conjunction with scenario development to model potential least-cost pathways. It will also incorporate the findings from the many studies NJBPU is conducting and establish metrics and implementation details. The final EMP will be submitted to the Governor and Legislature in December 2019.

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. Through a robust stakeholder process, NJBPU held six public hearings and published over 100 questions designed to solicit essential feedback in the following areas and working groups:

- Clean and Renewable Energy;
- Sustainable and Resilient Infrastructure;
- Reducing Energy Consumption;
- Clean and Reliable Transportation; and
- Building a Modern Grid.

Following this draft's release, six additional stakeholder meetings will be held over three days to elicit feedback before the final EMP is published.

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 will be thorough analysis and planning across the state and regional energy system to evaluate a series of variables, benefits, costs, technologies, and externalities that will drive future energy supply and demand in New Jersey, the region, and the Eastern Interconnection.

The Integrated Energy Plan is a study NJBPU is developing that will model several scenarios reflecting the objectives, strategies, and preferences established in the EMP. NJBPU will use the modeling scenarios to inform the most strategic and cost-effective pathways to achieve its goals of 100% clean energy and the 80x50 emissions target. Importantly, there is an obvious uncertainty about how technology will develop over the next thirty years; NJBPU through the Integrated Energy Plan will be

exploring likely pathways of technological maturation and cost projections to inform the later years of New Jersey's pathway to clean energy.

The modeling will include the 80x50 emissions target required by the GWRA as a constraint, and it adjusts energy demand-side and supply-side constraints to consider the costs of various pathways in which New Jersey can achieve the 80x50 target. The modeling study will also juxtapose the pathways, costs and benefits of action against the costs of a sub-optimal "business as usual" pathway. The scenarios that result from the modeling study will quantify these differences and help NJBPU prioritize pathways to reach the state's clean energy goals.

The Integrated Energy Plan will be developed in concert with a robust and interactive stakeholder and workshopping process through the summer and fall, and will be incorporated into the final EMP.

The GWRA Report will incorporate the vision, goals and pathways laid out in the EMP, and will also introduce comprehensive modeling of the state's emissions in the energy and other emission-generating sectors. It will make specific recommendations on how to achieve the emission 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 two plans will cover all aspects of New Jersey's greenhouse gas emissions and energy system. They will provide guidance, policies, and regulatory and legislative recommendations to enable New Jersey to reach 100% clean energy by 2050 and reduce its emissions to meet or exceed the GWRA's 80x50 mandate. 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.

IV. 100% Clean Energy by 2050

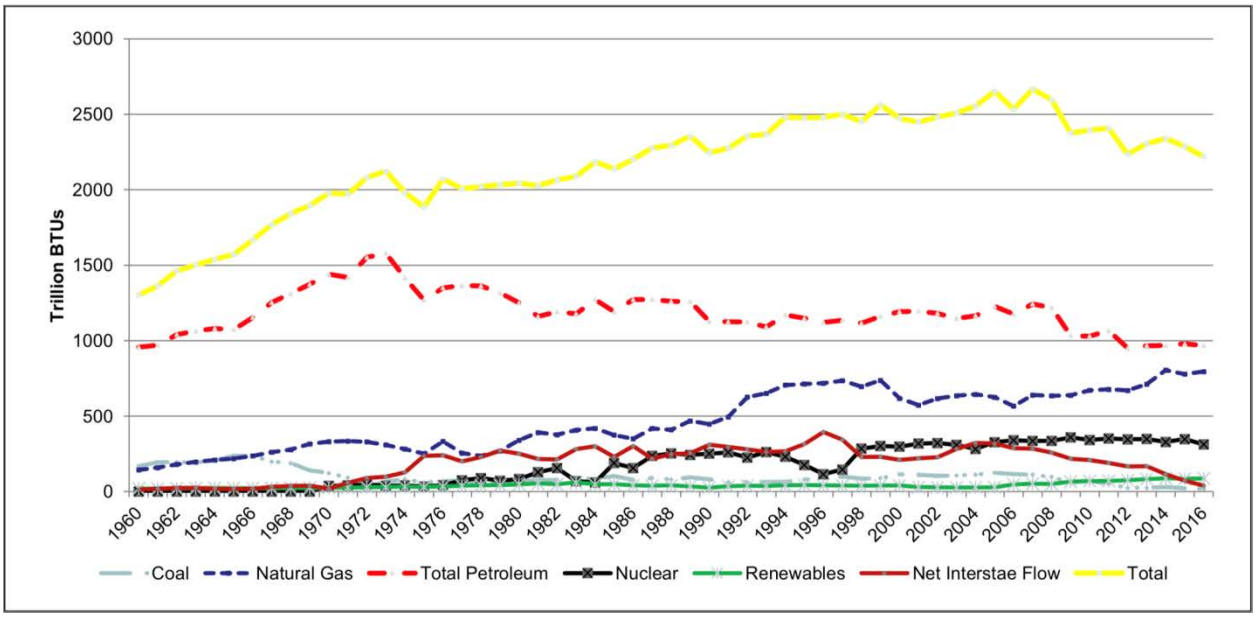
The Draft 2019 EMP defines "100% Clean Energy by 2050" to mean 100% carbon neutral electricity generation and maximum transition to electrification of the transportation and building sectors by 2050, with the goal of meeting or exceeding the 80x50 GWRA requirements.

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, and we can start by considering aggregate demand of primary energy.[5]

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



Further, New Jersey generated about 77 million MWh of electricity in 2016, including about 30 million MWh from nuclear power and 44 million MWh from natural gas, which was enough to meet the state's current electricity demand. New Jersey is aggressively pursuing a carbon neutral[6] power sector, having already increased the RPS to 50% by 2030, by ambitiously installing offshore wind and solar energy, supporting nuclear energy, and developing a least-cost market solution to ensure a carbon neutral solution for the remaining electricity consumed by New Jersey load.

Reducing the carbon from the state's electricity sources, incentivizing deployment of renewable generation and carbon neutral distributed energy resources, upgrading the grid to handle large, variable electricity loads, and decreasing energy demand through efficiency measures and conservation are vital actions the state can begin immediately.

[5] 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.

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

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 electrification of the transportation and building sectors, which have not been significantly addressed in previous state EMPs.

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, its current electricity generation profile is far cleaner and more efficient than natural gas or petroleum burned in vehicles and buildings.
- *They reduce overall energy consumption.* 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 Plan, 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 electricity resources.

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.

The Integrated Energy Plan, the comprehensive modeling study that is being generated for the EMP, will forecast the growth of electricity demand to 2050 considering several variables, such as the rate of adoption of electrified vehicles or heat pumps; the success of energy efficiency programs; and the effect of new rate structures to incentivize energy reductions and managed use of electricity. The modeling will also equip the state with information necessary to evaluate the necessity or financial prudency of future gas infrastructure projects in light of a presumptive decrease in demand of natural gas possible stranded assets within the next three decades.

Electrification of the building and transportation sectors will increase the electricity load on the grid, but there are ways to slow the rate of demand increase and defer the need for additional electricity generation and distribution and transmission system upgrades. Indeed, reducing wasted energy is the most cost-effective and cleanest of energy system options. These methods can include, but are not limited to:

- Robust energy efficiency programs;
- Redesigned rate structures;
- Managed EV charging and demand response programs;
- Stringent appliance standards and building and energy codes;
- Improved thermal insulation; and
- Reduction of vehicle miles traveled.

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

For these reasons, the rapid deployment of renewable energy generation and further development and installation of electricity and thermal energy storage systems, coupled with proper planning via Integrated Distribution Plans (IDP) and the programs and objectives listed above to reduce and manage load, will be critical factors in reaching 100% clean energy by 2050. The results of the modeling study incorporated into the EMP will discuss with granularity the effect on costs, demand growth, and other variables.

The Murphy administration acknowledges the conflicting interests in moving to a decarbonized energy system, including the evolution of existing industry practices and the cost of embracing a clean energy economy. The Integrated Energy Plan study will model a "Reference Case" from 2020 through 2050 in which it will assume a business-as-usual approach to energy consumption over the next three decades. It will enable 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.

As New Jersey progresses in its efforts to enact the aforementioned initiatives, the state will also have to reach far beyond these early goals to continue on its pathway to achieve its 2050 climate and clean energy mandates. 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 climate emissions and other air pollutants as it transitions to 100% clean energy and the GWRA 80x50 target:

1. Reduce Energy Consumption and Emissions from the Transportation Sector
2. Accelerate Deployment of Renewable Energy and Distributed Energy Resources
3. Maximize Energy Efficiency and Conservation and Reduce Peak Demand
4. Reduce Energy Consumption and Emissions from the Buildings Sector
5. Modernize the Grid and Utility Infrastructure
6. Support Community Energy Planning and Action in Low-and Moderate-Income and Environmental Justice Communities
7. Expand the Clean Energy Innovation Economy

V. 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 in space. 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 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 high-level strategies and policy guides to be further refined and supported by the many studies NJBPU and NJDEP are currently conducting, elaborated upon and rolled out for implementation in the final EMP and the forthcoming GWRA Report, to achieve New Jersey's decarbonization and emission reduction goals. 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.

Strategy 1: Reduce Energy Consumption and Emissions from the Transportation Sector

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. Further, there should be a concerted effort to reduce vehicle miles traveled and reduce port and airport emissions through electrification.

In New Jersey, the transportation sector accounts for 46% of the state's net greenhouse gas emissions, the largest of the state's sources of emissions and nearly double the national average (28%).[5] Mobile sources are also the largest cause of ozone precursors in New Jersey, 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 USEPA's National Ambient Air Quality Standards (NAAQS), all 21 counties in New Jersey are in moderate or marginal non-attainment for ground-level ozone standards.[6]

Because petroleum produces more greenhouse gases and air pollutants than electricity generation, especially given New Jersey's relatively clean electricity sector, the state must take further concrete steps to start to phase out motor gasoline and conventional diesel consumption as quickly as possible by electrifying the transportation sector, reducing reliance on vehicles, and increasing mass transit ridership.

Goal 1.1: Electrify the Transportation Sector

- **1.1.1 Support the deployment of 330,000 light-duty electric vehicles on the road by 2025, per the Zero Emission Vehicle MOU**
- **1.1.2 Deploy electric vehicle charging infrastructure throughout the state**
- **1.1.3 Encourage electric vehicle adoption through incentives for charging station installation in certain locations and the purchase of electric vehicles**
- **1.1.4 Increase consumer and fleet owner awareness and acceptance of electric vehicles**
- **1.1.5 Rollover the state light-duty (passenger) fleet to electric vehicles**
- **1.1.6 Continue to improve New Jersey 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, or 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 relative to 2006 by 2050 (80x50), New Jersey will electrify most of its transportation sector. As discussed earlier in Section IV: 100% Clean Energy by 2050, electrifying the transportation sector will have three major benefits:

- *Electrified transportation is considerably more efficient than conventional transportation, particularly if properly planned with managed charging through an IDP.* Light-duty 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.

- *Electrified transportation is less polluting than conventional transportation.* As discussed above, electrified transportation produces less greenhouse gas emissions or other air pollutant emissions, including carbon monoxide, nitrogen oxides, particulate matter, 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.

In addition, fossil fuel-powered transportation is New Jersey's leading cause of air pollutants.[7] According to a 2016 American Lung Association report, "Clean Air Future: Health and Climate Benefits of Zero Emission Vehicles," pollution from motor vehicles cost New Jersey residents $4.6 billion in climate damage and public health costs 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 of our population, particularly among communities that are disproportionately impacted by pollutants, also known as environmental justice communities.

Electrifying the transportation sector also yields 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;
- Advancing EV technology and driving down the cost of production through improved processes and economies of scale;
- Providing consumer protection against wide swings in the cost of gasoline and diesel;
- Reducing the overall cost of electricity for all customers through more efficient utilization of the grid; and
- Reducing medical visits and time off from work or school due to fewer pulmonary and respiratory illnesses.

Detailed modeling for the final EMP will help identify specific electrification targets, but early analysis suggests that New Jersey must electrify close to 100% of its light-duty vehicles and a substantial number of medium- and heavy-duty vehicles and off-road mobile sources to meet our emissions targets. As an additional and interim goal, 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.

In 2011, only 338 EVs were registered in New Jersey, and 88% of them were plug-in hybrids. In December 2018, the total number had increased to over 23,000, including 11,670 battery EVs and 11,597 plug-in hybrid EVs. Battery electric (non-hybrid) cars now make up 50% of the state's EVs, representing massive growth against hybrid sales. However, battery EVs still make up a very small share of the state's total vehicle registrations – only 0.3% of the 6.8 million registrations in 2018.[8]

An analysis by Bloomberg New Energy Finance suggests that 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.[9] As EVs become cost competitive in total cost of ownership without government subsidies – likely between 2025 and 2030 – EV sales will start climbing higher, reaching nearly 60% of total U.S. new car sales by 2040.

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 MOU. Governor Murphy became a signatory of the State Zero-Emission Vehicles Programs MOU in 2018.[10] 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 will support deployment of 330,000 zero emission vehicles by 2025; the collective target for all ZEV Task Force states is 3.3 million by 2025. The task force will collaborate on infrastructure development, incentivizing EV adoptions, transitioning municipal fleets, and dealership and consumer education and outreach.

Separately, 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.[11] 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.

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 massive shift in new vehicle purchases from gasoline to electric powered vehicles, without a replacement for lost gas tax revenue, would adversely impact the NJ Transportation Capital Program. Alternative funding sources to the motor fuels tax should be explored, developed, and implemented as the state moves on 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.

Goal 1.1.2: Deploy EV charging infrastructure throughout the state. The largest barriers to mass adoption of passenger EVs include range anxiety, the high upfront capital costs compared to their gas-powered counterparts, limited model choices, and the lack of consumer and dealer awareness. The EV industry to date has largely been described as a market failure, or 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 with limited range.

According to a study by NESCAUM, New Jersey ranked 45th in the nation in electric charging outlets per registered vehicle as of 2018.[12] New Jersey had 76 DC Fast Charging outlets at 42 locations and 46 Tesla Supercharger outlets at 7 locations in New Jersey as of August 16, 2018.[13] We must establish New Jersey as "range safe" by substantially increasing publicly accessible electric charging infrastructure statewide.

New Jersey is committed to leveraging a combination of funds from the Volkswagen Settlement Fund, the NJ Clean Energy Program, utility programs, and public-private partnerships to build out initial charging infrastructure. The Murphy administration in June 2019 announced the New Jersey Partnership to Plug-In, a statewide partnership, led by NJDEP, NJBPU, and NJEDA, to build out the necessary infrastructure to support electric vehicle ownership to improve air quality and reduce greenhouse gas emissions. The Partnership to Plug-In will dedicate $7 million of Volkswagen settlement funds for fast-charging infrastructure technology. NJDEP has also requested an additional $16 million from the Volkswagen Environmental Mitigation Trustee for the deployment of electric heavy-duty garbage trucks, school buses, and port-related vehicles, and previously issued $11.2 million of Volkswagen settlement funds to purchase electric buses and the City of Camden and additional charging infrastructure.

Additional agencies, including NJDCA, NJMVC, and NJDOT will further support the Partnership to Plug-In. As an example, NJDCA will produce model municipal zoning ordinances to require charging infrastructure on new or redeveloped parking areas, encourage municipalities to update zoning ordinances and redevelopment plans to include EV infrastructure, and update building codes to require supporting electric infrastructure for EV infrastructure in new construction, major renovations and electric infrastructure upgrades in multi-unit dwellings to support the adoption of EVs among apartment residents. NJDOT will install signage, and NJMVC will track registrations.

Finally, 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. In establishing criteria for publicly accessible charging, considerations should be made toward the distance between existing and planned public charging stations, average employee commute to workplaces, equipping multi-unit dwellings and workplaces, accessibility to interstates and state highways, and roadways leading to tourism destinations.

In keeping with New Jersey's commitment to the State Zero Emission Vehicle MOU, the Partnership to Plug-In will collaborate with utilities, private transportation network companies, investors, and other energy providers to establish an implementation roadmap for installing charging infrastructure in strategic and critical locations, including assessing the distribution of Level 2 and DC Fast Charging

stations and identifying a clear role for regulated utilities in building out the infrastructure. The state can further encourage adoption of these technologies by asking both regional Metropolitan Planning organizations and Transportation Management Associations to incorporate charging stations and alternative fuel transportation into their short-term work programs and long-term plans. In planning for EV infrastructure, the Partnership to Plug-In should take into consideration the integration of mobility on demand services that has the potential to decrease personal vehicle ownership and increase the use of shared EVs. Finally, as charging infrastructure gets built out, NJBPU must use its regulatory authority to ensure that EV drivers are paying just and reasonable rates for charging service.

Goal 1.1.3: Encourage EV adoption through incentives for charging station installation and the purchase of EVs. In an effort to bolster EV adoption and mature the market, New Jersey supports reducing the upfront cost of EVs through incentives for charging station installation and EV purchases. As noted above, through the Partnership to Plug-In, the state can continue its program to subsidize the cost of installing electric charging infrastructure and develop rebates for the purchase of EVs. Through the Clean Cars Program, the State Treasury Department (Treasury) will also continue the sales tax exemption program for new and used plug-in only vehicles.

Importantly, the New Jersey Motor Vehicle Commission (NJMVC) will establish a mechanism to distinguish EVs from conventional vehicles during registration. This will aid in the tracking of 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 distribution companies 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 EVs. In addition to NJDEP's continued education and outreach campaign, New Jersey will seek to 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 Drives."

Goal 1.1.5: Rollover the state light-duty (passenger) fleet to EVs. In early 2019, the New Jersey Department of the Treasury issued a bid solicitation for passenger 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 government agencies to purchase light-duty EVs. The state will seek to transition its light-duty fleet to electrification as vehicles reach the end of their useful life, with transition to full EVs beginning in the Fiscal Year following the implementation of the state's charging infrastructure contract(s).

In moving toward these goals, particular attention must be paid to establishing which light-duty vehicles have high daily mileage demands – these may include police and highway patrol vehicles. In specific cases, hybrid vehicles may be more appropriate for existing battery technology, and will still reduce emissions without impacting job function. In other cases, suitable EVs alternatives, such as SUVs, may not be on the market yet, though this is expected to change within the next five years.

Wherever otherwise appropriate, new purchases of other 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 purchasing of EVs and 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.

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, NJ Transit bus operations emit 52% fewer emissions per passenger-mile than a single occupied vehicle. 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 even 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 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.

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 areas, neighborhoods, 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 impact 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 were reduced 98%.

NJ Transit will continue to pursue pollutant-reduction strategies like electrifying buses and other carbon neutral strategies. Electric bus and alternative fuel technologies are still maturing and the agency needs to assess how to incorporate electric and alternative fuel buses into its operations and budgeting, including establishing when and where buses should recharge within routes and establishing a budget for electric bus and charging infrastructure purchasing and installation.

In the spring of 2019, NJ Transit received funding for the purchase of eight electric buses and for facility upgrades at its Camden bus garage in an electric bus early deployment program with 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 to reduce local air pollutants in those communities while it incorporates electric buses into fleet operations and management. NJ Transit is continuing to further monitor rapidly improving electric bus technology, establish long-term plans to continually adopt new electric buses as older buses retire, and continue to replace old diesel-engine buses with cleaner diesel engines.

NJ Transit has also steadily taken steps to reduce emissions in its locomotive fleets by ensuring they meet or exceed all Federal 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-45 Dual Power Locomotives, which have the ability to switch from diesel power to electric power whenever catenary power is available, and the EPA Tier III compliant engines emit fewer emissions when running on diesel power than older engines. NJ Transit is in the process of purchasing 17 additional ALP-45 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.

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. Such options can include offering additional EV rebates to residents of low-and moderate-income and environmental justice communities to incentivize mass adoption of clean cars in highly-polluted neighborhoods and facilitating electric charging infrastructure though public private partnerships with property or parking lot owners or though electric distribution company filings.

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, scooter sharing, bike sharing, and community charging hubs. Such opportunities will be further explored in "Strategy 6: Support Community Energy Planning and Action in Low-and Moderate-income and Environmental Justice Communities."

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, or 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 a boon 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 do not currently last long on a single charge. Further, EV infrastructure isn't yet widely available to the public, and not all trucks can return to base 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, 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. 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).

New Jersey should also consider truck and bus voucher programs to significantly reduce the incremental cost of purchasing EVs over their conventional counterparts, or explore a state-wide procurement mechanism wherein the batteries in EVs are leased, thereby reducing the up-front cost of one comparable to a new diesel vehicle, and allowing the reduced operating costs (fuel and maintenance) to cover the battery lease payments over time. In addition, New Jersey will work with transportation network companies, as discussed earlier, to advance the deployment of public charging infrastructure along busy transportation corridors and to ensure private sector support for an electric fleet transition.

Municipal and statewide fleets transitioning heavy duty vehicles to electrification or alternative fuels may require county or shared service investments to facilitate centralized charging or procurement of cleaner liquid fuels and to make the vehicles more cost effective to local municipalities.

Finally, developing fuel cell technology powered by hydrogen extracted from renewable energy electricity may play a larger role in commercializing zero emission trucks and displacing highly-polluting diesel engines, particularly in sectors that are difficult to electrify, 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 monitor evolving fuel cell research and convene a task force to develop, determine, and resolve safety concerns related to this technology; at this time, Port Authority of New York & New Jersey (Port Authority) does not allow hydrogen fuel cell vehicles to traverse 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 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 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, additional measures should be explored.

The state should work within the Transportation Climate Initiative and with the regional port authorities to convene a working group to develop a comprehensive strategy to address these more challenging, carbon-intensive sectors of the economy. The state should also support ongoing efforts by regional port authorities to identify mechanisms for private operators to procure cleaner equipment and establish a transportation R&D and clean tech transfer forum for private enterprise, government, and academia.

Goal 1.2: Decrease vehicle miles traveled

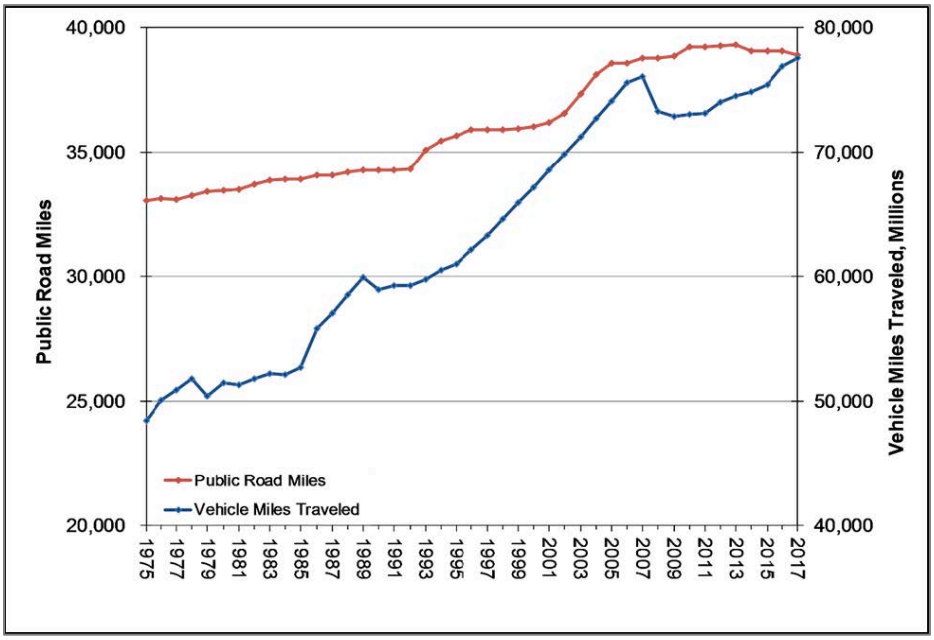
1.2.1 Identify opportunities to reduce vehicle miles traveled

1.2.2 Accelerate the implementation of the Transit Village Program

1.2.3 Relieve congestion and idling throughout New Jersey

When considering the amount of energy consumed and emissions produced from the transportation sector, the efficiency and fuel type of vehicles and other transit options is only one variable. Importantly, the number of vehicle miles traveled is increasing. In 1984, the earliest year in which we have data, annual vehicle miles traveled in New Jersey was roughly 52.2 billion. Vehicle miles traveled 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, an increase of nearly 49% since 1984, or roughly 1.4% per year.[14] At the same time, miles of road increased from 33,879 miles in 1984 to 38,896 miles in 2017, an increase of about 15%, or 0.44% per year (Figure 4).

Figure 4: New Jersey Public Road Miles and Estimated Vehicle Miles Traveled from 1975 to 2017[7]



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 total commuters, 71% drive to work alone, while 8% carpool and 12% use mass transit. The remaining 9% walked (3%), worked from home (4.5%), or traveled by other means (2%).[15]

As policies or strategies to reduce vehicle miles traveled are developed, it is important to consider the factors influencing them. As the state's population has increased over the years, so have vehicle miles traveled. It also tracks closely with the health of the economy, because people take more trips when the economy is stronger. Further, the level of vehicle miles traveled is an outcome of residential and business location decisions, as well as personal travel choices. While the state cannot reduce vehicle miles traveled 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.

Goal 1.2.1: Identify opportunities to reduce vehicle miles traveled. The state can take steps now to continue to reduce the overall transportation energy footprint, 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 result in reduced vehicle miles traveled. A range of options are available, including encouraging mass transit utilization throughout the state, "smart growth" and redevelopment opportunities that support more transit use, bicycling, and walking, and opportunities to

[7] NJ Department of Transportation.

move goods by rail instead of truck. 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 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.

With the advent of ride-hailing (e.g., Lyft, Uber) services, 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 it will impact the level of vehicle miles traveled. NJ Transit and state agencies, Port Authority, local municipalities, and stakeholders will work together to reduce dependence on vehicles.

NJ Transit will examine opportunities to substantially increase and incentivize mass transit utilization, such as Bus Rapid Transit, between bus terminals, park and rides, and large communities that aren't easily served by trains. The agency will also explore more opportunities for cross modal transportation. Further, it will also explore how the placement of EV charging stations and/or EV car shares at Park and Rides might encourage additional transit use.

Additionally, Port Authority is 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 (Newark Airport), which will also improve regional mass transit options and reduce vehicle miles traveled and congestion on local roadways.

Additionally, 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 bike parking and bike repair terminals along train stations and Park and Rides and consider installing bike or scooter-sharing services.

The NJMVC will explore clarifying rules regarding the legality of electric bikes and make it easier for customers to register their vehicles.

Municipal land use law can be adapted to further encourage walkable and bike-able communities and extending bike and scooter sharing, Jitney services, and community EVs in community and commercial areas to decrease the need for personal vehicles in local traffic.

Finally, the state can 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.

Goal 1.2.2: Accelerate the implementation of the Transit Village Initiative. 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 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. By doing so, municipalities commit up front to growing in 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, etc.) 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, the goals for the Transit Village Initiative are 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 NJ Transit Village.

Goal 1.2.3: Relieve congestion and idling throughout New Jersey. Reducing vehicle miles traveled and encouraging alternative modes of transportation produce the ancillary benefit of clearing up the road to relieve road congestion and idling, thereby reducing energy consumption and air pollutants. The NJDOT has reported that congestion cost the state's trucking industry approximately $3 billion in 2015.

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. The purpose of the CMAQ

program is to provide 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, as well as 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. 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.

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 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, the 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.

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 to continue 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 into service six electric buses at Newark Airport – these buses are the first electric buses 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 Knocks multi-purpose crane, is its first fully electric crane and produces no emissions. Similarly, Port Authority is working with its terminal operators to demonstrate alternative-fueled equipment. This year Port Authority will begin a pilot of electric cargo-handling equipment 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 historical heavy reliance on trucks to transport cargo that arrives at the port via ship to its final destination, and each rail lift is expected to eliminate 1.5 truck trips on regional roadways.

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

Goal 1.3.2: Support a diesel truck buy-out program. Port Authority implements several important initiatives under its Clean Air Strategy to improve air quality and lower greenhouse gas emissions. In early 2019, the federal Environmental Protection Agency (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) visits have increased gradually, now accounting for 57% of all visits 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 government, and local community groups to collaborate on establishing opportunities to provide solar energy to the 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, to add it its existing nearly one-megawatt of on-site solar generation at Newark Airport and PATH facilities. 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 under construction. Included in the requirements for the facility design is the installation of a solar roof, which is estimated can 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 utility and respective state agencies to determine the viability of a community solar project.

Strategy 2: Accelerate Deployment of Renewable Energy and Distributed Energy Resources

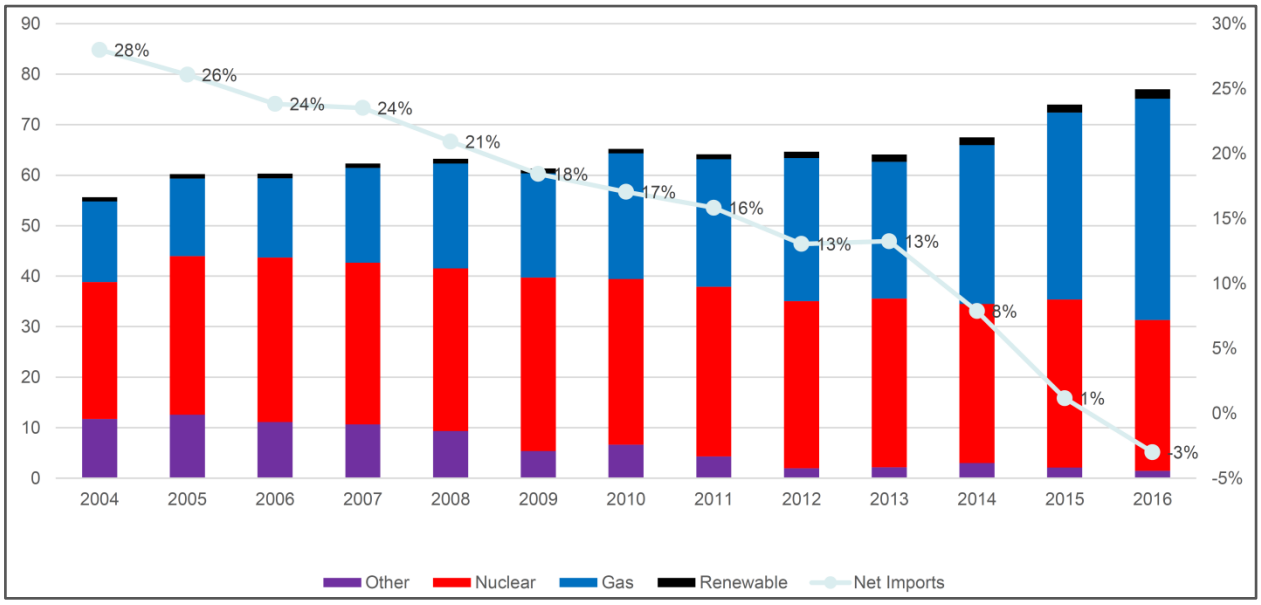
New Jersey should promote the development of offshore wind and in-state renewable energy generation and the interconnection of carbon-neutral distributed energy resources (DER) – on-site systems, storage, equipment or processes that are appropriately sized, modular, and decentralized – to support the economy and increase local jobs, encourage private sector investment, accelerate clean power production, and improve resiliency.

New Jersey generated 75.255 million megawatt hours (MWh) of utility-scale net electricity in 2018,[16,17] using primarily a combination of natural gas (51.6%) and nuclear (42.5%) power sources.

New Jersey is a founding member of the PJM Interconnection, 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 is the largest regional electricity market in the U.S. Importantly, due to New Jersey's integration with PJM's regional grid, New Jersey can generate power that is transmitted to other states, and New Jersey can likewise import electricity generated elsewhere. PJM also coordinates the flow of electricity produced between New Jersey and New York, which is a separate power system.

Due primarily to the discovery of the Marcellus Shale, the largest natural gas field in the U.S., spread throughout much of the Appalachian Basin, including in neighboring Pennsylvania, the recent fracking boom, and a decrease in natural gas prices in recent years to historic lows, the electric generating sector in New Jersey and the broader PJM region has experienced an expansion in combined cycle natural gas units. This has resulted in new generation capacity coming on-line in New Jersey that is more efficient and economic than older simple cycle turbines and coal boilers. Natural gas has overtaken nuclear as the dominant electricity source in New Jersey, and coal is almost entirely out of business. In 2004, New Jersey had to import about 40% of its energy 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 5).

Figure 5: Total NJ Electric Generation by Source with Percent Total Generation Imported Power[8]



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. In addition, PSEG Power closed its last two remaining coal plants in May of 2017[18], and the coal plant B.L. England recently withdrew its proposal to transition to natural gas and instead shut down completely in May 2019. 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.

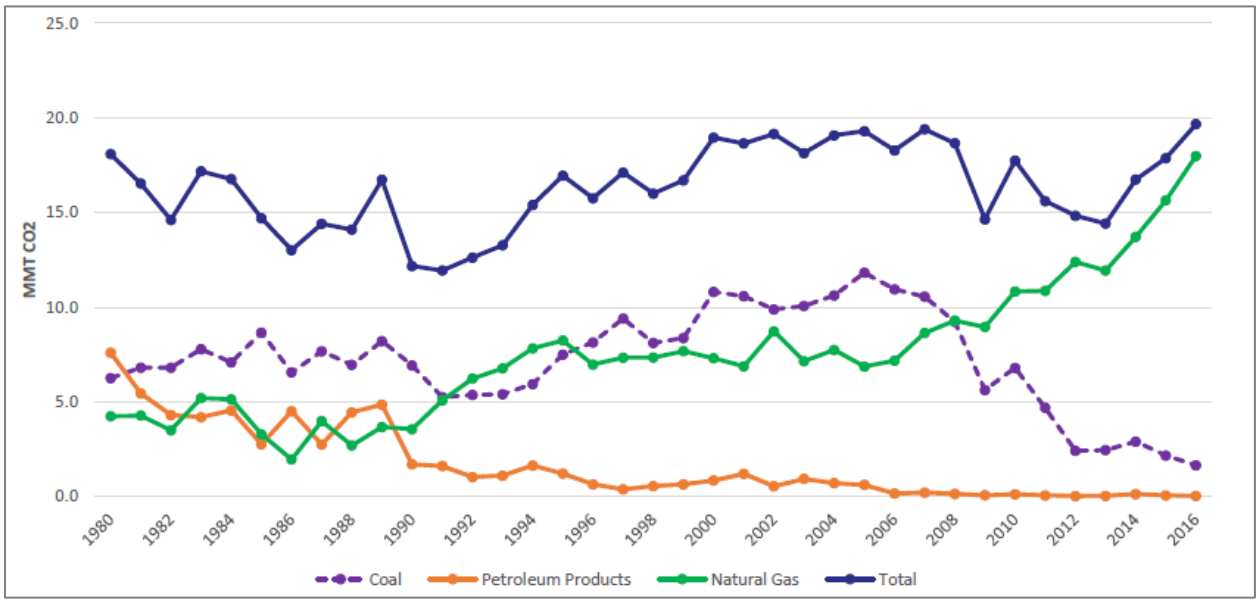
The New Jersey bulk utility electric grid is currently served by 35 large generating facilities consisting of 101 electric generating units. With the exception of the state's last two coal-fired facilities, these electric generating units are primarily fired with natural gas; one cogeneration facility also fires some refinery gas, and fuel oil is sometimes used as a backup or emergency fuel at certain facilities. Natural gas burned in plants with state-of-the-art technology has been an important transition, or "bridge," fuel that has helped wean the state off the heaviest polluting fuels, like coal, while also reducing emissions and lowering the cost of electricity. Natural gas also contributes important reliability services to the grid.

Importantly though, New Jersey's electricity generation sector accounts for 20% of state net greenhouse gas emissions, which is almost entirely attributable to natural gas (Figure 6). It is also a significant source of local air pollution. Given current economic conditions, natural gas is expected to remain the predominant electricity fuel source in the near future without a change in state, regional, or federal

[8] Data from U.S. EIA. Graph generated by Rutgers Energy Data Center. http://njenergydata.rutgers.edu/

policies. In order to achieve a 100% clean energy future and reach the 80x50 target, the state must also model, assess, and implement ways to minimize reliance on natural gas as the state transitions to a clean energy economy.

Figure 6: Electric Power Sector CO_2 Emissions by Fuel Source (1980-2016)[9]



Goal 2.1: 100% clean power by 2050

- **2.1.1 Establish a 50% RPS by 2030**
- **2.1.2 Establish specific in-state Class I renewable energy goals and milestones including but not limited to solar and offshore wind generation to enable a significant majority of electricity consumption to be produced from renewable resources by 2050**
- **2.1.3 Model scenarios and pathways to achieve 100% clean, carbon-neutral electricity 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 DER and EV charging**
- **2.1.6 Develop a mechanism to compensate DER for its full value stack at the regional and federal level**
- **2.1.7 Develop low-cost loans or financing for DER**
- **2.1.8: Coordinate permitting and siting processes**
- **2.1.9: Begin stakeholder engagement to explore rules to limit CO_2 emissions from Electric Generating Units**

[9] Data from U.S. EIA. Graph generated by Rutgers Energy Data Center. http://njenergydata.rutgers.edu/

In signing Executive Order Nos. 7, 8, and 28 and the Clean Energy Act of 2018, Governor Murphy signaled his commitment to advance the clean energy economy early in his administration. There are several reasons why New Jersey should seek to increase its share of local and renewable energy generation, including the opportunity to grow the economy and establish New Jersey as a center for energy innovation, to reduce greenhouse gas emissions enough to meet or exceed the 80x50 GWRA and the U.S. Climate Alliance targets, and to bolster resiliency both to increasingly extreme weather events and fossil fuel price fluctuations.

- *Growing the economy:* All electricity generation produced in-state yields economic benefits. In New Jersey, natural gas power generators directly employ 1,789 people and nuclear power generators directly employ 2,694 people.[19] The renewable energy market provides even more jobs; the solar industry in New Jersey employs 6,000 to 7,000 people and the emerging offshore wind industry is expected to produce roughly 15,000 jobs through 2030 to build and operate the infrastructure. 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 DERs also drives innovation and technological development and can be sited throughout the state, including in dense, urban environments. Further, locally produced energy generation creates ancillary economic benefits such as reducing production costs, reducing electricity demand and prices on the distribution grid, and deferring grid and capacity upgrades. Finally, locally produced renewable energy is particularly important for supporting LMI communities; community solar will enable those who wouldn't traditionally benefit from rooftop solar to yield the benefits of clean energy, and urban rooftop solar can be built out and maintained by the local workforce.

- *Reducing greenhouse gas emissions and other air pollutants:* As noted earlier, electricity generation in New Jersey produces 20% of the state's net greenhouse gas emissions, and also contributes to criteria air pollutants, including 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. Using 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.

- *Resiliency:* In the traditional hub-and-spoke energy system model, power is generated at a central facility and distributed to end users around the clock. Recent events, such as the Northeast Blackout of 2003 and Superstorm Sandy in 2012, illustrate the vulnerabilities of our current energy system. Adding decentralized and locally-produced carbon-neutral electricity generation to the system mix adds energy diversity and reduces the risk of a widespread or consequential blackout. It also reduces the risk of price shock should the cost of natural gas rise in the future.

The state can take several steps to foster local renewable energy generation and DER integration, and the state will seek to maximize the benefits from installation of these resources. Relevant regulatory agencies, including NJBPU, NJDEP, and NJDCA will work together, continuing efforts and action needed to improve efficiency of deployment of DERs and maximize 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: Establish a 50% RPS by 2030. New Jersey must shift its electricity generation resources from predominantly fossil-fuel based to predominantly based on renewable energy.

Renewables have grown steadily in recent years; passage of the Electric Discount and Energy Competition Act (EDECA) in 1999 enabled market competition for electricity generation and the first RPS was codified in rules and first implemented in 2003. New Jersey sourced more than 5% of its electricity from renewable sources, primarily solar and waste to energy plants, in EY 2018, which spanned June 1, 2017 through May 31, 2018. Solar power accounts for nearly 75% of the state's net renewable electricity generation.[20] This estimation is based upon electricity generated by three types of renewable power generators: New Jersey-based merchant wholesale electric generation facilities, New Jersey-based net metered electric generation facilities, and PJM system mix generation supplied by out-of-state merchant facilities.[10]

With passage of the Clean Energy Act of 2018, New Jersey's RPS was aggressively increased to 50% of Class I renewables by 2030, with interim milestones of 21% by 2020 and 35% by 2025. 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 three 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 three MW and less than 30 MW.

Today, New Jersey's RPS is largely fulfilled through the purchase of out-of-state Renewable Energy Certificates (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 toward retirement by the entities required to demonstrate compliance with the RPS. While New Jersey's reliance largely on out-of-state RECs to satisfy the RPS requirement is of benefit to the PJM region, it is of lesser benefit to New Jersey specifically. In order to promote and accelerate renewable energy generation in-state, NJBPU has

[10] New Jersey-based net metered electric generation facilities are not included in USEIA's reporting of utility-scale renewable energy generation, which accounts for the discrepancy in NJBPU's accounting of total renewable energy generation in state compared to federal utility-scale data.

established carve-outs for in-state solar and offshore wind through 2030. 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 to motivate additional in-state solar electric generation. This can be established in conjunction with the planning and goal setting of renewable energy generation through 2050, as further described in Goal 2.1.2.

Goal 2.1.2: Establish specific in-state Class I renewable energy goals and milestones including but not limited to solar and offshore wind generation to enable a significant majority of electricity to be produced from renewable resources by 2050. As discussed above, New Jersey passed an ambitious increase to its RPS in 2018, mandating that the state supply 50% of its electricity from renewable sources. Importantly, with the exceptions of a small and decreasing in-state solar carve-out in the RPS through the issuance of SRECs and an undetermined future offset for offshore wind in the form of ORECs, the state's RPS is currently 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, there are myriad ancillary benefits to in-state renewable energy generation and DER, including reductions in electricity congestion and locational marginal prices, and increased system resiliency. Further, they produce ongoing, local jobs in innovation-centered STEM careers such as planning, installation, maintenance, and operations.

Through evaluation of evolving renewable energy markets, the state will establish goals to quantify the amount of carbon-free energy that should be generated in-state through 2050 to meet consumer demand and develop appropriate market-based mechanisms to ensure that New Jersey's energy mix meets our zero-net carbon emission goals. Consideration should be given to maximizing renewable energy potential with the aim of meeting those targets at the lowest possible price, while still encouraging electricity generated from in-state renewable resources. Modeling for the Integrated Energy Plan, the Solar Transition Program, and the Offshore Wind Strategic Plan, as well as feedback from the stakeholder community, should enable NJBPU staff to accurately assess ambitious but achievable solar and offshore wind targets for the final EMP, as well as how best to decarbonize the remainder of New Jersey's energy usage.

Goal 2.1.3: Model scenarios and pathways to achieve 100% clean, carbon-neutral electricity generation 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 energy consumption, but poorly managed electrification could exacerbate peak load and greenhouse gas emissions and introduce electric grid capacity concerns.

Further, there are many potential but unproven pathways to achieving 100% clean energy by 2050. Today, New Jersey sources roughly 5% of its electricity from renewable energy sources. 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 today to increase its renewable energy production, accelerate energy efficiency initiatives, and reduce reliance on fossil fuels. But as New Jersey gets closer to reaching 100% clean energy in the coming decades, further progress toward a completely carbon neutral system will become more challenging without greater advancement of technology and infrastructure and changes to regulatory structures and market design.

The state must establish and model full energy system scenarios and pathways in New Jersey and throughout the regional system and Eastern Interconnection that will inform decisions about how New Jersey can achieve 100% clean energy and an 80% reduction in greenhouse gas emissions at the least possible cost. New Jersey has not previously performed a study of this magnitude. A 30-year forecast will inform energy system decisions and enable state government and industry to put policies and practices in place to support 2050 ambitions.

Goal 2.1.4: Explore regulatory authority to achieve 100% clean energy by 2050. In producing the above modeling assessment, a significant question must be raised: is New Jersey's existing regulatory structure going to realize an optimized pathway to 100% clean energy by 2050? Given current regulatory structures and electricity system mix throughout the regional transmission organization, as impacted by federal policies, the answer is likely, "no." Since the state restructured its utility industry with the passage of the Electric Discount and Energy Competition Act in 1999, the state has largely relied upon competitive markets for electric generation, and the state has not provided NJBPU with the legislative authority to mandate a 100% carbon-neutral grid or the ability to prohibit sale of non-carbon free power. Further, federal policies, including those emanating from the federal Department of Energy that seek to subsidize carbon-emitting resources, may prove unfavorable to, if not incompatible with, New Jersey's efforts to realize 100% clean energy by 2050. Regulatory change may be necessary as a result.

Further complicating New Jersey's efforts to establish a clean energy future and reduce emissions is that Maryland and Delaware are currently the only PJM states that participate in RGGI, which will make it easier for more polluting power plants in non-RGGI PJM states to compete in the PJM market against the cleaner, but likely more expensive RGGI-state power plants; this is a known industry issue commonly referred to as "leakage." 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.

Complementary to modeling pathways and scenarios to achieving 100% clean energy by 2050, NJBPU intends to assess the use of its authority over retail sales of electricity (over which the state generally has plenary authority) to reach its most cost-effective and optimized path to 100% clean energy by 2050. Such programs could include a carbon-neutrality requirement for Basic Generation Service (BGS) load or a clean energy market that competitively sources carbon-free energy.

Goal 2.1.5: Update interconnection processes to address increasing DER and EV 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 improve the amount and location of 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 distribution companies (EDCs) have circuits that are restricted from accepting new requests for interconnection of DERs. Depending upon 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.

NJBPU staff will explore with stakeholders and the EDCs the measures and means to open currently restricted circuits via strategic adoption of energy storage, energy efficiency, smart inverters, and other distribution system protective equipment.[21] Without a carefully considered increase to current limitations, DER penetration will not reach maximum potential. NJBPU staff will also continue to work with the RTO in its efforts to expedite utility-scale, transmission-level DER interconnection approvals.

Goal 2.1.6: Develop a mechanism to compensate DER for its 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 lower production costs in such forms as increased resiliency, lower electricity demand via behind-the-meter energy generation, presumptive deferred grid and capacity upgrades, and lower Locational Marginal Pricing,[11] which is the price of energy purchases and sales in PJM's wholesale electricity market based upon the value of the electricity at the time and location in which it is delivered.

NJBPU staff will determine whether this value is fully revealed in the existing regulatory framework, which is currently under revision, and will actively engage at the federal and regional levels to recommend pathways to further unlock benefits of DER deployment. NJBPU staff will further evaluate which streams of value (i.e., in the value stack) are prudently compensated after evaluating all market opportunities, and which are not. NJBPU staff will determine the extent of New Jersey's retail compensation program, and make recommendations regarding market participation to guard against over compensating and maximizing competitive opportunities. Further, NJBPU's evaluation will consider how to design utility tariffs to encourage DER deployment without encouraging undue cross-subsidization between entities with DER and those without.

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 staff will also explore the establishment of distribution-level, retail demand response programs that can complement the Federal Energy Regulatory Commission (FERC) jurisdictional markets. This assessment will be further informed by submission of integrated distribution plans by the EDCs, as established in Goal 5.1.1.

[11] Locational Marginal Prices (LMP) are wholesale energy prices set by PJM at each node throughout its system based on generator and 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.

Goal 2.1.7: Develop low-cost loans or financing for DER. 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 rate loans and financing through mechanisms such as establishment of a State Green Bank, expansion of the Environmental Infrastructure Trust, issuance of green bonds, on-bill financing, and other financial options, which are 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 the Clean Energy Program. NJBPU and NJEDA should determine if continued reliance on rebates 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 SREC program will be discussed below.

Goal 2.1.8: Coordinate permitting and siting processes. 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 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 established through expansion of state agency programs, such as NJDEP's Office of Permit Coordination, through programs hosted within the proposed WIND Institute (Goal 7.4) or a Community Solar Center, or through new developments or a combination of the above.

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. 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 vulnerable to climate change.

Goal 2.1.9: Begin stakeholder engagement to explore rules to limit CO_2 emissions from Electric Generating Units. Consistent with Executive Order No. 7, New Jersey is poised to rejoin RGGI and 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 we move forward to attain our 2050 goals. However, additional regulation of CO_2 may be prudent to ensure attainment of the 80X50 GWRA mandate. NJDEP will begin stakeholder engagement in the coming months to solicit ideas and inform potential future rulemaking options. Similar to RGGI going forward, 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 3500 MW of offshore wind power by 2030

- **2.2.1 Develop offshore wind power 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; create ongoing, unionized 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.

Many states across the U.S. are also pursuing offshore wind opportunities. On the east coast, New Jersey, Massachusetts, Rhode Island, Connecticut, New York, Delaware, Maryland and Virginia collectively have commitments or goals reaching 19 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 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 power generation. NJBPU should assess opportunities to build additional offshore wind capacity beyond the initial 3,500 MW goal set in Executive Order No. 8 and the Clean Energy Act of 2018 and establish milestones and goals in the near term through 2035, and through 2050, determining how much of New Jersey's energy demand should be met with offshore wind electricity generation (see Goal 2.1.2).

According to the U.S. DOE, 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 wind capacity. New Jersey and other states along the East Coast are taking action to increase 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 towards achieving New Jersey's goal of 3,500 MW by 2030; NJBPU anticipates making an award in June 2019. 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. Using a more accepted power density ratio could double the amount of offshore wind that could be supported in these lease areas.[22]

Importantly, the cost of offshore wind power has continued 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.[23] In addition, the U.S EIA's projected Levelized Cost of Energy Analysis for unsubsidized offshore wind generation entering service in 2023 was $ 0.118/kWh.[24] Because renewable energy's cost is largely front-loaded due to the capital cost of construction and does not need to consider the risk of fluctuating fuel prices, it provides more cost stability to investors than traditional energy generation, which rises and falls with the cost of coal, oil, and gas, though the intermittency of the renewable energy can create a revenue risk. As the industry develops and technologies and processes mature, cost is expected to continue to decrease.

As discussed above 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. If unsuccessful, New Jersey must evaluate whether other regulatory structures are more appropriate to realize the state's goals, as discussed above.

NJBPU should endeavor to collaborate with the RTO to ensure that transmission planning and interconnection rules accommodate these resources. Moreover, consistent with the state's commitment to affordability, NJBPU should continue to advocate at the federal and regional level that the cost associated with such transmission, interconnection, or other grid-related upgrades are allocated on a just, reasonable, and nondiscriminatory basis among states regionally and inter-regionally. As discussed above, the NJBPU may have to exercise authority previously untapped, 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.[25] If the U.S. succeeds in installing the on and offshore wind energy capacity that U.S. DOE anticipates in 2050, the wind industry could support over 600,000 jobs nationally.

As part of New Jersey's efforts to ensure that the state is a leader in offshore wind in the Northeast, New Jersey will target high value companies in the wind industry supply chain to base 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 indicated in the NJBPU's first 1,100 MW OREC solicitation, 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 well positioned to capture supply chain jobs including manufacturing, painting, installation, logistics, project development, engineering, finance, and technology development.

In addition to active outreach to support 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 supply chain development. 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. NJEDA is building the New Jersey Offshore Wind Supply Chain Registry as part of its membership in the Business Network for Offshore Wind, a non-profit organization dedicated to growing the U.S.-based offshore wind 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 which may 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 help support the development of a New Jersey-based supply chain. Many of the companies that are located in the state today will need to 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 its first 3,500 MW of offshore wind through 2030, the state projects to create approximately 15,000 fulltime equivalent positions through the construction, operations, and maintenance of offshore wind generators.

The state is collaborating with industry to establish a workforce needs assessment. This assessment will look at talent pipelines across a wide-variety of blue-collar and white-collar job-types necessary to develop the offshore wind industry, as described above. 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 Nontraditional 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 a pathway for careers within the offshore wind industry.

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/marshaling/load-out, and operations and maintenance (O&M). 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.

Strategic investment in port facilities is a key component to attracting developers and OEMS to locate 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 critical as New Jersey looks to develop port infrastructure. Importantly, regional port authorities, such as Port Authority, the Delaware River Port Authority, and the SJPC will play an important coordinating role in infrastructure development.

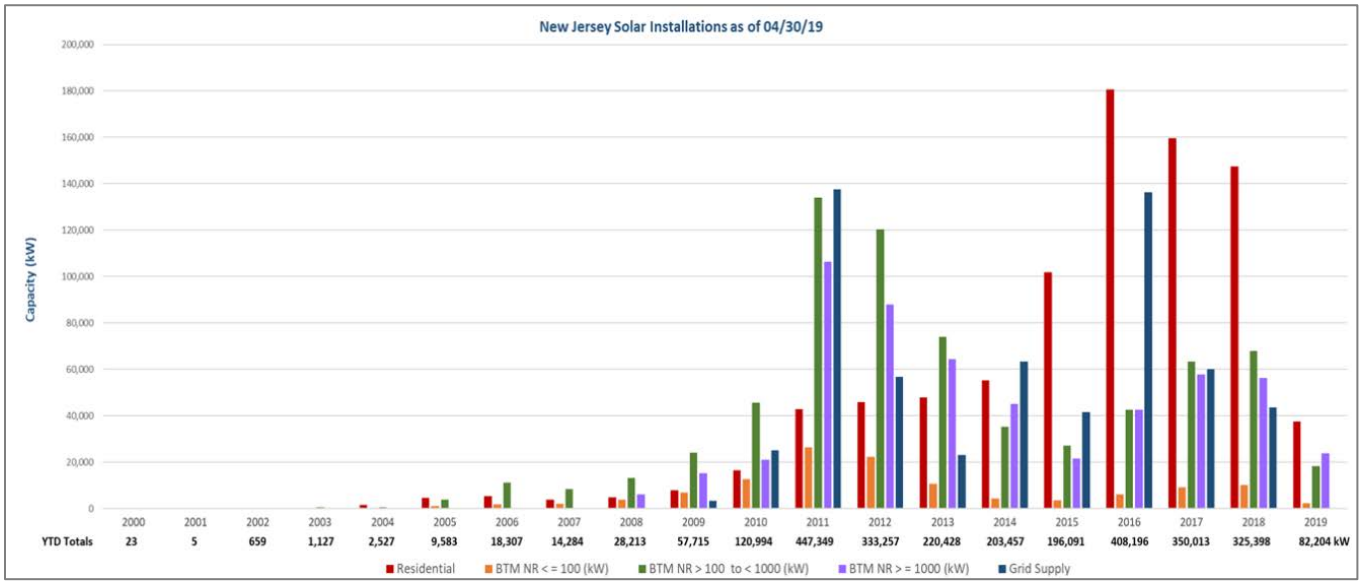
Goal 2.3: Maximize local (on-site or remotely-sited) solar development and DER by 2050

- **2.3.1 Establish and grow a 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 LMI communities using the local workforce**
- **2.3.4 Mandate non-wires solutions on state-funded projects, including new construction and rehabilitations**
- **2.3.5 Develop mechanisms for achieving 600 MW of energy storage by 2021 and 2,000 MW of energy storage by 2030**
- **2.3.6 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 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 (approximately 100,000 installations at 825 MWdc) and commercial markets (6,200 installations at 1,315 MWdc). Utility-grid solar has increased as well; 588 MWdc came online through 2018. As of late 2018, New Jersey had the sixth largest installed solar capacity in the country,[26] with 2,733 MW of

installed capacity as of year's end 2018[27] and 661 MW[28] in the pipeline (Figure 7). Notably, the local solar industry also provides 6,000 to 7,000 New Jersey jobs.

Figure 7: New Jersey Annual Solar Installations as of 4/30/19



Solar and biopower (the conversion of organic materials into heat and electricity) are expected to make up the bulk of New Jersey's in-state renewable power generation in the immediate future. New Jersey's existing biopower resources largely include landfill gas to energy plants, waste to energy plants, and wastewater treatment plant biogas to energy plants. In particular, the conversion of biogas to electricity at wastewater treatment plants or food waste processing facilities offer additional promise for increased renewable electricity generation. As discussed above, offshore wind holds great promise for New Jersey and could become the state's largest renewable energy resource; offshore wind energy generation is expected to begin within the next six years.

Goal 2.3.1: Establish and grow a community solar program. NJBPU has 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 by receiving a credit on their utility bill. The Pilot Program sets an ambitious 40% carve-out for projects that serve at least 51% LMI customers.

Like other types of DER, community solar aids in decentralizing generation and bolstering resiliency. Further, 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 reap the rewards of clean energy participation previously only accessible to those who could install solar energy generation on their own property.

As NJBPU implements its Community Solar Energy Pilot Program, it should also work to establish, in conjunction with other NJBPU initiatives such as the Solar Transition Plan and the Integrated Energy Plan

and as part of Goal 2.1.2, a percentage of community solar-sourced renewable energy to contribute to New Jersey's in-state solar generation requirements. Further, NJBPU can also establish goals for supporting community solar in environmental justice communities, in addition to meeting or exceeding the existing 40% carve-out for projects that serve at least 51% LMI customers.

Goal 2.3.2: Transition to a successor solar incentive program. NJBPU is currently undergoing a robust study and stakeholder process to transition from the existing SREC incentive program to a transition and 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 seven percent cap thereafter.

NJBPU has engaged a consultant to model the costs of representative size solar electric generation facilities as a well as program wide costs in order to inform the development of alternative approaches to reaching the state's solar goals as equitably and cost effectively as possible. As part of the transition process, the law also requires NJBPU develop megawatt-based targets for different installation types and incentive payment caps. A stakeholder process has commenced with staff straw proposals issued in December 2018 and April 2019, and stakeholder meetings initiated in May 2019. A transition incentive program should be presented to NJBPU in fall 2019 and a successor to the SREC incentive system is anticipated to be presented for NJBPU consideration in May 2020.

Through the transition and successor incentive program development, NJBPU will establish offset goals that will mandate a certain amount of in-state solar energy to be procured by the EDCs to satisfy the RPS.

Goal 2.3.3: Maximize solar rooftop and community solar development in urban and LMI communities using local workforce. As further discussed in Goal 6.2, maximizing rooftop, carport, and community solar development in LMI communities and training the local workforce to build, maintain, operate, and possibly engage in energy trading offers the dual benefit of enabling low- and moderate-income communities to participate in and benefit from the clean energy transition, including reducing energy bills and establishing new, local jobs. State agencies should make a concerted effort to work with utilities and developers to steer development toward urban rooftops, and coordinate with the Department of Labor and Workforce Development (NJLWD) 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: Mandate non-wires solutions on state-funded projects, including new construction and rehabilitations. Non-wires solutions (NWS) 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. As an example, 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. Similarly, a residence built to zero-carbon standards with a tight thermal envelope, rooftop solar and battery storage is another type of NWS; unlike traditional developments, it will not increase load on the distribution grid.

State-funded buildings and projects should seek to assess and implement NWS 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 and NWS. 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' IDP (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 2.3.5: Develop mechanisms for achieving 600 MW of energy storage by 2021 and 2,000 MW of energy storage by 2030. Pursuant to the Clean Energy Act of 2018, NJBPU conducted an Energy Storage Analysis that will be released this June. Further, 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.

New Jersey has 477 MW of existing energy storage, the majority of which is from one pumped-hydroelectric storage facility. Findings from the Energy Storage Analysis prepared by Rutgers University 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, but is not currently cost effective for most storage applications. While costs for battery storage systems are dropping rapidly, the predominant chemistry Lithium-ion systems may not be cost-competitive for most applications through 2030.

NJBPU will seek to achieve the energy storage targets at the least cost, starting at a small capacity goal that increases as cost decreases and accelerate the adoption of energy storage enabled infrastructure improvements. The following options are potential ways to beginning to achieve the Clean Energy Act requirements.

Battery storage systems can currently provide cost-effective ancillary services for bulk power markets. Further, energy storage could assist in the development of offshore wind. In addition, stacking the value of distributed Lithium-ion systems including increased local energy resiliency, peak power reduction, shifting load, and providing ancillary services – if coupled with renewable energy – can move Lithium-ion energy storage in the cost-effective direction. Energy storage currently adds more value if it is sited across the distribution network and integrated with solar rather than centralized on the grid.

Targeted deployment of Lithium-ion systems could potentially provide increased hosting capacity for behind the meter solar systems in areas with overloaded line sections of the distribution system, increased resiliency of critical facilities with solar energy, and assistance in energy bill management for commercial facilities with solar power systems to manage high demand charges.

Additional opportunities for energy storage will emerge with increased use of EVs including the reduction of demand charges for fast charging stations with the availability of vehicle to grid (V2G) and vehicle to home (V2H) technologies.

Goal: 2.3.6: 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 the reduction of waste transport and disposal costs and emissions from landfilling. 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 should consider requiring source separation of organic wastes from municipal solid waste and incentivizing anaerobic digestion technology for processing wastewater as well as food wastes. 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 reduce related emissions and energy use.

Strategy 3: 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 and accountability; reduce wasted energy through improvements in building thermal envelopes, appliance efficiency, energy benchmarking, equipment controls, strategic energy management, and attention to peak demand reduction; and ensure access to increased efficiency for all residents so that energy burden disparities are not amplified.

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 .75%, respectively, including the establishment of clear performance indicators and evaluation, measurement, and verification methods while continuing to review and develop cost recovery mechanisms for utility-run energy efficiency and peak load reduction programs**
- **3.1.2 Increase funding for, awareness of, and access to New Jersey's Clean Energy Program and its suite of statewide programs**
- **3.1.3 Adopt equitable clean energy financing mechanisms that enable greater penetration of energy efficiency opportunities for all customers**
- **3.1.4 Streamline marketing, education, awareness, and program administration**
- **3.1.5 Revise street lighting tariffs as necessary to incentivize mass adoption of energy efficiency initiatives**

Energy efficiency and load management are the most cost effective energy resources for meeting customer needs[29] and are critical to successfully meeting New Jersey's goal of 100% reliance on clean energy sources by 2050. 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 by 2029.[30] Nationwide, energy efficiency is the third-largest electricity resource[31] and is the cheapest method to meet customer needs. Energy efficiency employs 33,815 individuals in New Jersey[32] and contributes to greenhouse gas emissions reductions and improved water quality, as well as strengthens grid resilience and improves health and comfort. A variety of policy options will allow New Jersey to improve efficiency efforts and leverage efficiency as a valuable resource[33] 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 equitability and dramatically reduce greenhouse gas emissions.

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 while continuing to review and develop cost recovery mechanisms for utility-run energy efficiency and peak load reduction programs. Utilities and third-party providers are critical allies in the delivery of efficiency programs, especially in meeting customized needs of particular customer segments. Establishing a comprehensive statewide energy efficiency program and clarifying the role that utilities and third-party providers will play in implementing energy efficiency programs is crucial to meeting state goals.

The recent Clean Energy Act's mandated utility reductions in energy consumption (2% for electric utilities and .75% for natural gas utilities) have enhanced the need for customers to participate in achieving reductions in consumption, and for the utilities to promote and achieve those reductions. The Clean Energy Act establishes requirements related to energy efficiency and allows for incentives based on achieved efficiency. Additionally, public utilities will be required to implement programs to promote energy efficiency and peak demand reduction. To ensure the success of the Clean Energy Act's objectives, the state will determine the role of utilities in energy efficiency, provide clear strategic direction, and support the utilities' efforts to achieve reduction targets. Further, the state must foster job growth through investments in energy efficiency and related technologies to increase opportunities for manufacturers and providers while reducing the cost of energy efficiency upgrades.

NJBPU has completed an energy efficiency market potential study and is continuing its stakeholder engagement through the summer of 2019. This includes feedback from the newly established Energy Efficiency Advisory Group. Based on this input, NJBPU will adopt a methodology for filing in fall 2019.

As utilities increase their investment in energy efficiency, NJBPU will set 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 reduces energy consumption in line with increasing opportunities, cost-effectiveness, and changing trends. Ongoing attention to these interim goals will advance New Jersey toward its 2030 and 2050 clean energy goals.

In establishing these targets, NJBPU will also engage with stakeholders to continually enhance the metrics and evaluation methods utilized to measure energy savings and utility program success. NJBPU's Energy Efficiency Advisory Group will provide engagement opportunities for stakeholders in the consideration of critical issues such as program administration, eliminating redundancy between state and utility-run programs, reviewing evaluation, measurement, and verification processes, and establishing program filing timelines and reporting requirements.

NJBPU will review and clarify the processes for utilities to submit proposed programs and report program success to NJBPU. NJBPU will also establish the structure for cost-recovery and the assessment of incentives and penalties, particularly in light of both state-run and utility program offerings and requirements from the Clean Energy Act.

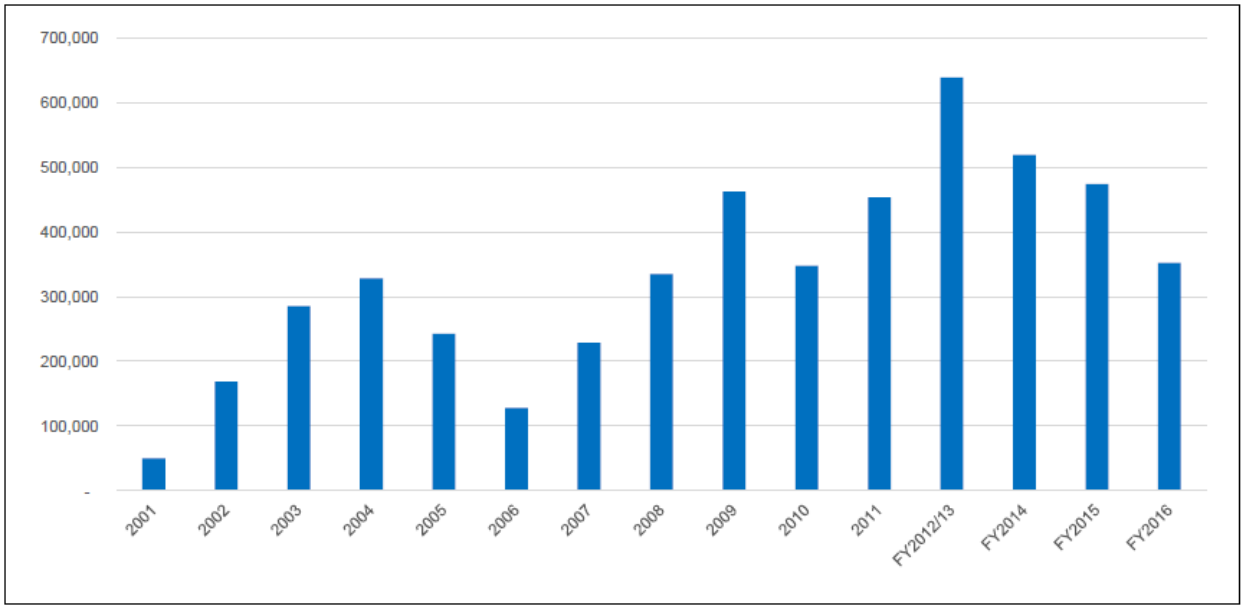
Other important issues NJBPU will consider include ensuring equitable access to energy efficiency programs by establishing a minimum threshold for hard-to-reach customer bases like multi-unit dwellers, LMI households, and small commercial and residential customers. The utility-run programs will be important opportunities in New Jersey's clean energy portfolio, as they can reach customers through localized programs that complement state-wide programs, support the adoption of energy efficiency through existing customer relationships, and pilot new technologies.

Energy efficiency policies should be continually evaluated and upgraded based on emerging technologies and Clean Energy Program best practices in order to support more ambitious efficiency goals.

Goal 3.1.2: Increase funding for, awareness of, and access to New Jersey's Clean Energy Program and its suite of state-wide programs. Complementary to strategic and integrated planning for utility-run energy efficiency programs, NJBPU must also enhance the role of the state-led Clean Energy Program and realign existing programs to meet state energy and climate goals.

Since 2001, New Jersey has spent $2.1 billion on statewide energy efficiency programs through New Jersey's Clean Energy Program (NJCEP). Through June 2018, these investments have saved 72 million lifetime MWh and 224 million lifetime Dtherms across the residential, commercial, and industrial sectors (Figure 8). These lifetime savings have been achieved through the participation of more than 1.7 million New Jersey electric and gas customers and resulted in the elimination of 58.5 MMT of CO_2 (equivalent to 6.5 billion gallons of gasoline consumed).[34]

Figure 8: NJCEP Annual Electricity Savings (2001-2016) in MWh



New Jersey's statewide programs are an important component of advancing the state's clean energy goals, as they ensure access to programmatic opportunities across the state. The state's administration of energy efficiency programs ensures that all customers who support the Societal Benefits Charge have equitable access to the resulting programs and incentive opportunities.

New Jersey should closely monitor technology advancements and opportunities to explore and invest in deeper energy saving measures, allowing the state to lead the way in adopting new technologies. As the saturation of certain equipment and building standards are achieved, and as market forces, such as demand and pricing, are altered, program design will need to be updated. Continued efforts towards increased efficiency will mirror advancements in other clean energy areas moving forward.

Goal 3.1.3: 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 existing programs are aimed at specifically meeting the needs of small, non-profit, large or industrial energy users, but gaps remain for options available to all residents and customers, as mentioned in Goal 3.1.1.

Challenges such as ownership structure, metering configuration, and 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.

As the Murphy administration is committed to a Stronger and Fairer New Jersey, we recognize that 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 million to LMI customers for energy efficiency projects in Fiscal Year 2018, and the Weatherization Assistance Program (funded by the U.S. DOE and administered by the NJDCA) help to decrease the energy burden and increase the comfort of lower income residents. However, a wider variety of programming that provides opportunities for residents of all income and without regard to metering and ownership configurations is important. In particular, programs that target moderate-income customers are important to closing gaps in program affordability. The equitability of energy efficiency policy is crucial to the success of New Jersey's clean energy goals and, with the proliferation of energy efficiency, will define the equitability of the state, overall, into the future.[35]

Establishment of a state Green Bank to provide low-interest loans and financing for energy efficiency projects would provide myriad benefits, including lowering the overall cost of implementing energy efficiency projects and addressing an existing gap in customer segments: those who lack access to capital to afford 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 options that would 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, lowering energy bills, growing the energy efficiency job sector, reducing energy consumption, and reducing greenhouse gas emissions and criteria air pollutants. Financing the clean energy economy is further discussed in Strategy 7.

Goal 3.1.4: Streamline marketing, education, awareness, and program administration. The state should consider ways to coordinate and streamline the multitude of programs that are or will be offered through the utilities, the Clean Energy Program, and other state and federal programs administered in New Jersey with the goal of reducing programmatic and administrative costs and inefficiencies, clarifying and increasing awareness of program options, and maximizing penetration. As an example, the

state and federal government run several programs addressing LMI populations. Developing a clearinghouse for all low-income-targeted home energy programs could lower overall costs and maximize program potential.

Goal 3.1.5: Revise street lighting tariffs as necessary to incentivize mass adoption of energy efficiency initiatives. NJBPU is investigating methods to implement a statewide street light replacement program. There are potentially significant energy savings from replacing outdated streetlight heads with more energy efficient LED fixtures, and NJBPU has received numerous requests from towns and municipalities to address this issue. While LED replacements are currently allowed within electric distribution company tariffs, there are currently little to no savings due to the current tariff structures. NJBPU is planning a workshop to address this and will ultimately conduct a stakeholder process to resolve these tariff issues and make streetlight fixture replacement with LEDs more incentivized on the customer side to foster mass implementation. This effort will not only lower costs but also has significant energy savings potential.

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.

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 EV charging and encourage customer-controlled demand flexibility**

Meeting state energy and climate goals will not only include reducing overall energy demand, but also decreasing peak demand, which is often provided for by the most polluting and expensive energy generators. Utility management of peak load and policies that encourage peak demand reduction are part of the Clean Energy Act requirements. 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 MWh, over the next ten years.[36]

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. Complemented with Advanced Metering Infrastructure (AMI, or “smart meters”), which can provide granular data about energy use and costs, such control should include new rate designs, such as Time of Use (TOU) rates to incentivize customers to reduce energy use during periods of peak energy use. 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 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.

Importantly, the state must continue to advocate at the regional and federal levels for appropriate compensation of the full value stack that demand response, energy storage, and other forms of 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: Modernize the Grid and Utility Infrastructure.

Goal 3.2.2: Pilot alternative rate design to manage EV 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 EV technology and increasing variety of vehicle models available for lease or purchase, New Jersey is likely to see rapid growth in demand for EV charging in the near future. NJBPU should work with utilities to pilot alternative rate design to manage EV charging, thus limiting grid impact as EVs proliferate.

NJBPU can additionally develop an energy storage and EV charging pilot program for peak load reduction for commercial and industrial customers with existing solar facilities to reduce their load and energy bill.

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 mechanisms to increase building efficiency in existing buildings**
- **3.3.3 Build state-funded projects and buildings to the tightest thermal envelope**
- **3.3.4 Improve energy efficiency and retrofit state buildings to the tightest thermal envelope**
- **3.3.5 Increase compliance of mandated building and energy codes**
- **3.3.6 Establish benchmarking and energy labeling**
- **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, the use of building energy 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.[37] 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 2014 U.S. DOE 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. This translates to consumer cost savings of $4.96 billion ($2016) and 25.99 MMT of avoided CO_2 emissions.[38]

Goal 3.3.1: Advocate for net zero carbon buildings in new construction in the upcoming 2024 International Code Council (ICC). NJDCA adopts updated 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 offsets its energy demand, often through rooftop solar generation or through connection to a local distributed generation source. 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 mechanisms to increase building efficiency in existing buildings. New construction codes ensure new buildings are built to high thermal efficiency standards, but much of New Jersey is already developed. The state must 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 is 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.[39]

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 programs in the Clean Energy Program or changes to the energy code can establish pathways to reducing energy demand as buildings are being renovated.

Goal 3.3.3: Build state-funded projects and buildings to the tightest thermal envelope. Complementary to the above goal, state-funded buildings and projects should be built to above-code standards.

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 category. 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 3.3.4: Improve energy efficiency and retrofit state buildings to the tightest thermal envelope. Energy use in state buildings is managed by NJBPU and Treasury. The state should 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, or through HVAC equipment upgrades, weatherization, or whole building automation and other "smart building" techniques. The current ASHRAE 90.1 standard has many controls built in related to lighting and HVAC usage, which would be a helpful guide for audits. 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 3.3.5: Increase compliance of mandated building and energy codes. Additional evaluation related to code compliance and attribution would provide further 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.

Goal 3.3.6: Establish benchmarking and energy labeling. Opportunities for building energy savings include programs that encourage energy labeling and publicly available energy use benchmarking. Research has shown that increased energy use transparency, in both the commercial and residential sectors, is a significant factor towards 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.[40]

The Clean Energy Act's requirement that commercial buildings over 25,000 square feet benchmark their energy and water consumption via EPA's Portfolio Manager, an online tool to measure and track a buildings' energy and water consumption and greenhouse gas emissions, is an important step towards benchmarking in New Jersey. However, additional opportunities to promote efficiency through building energy use benchmarking and labeling remain. The state should explore industry best practices beyond benchmarking of large buildings, such as providing an energy audit during real estate sales and leases, to increase awareness and transparency of energy consumption.

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 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. For example, Colorado recently passed HB19-1231, which sets 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.[41] Vermont and Washington have also passed similar laws, and Connecticut, Rhode Island, and Massachusetts have bills pending in legislation.[42]

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 re-invested in New Jersey's economy rather than go to energy costs.[43] 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 many standards cost the buyer nothing. Seven of the appliance standards that ASAP recommends have 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 .7 to 2.8 years. These short payback periods lead to long-term benefits that are three times greater than the amount invested.[44] 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 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.

Strategy 4: Reduce Energy Use and Emissions from the Building Sector

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

Natural gas- and oil-fueled space heating, water heating, appliances, and industrial use account for 28% of New Jersey's greenhouse gas emissions, including 15.5 MMT CO_2e in the residential sector, 9.2 MMT CO_2e in the commercial sector, and 4.3 MMT CO_2e in the industrial sector. Buildings are also responsible for a combined 61.7% of the state's total end-use energy consumption, including similar energy consumption in commercial buildings (25.6%) and residential buildings (24.5%), followed by the industrial sector (11.6%).[45]

75% of residences in New Jersey are heated with natural gas; another 10.3% use oil or propane.[46] Decarbonizing the building sector will be a substantial undertaking because much of the state is built out and the transition to electrification will depend on technologies that are still maturing. However, much of the infrastructure, technology, and assets used to power the building sector have decades of anticipated lifespan. Delaying the transition now means postponing it for years or saddling rate payers with the burden of stranded assets in the future by overhauling a functional but highly polluting system.[47] This would be neither fiscally nor environmentally responsible.

As the state weighs the many competing demands and opportunities to phase out fossil fuel use, transition to a clean energy system, and reduce climate emissions and other air pollutants, reducing reliance on natural gas for building heat will be one of the state's most vexing challenges. According to the U.S. Energy Information Administration, the average consumer price of natural gas heating costs in the Northeast during the 2017-2018 winter season was nearly half the cost of electric heating costs (Table 1).[48]

However, the cost differential between electricity and heating oil was considerably less significant; the average cost of using home heating oil was only 2% cheaper than using electricity. Propane had the highest cost, at 32% more expensive than electricity.

Table 1: Average Consumer Expenditures for Heating Fuels in the 2017-2018 Winter in the Northeast U.S.

Natural Gas	$742
Heating Oil	$1,376
Electricity	$1,406
Propane	$1,856

Additionally, the choice of building heat carries different pollution profiles. Heating oil emits 161.3 pounds of CO_2 per million Btu of energy, compared to 139 pounds of CO_2 for propane and 117 pounds of

CO_2 for natural gas.[49] This is an admittedly imperfect comparison, as the different fuels also carry different pollution profiles in their respective extraction, processing, and distribution systems and we recognize that significant reduction in the use of all fossil fuels will be necessary to meet climate goals. Nevertheless, 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 Expand and accelerate the current statewide net zero carbon homes incentive programs for both new construction and existing homes**
- **4.1.2 Study and develop mechanisms and regulations to support net zero carbon new construction**
- **4.1.3 Develop EV ready and demand response ready building codes for new multi-unit dwelling and commercial construction**

New Jersey should begin its transition to building electrification by targeting new residential construction. New construction is the easiest and most cost-effective option to target because it requires no retrofitting or rehabilitation and no extension of the gas distribution pipeline. Additionally, the strongest and most cost-effective energy efficiency and building techniques can be applied to new construction, reducing overall energy demand.

Further, the state should develop programs and incentives to pair building electrification with onsite power generation to reduce utility bills. New construction built to net zero carbon standards, in which the property offsets its energy demand, often through rooftop solar generation or through connection to a local distributed generation source, has the benefit of reducing overall energy demand, contributing clean energy to the distribution grid, and building in local resiliency. Because a net zero carbon building offsets its own energy demand, the cost differential between natural gas heating and electric heating is negated.

Goal 4.1.1: Expand and accelerate the current statewide net zero carbon homes incentive programs for both new construction and existing homes. Through New Jersey's Clean Energy Program, the Residential New Construction (RNC) Program is designed to increase the energy efficiency and environmental performance of residential new construction buildings (single and multifamily) in New Jersey. The RNC program strategy is to establish standards for energy efficient new construction in New Jersey based on national platforms including EPA ENERGY STAR® Certified New Homes Program, U.S. DOE Zero Energy Ready Home Program, and the EPA ENERGY STAR® Multifamily High-Rise Program. The 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 RNC program, builders agree to work with independent third-party inspectors (raters) who inspect, measure, and test the home's performance during and after construction. Incentives are designed to partially offset the construction costs associated with building higher efficiency homes.

The RNC program offers builders flexibility and options to participate in the program by building homes to varying standards or guidelines. In all cases, the HERS Index is used to calculate the home's energy efficiency achieved.

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) and to broaden availability of the program to include existing buildings seeking retrofits.

Goal 4.1.2: Study and develop mechanisms and regulations to support net zero carbon new construction. State regulations enable NJDCA to establish energy codes that are more aggressive than those set in the International Energy Conservation Code (IECC) if an institution of higher education can establish an expected seven-year payback period for energy conservation measures.[50]

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.[51] 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, Ill. The study found for new construction, electrification with heat pumps offered consistent cost savings for 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.[52]

NJBPU and NJDCA should work with a state college or university to develop 10-year energy price projections and cost recovery projections for a number of "above code" building electrification techniques and electricity generation techniques, including the installation of electrified heat pumps and water heaters rather than oil or natural gas heating systems and water heaters, and the installation of rooftop solar panels.

Based on the results of the analysis, NJDCA should adopt new regulations guiding developers to these clean energy technologies, thus establishing a pathway for New Jersey to begin electrifying the building sector and decreasing reliance on fossil fuels for thermal and appliance use.

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

Goal 4.1.3: Develop EV 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 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.

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.[53] NJBPU, NJDCA, and the utilities should establish criteria for effective demand response parameters and determine if incentives and rules are enough to help the state meet its energy efficiency potential, or if new legislation will be required.

Goal 4.2: Start the transition for existing oil- and propane-fueled buildings to become electrified

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. The state will carefully, and with the guidance of today's best building practices, navigate a complicated path of balancing the need to aggressively electrify the existing building sector using rapidly improving but still immature technologies and processes, while also maintaining fiscal responsibility. The state should also develop a plan to encourage accelerated development of this technology.

Over the next ten 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. 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 electrified heat is less expensive than propane and similarly priced to 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-$7,000 for a typical residence. The American Council for an Energy-Efficient Economy (ACEEE) found the paybacks to be in the two-year timeframe for oil or propane furnaces, and six to nine years for oil and propane boilers compared to high-efficiency heat pumps. In addition, since the heat pump can also provide high-efficiency air conditioning, there is also an electricity savings.[54] NJBPU should develop a program to ease the financial burden of making this one-time upgrade.

Combined, oil and propane fuel 10.3% of New Jersey residences, and also 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 gain in carbon reductions. It will also set the stage for the more complicated transition away from natural gas in the out years.

Additionally, NJBPU should offer financial incentives for natural gas-heated properties to upgrade to electric heating and cooling now, and ramp down approval of new subsidies that incentivize building owners to retrofit from oil heating systems to natural gas heating systems. Notably, because electric

heat pumps actually provide heating and cooling services, owners of natural gas heating systems can find cost benefits and efficiency gains if high-efficiency heat pumps are installed to replace an aging boiler or furnace and air conditioning units.

Goal 4.2.2: Develop a transition plan to a fully electrified building sector. Early construction and rehabilitations will enable industry experts to become familiar with these new technologies and building techniques and will buy time for the technology to improve and economies of scale to drive down the cost. It is expected that heat pumps will become more economically attractive in colder regions as technology continues to improve and becomes more efficient.[55] While the modeling for the Integrated Energy Plan will provide more granularity, NJBPU expects that beyond 2030, state policy will have to aggressively target existing natural gas-heated buildings.

An interagency task force should be established to work in close coordination with relevant stakeholders to establish a roadmap through 2050 that transitions existing building stock away from fossil fuels. The task force should consider at a minimum how and where the state could benefit from district heating and which geographic regions need additional electrical transmission or distribution upgrades.

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

Finally, NJBPU and NJDCA should also work with critical facilities, such as hospital 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.

Strategy 5: Modernize the Grid and Utility Infrastructure

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, and actively engage in transmission planning and siting.

In order to realize the tandem goals of 100% clean energy and an 80% reduction in greenhouse gas emissions relative to 2006 levels by 2050 while maintaining a reliable, resilient, and affordable energy system, New Jersey must modernize its distribution grid. 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 transmission system and distribution grid.

Modernization will take place on many levels, including development of 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, DER, and bi-directional power flow and communication.

Critically, successful implementation of the four previously mentioned strategies – electrification of the transportation sector, increased renewable energy generation and DER, increased energy efficiency and peak load reductions, and electrification of the building sector – all require strategic planning, financing, and implementation of a modern grid.

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 IDPs within one year to expand and enhance the location and amount of DER and EVs on the electric distribution system**
- **5.1.2 Support bi-directional grid power flow**
- **5.1.3 Assess integration of Volt/Var Control**
- **5.1.4 Instruct utilities to propose and adopt non-wires solutions that encourage complementary private sector investments when seeking expansion or upgrade of the distribution and transmission system or generation sources**

Increasing renewable energy generation and increasing electricity demand through mass electrification of the transportation and building sectors will add stresses to the current distribution grid. Further, the distribution grid within the four electric distribution company territories has varying degrees of robustness. Certain territories have excess capacity to absorb increased demand, while others have reached their limit. The state must work with the utilities to develop the proper planning and enabling mechanisms to support growth of renewable energy, DER penetration, and increased electrification.

Goal 5.1.1: 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. The state

has an interest in encouraging locally produced renewable energy and DER, but existing structural impediments and policies limit potential growth in this market. Furthermore, the state expects to see significantly increased electricity demand in the coming years as the transportation and building sectors electrify.

To optimally and most cost effectively plan for and accommodate increased demand through electrification and further penetration of DER — including but not limited to renewable energy generation, storage, microgrids, and electric vehicles — the utilities should develop IDPs within one year of the final EMP's publication. Such plans should be submitted and approved by NJBPU and 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 DER, as discussed in Goal 2.1.5. In addition, proper distribution planning will enable DER to be fully valued for its avoided distribution costs, congestion mitigation, risk diversification, resiliency, and reliability, as discussed in Goal 2.1.6.

Through development of IDPs, the utilities will assess and recommend physical and operational changes to the electric grid to ensure safe, reliable, and affordable services and to create streamlined and equally accessible integration of distributed energy resources.

Modeling demand growth and prioritizing grid upgrades where it is most needed to accommodate anticipated electrification is another crucial aspect of IDP development. Significant and localized upgrades will be needed to accommodate fleet and port electrification in particular. IDPs will also enable customers and private investors to send price signals that encourage development of distributed energy resources where they can provide the most value, potentially deferring additional grid upgrades and increased electrical capacity.

A lack of IDPs produces a situation in which 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. Traditional distribution infrastructure was designed to send electricity in one direction from a central electric generating unit to the end-use customers. With the emergence and anticipated proliferation of decentralized renewable energy generation, battery storage, demand response, and microgrids, existing infrastructure must be adapted and replaced as necessary to support bi-directional grid power flow.

Such upgrades will include adoption of new software to manage power flow on the distribution grid. It will also necessitate the incorporation of smart inverters in a coordinated approach to maximize their functionality and replacement of grid infrastructure that is not designed for the modern grid.

Complementary to development of the IDP and updating of interconnection standards, utilities must work with NJBPU to establish and file plans to ensure the distribution grid is upgraded to handle the dynamic, decentralized, and bi-directional nature of maturing grid technology.

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 so as to minimize wasted electricity. Like advanced metering infrastructure, voltage optimization may prove to be a cost-effective, foundational platform for maximizing efficiency of the distribution grid.

Consistent with the Clean Energy Act, NJBPU must instruct state 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. Following the results of this study, NJBPU should consider rollout of Volt/Var Controls in some or all the electric distribution company service territories if such measures are in keeping with maximizing the efficiency of the modern grid, including reducing aggregate electricity consumption.

Goal 5.1.4: Instruct utilities to propose and adopt non-wires solutions that encourage complementary private sector investments when seeking expansion or upgrade of the distribution and transmission system or generation sources. Consistent with the state goals of transitioning to a clean energy economy established in this Energy Master Plan as well as the mandates established in the Clean Energy Act of 2018, including 100% clean power by 2050 and reducing aggregate and peak electricity demand, utilities must begin routinely and methodically integrating Non Wires Solutions (NWS) into planning and operations as an alternative or complement to traditional infrastructure and capacity upgrades and expansions.

Through adoption of such alternative resources — including but not limited to energy efficiency, demand response, load shifting, microgrids, storage, renewable energy generation, and grid modernization — utilities may be able to defer, reduce, or eliminate otherwise necessary increases or upgrades to the electricity system. NJBPU should instruct utilities to propose NWS as an alternative to traditional distribution infrastructure investments. NJBPU and the utilities should also consider if the cost of implementing NWS may be reduced over time as they are more routinely implemented. When NWS are found in the planning process to be a cost-effective alternative, it will be necessary to document the baseline, the cost of alternatives, and the effectiveness of the investment. NJBPU should enable electric distribution companies to propose a pilot program to identify approaches, best practices, and opportunities for making NWS standard practice in distribution infrastructure planning, investment, and operations.

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

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

During the last 10 years, New Jersey has seen tremendous growth in transmission investment, which has significantly increased costs to customers. Further, transmission upgrades have been built in New Jersey that provide benefits to customers out of state, but FERC has now repeatedly reallocated significantly larger shares of the project costs to New Jersey ratepayers and not out of state.

Rising transmission costs have been an on-going concern in New Jersey for three primary reasons, including the lack of sufficient oversight, unjustly high Return on Equity (ROE), and unfair reallocation of transmission costs; all of which are born by the ratepayers. Particularly — given future needs to increase transmission as the state modernizes the grid, as in-state electricity generation increases, and as transportation and building electrification add more stress to the grid — the state must 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.

Goal 5.2.1: Exercise regulatory jurisdiction to review and approve the need for transmission projects. Each of the four electric distribution companies in New Jersey also own transmission, and NJBPU has regulatory jurisdiction over these electric public utilities. Therefore, it is essential that NJBPU exercise this regulatory jurisdiction in order to meaningfully engage the regulated utilities and regional transmission organization in this grid modernization process.

PJM, which is regulated by FERC, 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, and 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; these additional projects are not subject to PJM's approval, nor are they usually subject to competition.

Importantly, New Jersey stands out in the PJM region as the only state that does not currently review the necessity of transmission projects. The Federal Power Act and regulations promulgated by FERC recognize the state's regulatory role. Exercising NJPBU's existing regulatory jurisdiction or, alternatively, expanding regulatory jurisdiction with new legislation, will enable NJBPU to manage the rising transmission costs, evaluate the necessity of projects, and actively engage in transmission planning. As New Jersey boldly 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 (ROE) 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 NJPBU 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 pre-determined 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.

On March 21, 2019, FERC issued two Notices of Inquiry (NOI). In the first NOI examining the return on equity of electric transmission companies, FERC sought comments regarding whether, and if so how, it should revise its policies on determining the base ROE used in setting rates charged by public utilities. In the second NOI examining electric transmission incentive adders, FERC acknowledged that existing rules were now nearly 13 years old and that during this time, "the landscape for planning, developing, operating and maintaining transmission infrastructure has changed considerably."[12]

NOIs are typically the first step in engaging all interested stakeholders to gauge whether there is a need to remove, revise or add to certain policies or regulatory requirements. NJBPU should file substantive comments in response to the NOIs as one avenue of addressing high electric transmission costs. The NOIs provide a valuable opportunity for NJBPU to continue its advocacy regarding rising transmission costs for New Jersey's ratepayers.

Goal 5.2.3: Advocate for federal policy changes to address inter-regional cost allocation issues. In addition to the above recommendations, further federal legislation may provide relief for New Jersey ratepayers. Cost reallocations for other on-going, or existing, transmission projects have resulted in higher rates for New Jersey ratepayers. As a result, New Jersey ratepayers end up paying 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, and could also alleviate (or at least prospectively prevent) some of the inter-regional cost allocation consequences felt along the New York Seam.

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 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, managed 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 Energy Master Plan, new technologies, such as Advanced Metering Infrastructure, and existing rate design and rate structure, will need to be evaluated.

[12] 166 FERC ¶ 61,208 at 10

Goal 5.3.1: Strategic and coordinated rollout of Advanced Metering Infrastructure. A foundational component of a modernized distribution grid is Advanced Metering Infrastructure (AMI), an integrated system of smart meters, communications networks, and data management systems that enables two-way communications between utilities and customers. AMI is anticipated to enable the state's transition to a dynamic, bidirectional electricity grid.

Previous utility filings to introduce smart meters were denied due to the cost differential between standard meters and smart meters, and the existing distribution grid was not sophisticated enough to support the presumptive benefits of a smart meter.

In August 2017, Rockland Electric Company (RECO) initiated an AMI case study throughout its service territory in Northwest New Jersey. In its Order approving the case study, NJBPU issued a moratorium on pre-approval of AMI rate recovery to the other electric distribution companies until the RECO AMI case study was completed and a Cost-Benefit Analysis (CBA) was performed and assessed.

RECO completed the AMI case study program in May 2019 and the CBA will commence soon. NJBPU is dependent upon the results of the analysis to assess best practices of incorporating AMI and related hardware and software and to guide the other electric distribution companies into making the most prudent investments.

In addition, statewide AMI installation is a prerequisite of many additional clean energy objectives including realization of potential gains in efficiencies and cost savings, customer-side demand shifts and peak load shaving, and alternative rate designs.

NJBPU's moratorium on pre-approval of smart meter installation remains in effect until completion of the CBA on the RECO AMI case study. However, given that smart meters have reached cost parity with traditional meters and the utilities have established annual meter replacement cycles, NJBPU should consider future replacement of meters with traditional meters rather than smart meters to be an imprudent investment.

Upon completion of the CBA and the final Energy Master Plan, NJBPU should consider issuing recommendations to utilities for accelerated AMI installation in a strategic, coordinated, and efficient manner so the state can begin realizing the benefits of a connected grid while also containing costs.

Goal 5.3.2: Develop standards to ensure customers have control of and accessibility to free and standardized energy management data. As AMI is implemented state-wide, NJBPU must concurrently issue guidance on such concerns as data standardization, ownership, privacy, and third-party access. Importantly, customers must have free and easy access to their data usage, as well as free and easy access to share their data with third parties. Further, utilities and third party providers must take precautions to ensure the privacy and security of data. NJBPU should establish statewide standards for utilities and third party providers, and may consider industry standard "Green Button Connect My Data" in implementing these changes.

Goal 5.3.3: Pilot and implement modified rate design to encourage customer-controlled demand flexibility, managed electric vehicle charging, and support demand response programs. Successful integration of advanced technologies, bi-directional power flow and communication, increased electrification, and mandated energy efficiency savings will necessitate consideration of a revised rate design. Such considerations should include recommendations addressing appropriate compensation for distributed energy resources and maximum value for ratepayers, as mentioned earlier in Strategy 2.

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 to enable customers to become aware of electricity usage and pricing. Recommendations should also establish price signals for electric vehicle charging to incentivize charging during non-peak hours or when there is an abundance of renewable energy.

As discussed further in Strategy 3, 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 and seek alignment on state goals to reduce energy demand and partner with customers and third party vendors in supporting 100% clean energy by 2050.

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 distribution companies are compensated largely through growth in electricity sales, which runs counter to state goals of reducing electricity demand. Further, pursuant to the Clean Energy Act, NJBPU is instructed 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.

Goal 5.4: Instruct gas utilities to identify and prioritize the replacement of pipelines leaking methane

Methane is the primary component of natural gas and a greenhouse gas with 25 times the potency of CO_2 over a 100-year period.[56] Eliminating methane leaks from the state's gas distribution system is crucial to meeting the 80x50 greenhouse gas emission reductions. Further, methane leaks present additional safety concerns.

NJBPU should instruct all gas distribution companies to incorporate advanced leak detection technology into operations to find, quantify, and prioritize gas pipeline repair and replacement and file repair or replacement plans with NJBPU.

Strategy 6: Support Community Energy Planning and Action in Low-and Moderate-Income and Environmental Justice Communities

Encourage municipalities that house predominantly low- and moderate-income (LMI) or environmental justice communities to establish community energy plans and enact them with state support and develop programs that support affordable access to renewable energy and energy efficiency throughout New Jersey.

Governor Murphy has made the promise of a Stronger and Fairer New Jersey a pillar of his administration, lifting all communities from the bottom up and growing the middle class.[57] A signature component of the governor's economic plan is to reduce existing disparities and inequities and to empower the workforce.

The state has a responsibility to facilitate equal access to and representation of the clean energy economy and all the opportunities and benefits it provides. LMI households spend a proportionately higher percentage of their income on energy bills than higher-income communities. 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.

In addition, environmental justice communities are disproportionately impacted by air pollutants and other environmental hazards, as well as being affected by the economic disparities inherent in lower-income populations. Electricity generation and energy consumption is a significant source of greenhouse gas emissions and criteria air pollutants. Governor Murphy signed Executive Order No. 23 in April 2018, directing NJDEP to develop guidelines on how all state departments can incorporate environmental justice into their actions.

In short, the state should encourage, support, and enable LMI and environmental justice communities to assess the cumulative impacts of localized pollution, assess energy demand, and establish opportunities for improvement across all sectors with the aim of developing the innovation economy at the local level and participating in and benefiting from the clean energy economy.

Goal 6.1: Develop a comprehensive Community Energy Plan 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. As New Jersey transitions to a clean energy economy, all state agencies, including NJBPU, NJDEP, NJDCA, and NJ Transit, should 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. The state should encourage and support holistic and comprehensive planning throughout the Community Energy Planning process, including non-traditional sources of energy consumption.

As an example, community redevelopment mechanisms to increase public space, walkability and bike-ability; decreasing congestion and idling; and enabling equitable transportation opportunities all support the co-benefits of improving public health and quality of life, in addition to reducing pollutants. Greening public space through initiatives such as community gardens, rain gardens, tree planting, and

other methods of green infrastructure captures excess rain water and improves local air quality. Comprehensive solid waste reduction plans and development of neighborhood or municipal composting are additional opportunities to realize energy demand reductions and related co-benefits.

Further, NJBPU should reach beyond energy efficiency and financing assistance and expand its newly created Community Energy Planning grant program to enable 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.

Finally, NJDCA administers the Opportunity Zone program, a federal designation for distressed communities that supports the revitalization of communities through private investments and tax incentives. New Jersey has 75 such municipalities, including at least one in each of the state's 21 counties. Incorporating urban revitalization projects with Community Energy Planning are mutually beneficial.

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

Clean power generation has the potential to provide LMI communities with locally supplied energy. Further, fossil fuel power generators are often located in or near environmental justice communities, placing addition burdens on them in the way of disproportionally contaminated air. By supporting clean power generation, the state can close 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. Encouraging development of rooftop and community solar are two initiatives that LMI communities should consider in collaboration with NJBPU, NJDCA, NJLWD, NJ Department of Education (NJDOE), and other state agencies. NJBPU's Community Solar 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. The Application Form evaluation criteria, established to guide the selection of projects in Year 1 of the Pilot Program recognize the importance of community planning by placing higher preference on projects designed in partnership with local communities and projects serving LMI customers.

Goal 6.2.2: Incentivize maximum installation of rooftop solar and community solar by the local workforce. As further discussed in Goal 2.3.4, the state should continue to develop opportunities to incentivize maximizing urban solar rooftop installations and train the local workforce to install and maintain it and possibly engage in energy trading, bringing new clean energy jobs to the community and enabling low-income residents to benefit from local, clean electricity generation. NJBPU and NJDEP are currently assessing solar rooftop potential in urban communities to assist in this effort.

Goal 6.2.3: Develop clean energy workforce opportunities and training programs. The state, through NJLWD, has several established pipelines for training through apprenticeships, industry partnerships, vocational training, and education. NJLWD will enhance and accelerate opportunities for the youth and local workforce in LMI communities and supply them with the skills, training, education, and opportunities necessary to thrive in clean energy occupations. Workforce training is further discussed in Strategy 7: Expand the Clean Energy Innovation Economy.

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

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

6.3.2 Build or incentivize electric vehicle charging infrastructure in lower-income communities

6.3.3 Develop an e-mobility program, including electric taxis and car sharing, neighborhood electric vehicles, scooters or e-bikes, and bicycles

Transportation emissions and air pollutants are disproportionately high in urban areas. The state should work with LMI and environmental justice communities to assess and develop mechanisms to prioritize clean transportation, such as developing an electric mobility program, installing EV chargers in community hubs, and piloting additional NJ Transit electric buses on urban routes. NJBPU won a competitive grant from the U.S. DOE to study electric car sharing opportunities for LMI communities. These lessons learned should allow for potential pilot programs in the near future to enable equitable access to electric vehicles. Early community engagement and energy planning driven by local needs will be critical for these initiatives, as well as those related to other renewable and emerging technologies.

Goal 6.3.1: Prioritize replacement of public transportation fossil-fueled 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 faced by these communities.

In February, NJDEP announced the purchase of eight new electric transit buses with funds 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.[58] Insights from this pilot should be utilized to develop strategies for the further implementation of electric buses in transit fleets throughout New Jersey, as discussed in Goal 1.1.7. The administration also in June 2019 announced an additional $16 billion from the Volkswagen settlement funding to deploy electric heavy-duty garbage trucks, school buses, and port-related vehicles in urban communities.

Goal 6.3.2 Build or incentivize electric vehicle charging infrastructure. Proper charging infrastructure must be built for the benefits of EVs to be realized. Low-income communities stand to benefit greatly from the environmental and transportation-related benefits that EVs can provide. Sufficient investment must be made in charging infrastructure in these areas to facilitate EV use.

Building extensive charging infrastructure also makes these communities more attractive to car-sharing and ride-hailing companies looking to expand their EV programs and 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 transportation services and sources of income. Programs such as these allow for EV technology to be utilized more equally across all communities, increasing the overall number of clean vehicles on the road.

Goal 6.3.3 Develop an e-mobility program, including electric taxis and car sharing, neighborhood electric vehicles, scooters or e-bikes, and bicycles. Shared mobility strategies such as car-sharing, ridesharing and scooter/bike-sharing have been shown to have environmental, social, and transportation-related benefits. By shifting people away from personally owned modes of transportation to shared ones, these services can reduce personal vehicle ownership, use and vehicle miles traveled.[59] These programs can benefit LMI and environmental justice communities by reducing pollution, traffic congestion and increasing access to affordable transportation. Shared mobility can also bridge the gap in existing public transit networks, increasing access to mass transit.

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

Goal 6.4: Eliminate barriers to participate in and benefit from the clean energy economy. The state should seek to eliminate barriers to participation in existing low-income energy efficiency programs and develop opportunities for enhanced efficiency incentives for low-income customers and for affordable multifamily housing.

The state administers several programs that aim to make energy bills more affordable and provide long-term solutions to LMI households.

- The Comfort Partners Program, though 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 the NJCEP energy efficiency expenditures were spent through the Comfort Partners Program. Since its launch 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 for 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 utility bill assistance programs, including the Universal Service Fund (USF), which is administered by NJDCA; the Lifeline Program (Energy Assistance), through the NJ

Department of Human Services; and the Payment Assistance for Gas and Electric (PAGE) Program, administered by the Affordable Housing Alliance. NJDCA administers the federally-funded Low Income Energy Assistance Program (LIHEAP).

- NJBPU also administers the Winter Termination Program, which protects certain customer categories from gas or electric shut off between November 15th and March 15th.

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 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. Similar measures are additionally discussed in Strategy 3: Maximize Energy Efficiency and Conservation and Reduce Peak Demand.

Strategy 7: 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 its clean energy economy. Today, there are nearly 52,000 jobs in the energy efficiency, clean vehicles, fuels, storage and renewable energy industries located in every county across the state.[60] The state must build upon this solid foundation and work to expand the clean energy economy to its full potential.

The ambitious renewable energy goals set in recent legislation will bring additional economic benefits of the rapidly growing industry to the state. Solar installers and wind turbine service technicians are currently the two fastest growing occupations in the nation[61] and in 2018 the two industries employed over 9,000 New Jerseyans.[62] Expanding these and other clean energy industries will create jobs and grow the economy, while ensuring the state meets its climate action goals. Further, growth in these industries will advance Governor Murphy's goal of a Stronger and Fairer New Jersey by increasing the opportunities for quality employment.

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. Investments to bring cutting-edge clean energy research and development to New Jersey must be made.

Goal 7.1.1 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 —nearly three times more than the fossil fuel industry.[63] Further, the clean energy economy is expected to continue growing between 4-6% per annum according to industry analysts and employers. 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.[64] 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.

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, including but not limited to support for renewable energy generation and distributed energy resources; grid modernization; energy efficiency services; transport system electrification including the installation of electric vehicle infrastructure and potential manufacturing and assembly of electric vehicle components; and zero carbon building construction and retrofits

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 a 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 its 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.[65] 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 county, including New York,[66] Massachusetts,[67] and California,[68] 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 New Jersey empowers its workforce and youth to thrive in a clean energy future.

Goal 7.1.1: Develop a workforce needs assessment for the clean energy economy, including but not limited to support for renewable energy generation and distributed energy resources; grid modernization; energy efficiency services; transport system electrification including the installation of electric vehicle infrastructure and potential manufacturing and assembly of electric vehicle

components; and zero carbon building construction and retrofits. As New Jersey embarks on a transition to a clean energy economy, several sectors will see opportunities for growth and will need a workforce which can meet the needs of emerging, maturing, changing, and expanding industries.

The Department of Labor and Workforce Development's (NJLWD) Office of Research Information (ORI) will develop a needs assessment for the clean energy economy. Initially, and in coordination with stakeholders including NJBPU, NJEDA, and industry, ORI will define the parameters of the needs assessment for the clean energy economy. ORI can then explore how workforce development impacts all the occupation areas included in the defined clean energy economy.

Following a defining of the parameters of the clean energy economy workforce needs assessment, ORI should engage in data collection and analysis. Using various methods including research, surveys, and focus groups, ORI can collect information about the positive and negative elements that build or detract from a clean energy economy. Using diverse systems 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 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 of what needs to happen in order to cultivate workforce development for the 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.

Goal 7.1.2: 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' growth and equity ambitions. Led by NJLWD, the state will investigate a range of potential programs to help retrain and reskill New Jersey's workforce for clean energy jobs.

For example, NJLWD 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. NJLWD's Industry Partnerships initiative is another example of an innovative program to match labor demand with training programs. Through this program, NJLWD will offer opportunities for its training partners and New Jersey businesses to upskill 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 other competitiveness needs of the sector.

- **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 what industry needs, and 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 7.1.3: Establish Vocational Training to establish a pipeline of well qualified, modern energy specialists. NJLWD has historically partnered with our vocational schools through its County Apprenticeship program as well as its Youth Transitions to Work program (YTTW). The YTTW program's focus is to introduce high school juniors and seniors to apprenticeships. In addition, NJLWD'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.

Goal 7.3: Provide innovating 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 the establishment of 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 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.

A state Green Bank could help deliver on New Jersey's clean energy market potential by providing public financing for the deployment of clean energy as well as driving the 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 access to participation in New Jersey's clean energy initiatives among all income levels and help New Jersey achieve its goals of achieving a 40% carve-out for community solar projects that serve at least 51% LMI customers and broadening participation in the state's energy efficiency programs.

New York and Connecticut offer successful examples of state Green Banks for New Jersey to follow. State Green Banks have been able to leverage around 3 to 4 private dollars of investment per public

dollar invested.[69] 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.[70]

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 in exchange for committing to a specific volume of lending on the most competitive terms.

A Green Bank can also stimulate private lending through non-financial measures to support lenders, borrowers and/or project developers 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.

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 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 proven effective as a means of 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.

Commercial Property Assessed Clean Energy (C-PACE) lending is another program that is being explored that can facilitate a greater amount of funding by private lenders, 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.

Goal 7.4: Capitalize on the offshore wind economic development opportunity 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

American offshore wind industry. The growing offshore wind industry on the U.S. East Coast is now projected to generate almost 18 GW of clean, cost-effective power in seven states by 2030, which represents nearly $70 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 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 to be awarded in July 2019, with additional solicitations in 2020 and 2022, created a level of market certainty that has garnered the attention of international offshore wind companies. 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 value proposition considering 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; and the creation of a Wind Innovation & New Development (WIND) Institute.

The New Jersey Wind Innovation & New Development (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, NJLWD, OSHE), private corporations, research institutions, utility providers, and labor unions to come together to advance New Jersey's leadership in the offshore wind industry.

In coordination with institutions of higher education, NJLWD should coordinate how energy leaders remain engaged with the WIND Institute. The Institute will continually require industry input related to curriculum development, requisite competencies, credentials, and certifications. This could also be facilitated through NJLWD's Industry Partnership Network.

Goal 7.5: Establish a Carbon-Neutral New Technology Incubator to fund and 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 a physical space 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 incubator and center focused on "Carbon-Neutral 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 and/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 these start-ups have a hard time accessing them. A carbon-neutral incubator could help coordinate access to these resources and support clean energy start-up growth.

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 incubator to help fund early-stage proof-of-concept and commercialization research.

Often such projects are launched as joint-ventures, and the state should consider developing the incubator through strategic partnerships with well-established corporations, early stage investors and New Jersey's exceptional research universities.

Goal 7.6: Establish 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 developments in New Jersey is critical to achieving the state's clean energy ambitions. One of the challenges in this regard is ensuring that investments are being made in technology development and workforce development in this area. 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 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 buildings. Increased awareness of these technologies can lead to greater implementation in the state's building sector and grow New Jersey's energy efficiency market.

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 must be made.

Training and educational opportunities also exist outside of the construction industry. The Consortium for Building Energy Innovation has identified the unique position commercial real estate brokers are in to promote building efficiency.[71] Educating brokers on energy efficiency allows them to inform their clients and incorporate the concept in 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.

Further, the Clean Buildings Hub could be a project of the NJLWD's Energy Industry Partnership. As the energy industry leaders convene, they would identify the Hub as a priority. NJLWD will support the Partnership and strategize on how to implement recommendations. Similar research hubs currently exist as examples for New Jersey to follow in creating its own Clean Buildings Hub.

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 thirty years.

As delineated above, the increased urgency around climate change led the state to take an innovative, systemic 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 Draft 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; Modernizing the Grid and Utility Infrastructure; Supporting Community Energy Planning and Action in 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 final Energy Master Plan will expand upon these strategies, incorporate findings from several analyses and modeling studies, and lay out a series of targeted goals and implementation mechanisms to achieve state goals.

In the process, the state will drive an innovation economy that invests in people and communities to create good-paying jobs, creates a diverse ecosystem, improves government efficiencies, and supports 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 if we are to mitigate the devastating impacts of climate change and the state is heeding the call. Ultimately, New Jersey 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 that will 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.

VI. Request for Feedback

Stakeholders will have opportunities to respond throughout the development of the Energy Master Plan, including six upcoming stakeholder meetings held over three days in the summer and fall to specifically inform the EMP, as well as additional engagement throughout the development of the GWRA Report.

The final EMP will include specific and targeted dates and metrics to set New Jersey on a defined and measurable path to 100% clean energy and at least an 80% reduction in greenhouse gas emission by 2050. Some of these decisions will be informed by the modeling in the Integrated Energy Plan and the many other studies and analyses NJBPU and NJDEP are undertaking to support these goals. In addition, the state is asking for stakeholder feedback to suggest ambitious but achievable goals to accelerate New Jersey's pace towards a clean energy future and to grow and strengthen the clean energy economy.

In addition to receiving overall feedback regarding the EMP policy objectives, NJBPU is particularly interested in receiving feedback on the following questions:

Strategy 1: Reduce Energy Consumption and Emissions from the Transportation Sector

1) In considering the policy mechanisms suggested in Strategy 1, how should the state seek to implement the policies to reduce transportation-related emissions? What policy mechanisms have we missed?
2) The state seeks to "lead by example" in the electrification of its fleet. What case studies, cities, states, etc. should New Jersey look to and learn from as it rolls out clean light-duty vehicles and buses?
3) Over what timeline should the state seek to rollover its light-duty (passenger) fleet to EV? Over what timeline should the state rollover its bus fleet? Please also consider incremental milestones.
4) How can the state work with the private sector to increase publicly-accessible EV charging infrastructure?
5) How can the state work with the private sector to advance the technology for medium- and heavy-duty vehicles and incentivize private sector adoption of alternative fuel vehicles?
6) What policy mechanisms should the state develop to reduce greenhouse gas emissions at its ports?

Strategy 2: Accelerate Deployment of Renewable Energy and Distributed Energy Resources

7) New Jersey is currently targeting the installation of 3,500 MW of offshore wind generation by 2030, but there is likely room for much more growth. Can New Jersey achieve more? Why or why not, and if so, how much is feasible? What concerns and barriers must we address in developing this resource?
8) How should New Jersey address the solar and NJ Class I cost cap established in the Clean Energy Act?
9) Does the allowance in the current RPS on the use of unbundled Renewable Energy Certificates (RECs) interfere with state efforts to incentivize in-state renewable energy power generation?

10) Which policy mechanisms do you recommend the state implement to lower the cost of capital for in-state renewable energy power generation?
11) What policy, legislative, or regulatory mechanisms can New Jersey develop to ensure that it can most cost-effectively pursue a 100% carbon neutral power sector?

Strategy 3: Maximize Energy Efficiency and Conservation and Reduce Peak Demand

12) New Jersey is currently targeting annual energy efficiency gains of 2% in the electricity sector and 0.75% in the gas sector. Do you recommend that New Jersey be more aggressive in approaching its energy efficiency goals? Why or why not, how much annually is feasible, and how long of a ramp up period is needed?
13) What are the strengths and weaknesses of the utility-run energy efficiency programs, third-party supplier-run energy efficiency programs, and state-run programs that NJBPU should consider?
14) How can the state ensure equitable access to and benefit from energy efficiency programs for all residents?
15) Which states or cities have successfully implemented stronger-than-average building and energy codes? How should New Jersey seek to strengthen its building and energy codes, and over what timeline?

Strategy 4: Reduce Energy Consumption and Emissions from the Building Sector

16) What policy, legislative, or regulatory mechanisms can New Jersey develop to successfully transition the building industry to develop net zero carbon construction? Over what timeline should the building industry seek to make this transition? What incremental goals and milestones should it set?
17) What barriers exist that could hinder successful implementation of new net zero carbon construction?
18) What policy, legislative, or regulatory mechanisms can New Jersey develop to incentivize and accelerate the transition from oil, propane, and natural gas heating systems to electrified heating systems? Please consider appropriate mechanisms for residential, commercial and industrial buildings. Over what timeline is this achievable? Please also consider incremental milestones for the different fuels and technologies.

Strategy 5: Modernize the Grid and Utility Infrastructure

19) How should New Jersey approach the modernization of the current utility model (e.g., decoupling or performance incentives, rate design, smart grid technology, demand response)
20) How should NJBPU consider planning and paying for upgrades to the electricity distribution system, including Distributed Energy Resource (DER) connections; EV charging; and utilities' recuperation of cost?

21) What regulations and legislation do other states use for evaluating transmission upgrades that New Jersey should consider modeling?
22) What best practices should New Jersey consider and which pitfalls should the state avoid regarding data ownership and privacy as it pertains to Advanced Metering Infrastructure?

Strategy 6: Support Community Energy Planning and Action in Low-and Moderate-Income and Environmental Justice Communities

23) How can NJBPU continue to engage with communities to support local energy planning?
24) How can New Jersey ensure that LMI households and environmental justice communities benefit from the goals and policies established in the Energy Master Plan?
25) What best practices utilized in other states or municipalities should New Jersey consider to support Community Energy Planning?

Strategy 7: Expand the Clean Energy Innovation Economy

26) What industry sectors or job occupations are expected to see growth? Which industry sectors and job occupations are expected to need job training support to ensure an appropriate workforce is available to meet the needs of a growing economy?

27) What industry sectors or job occupations are expected to stagnate as we get closer to 2050 and beyond, and what retraining tools and strategies can the state use to support transferable skills to new industries?

28) What are best practices, financial tools, and financial infrastructure that New Jersey should consider in supporting the clean energy economy, attracting private investment, and enabling clean energy opportunities to become more affordable for all?

VII. Appendix

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 Study
- 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 are or will be conducted by a wide array of experts including outside consultants, utilities, and Rutgers University. 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 the problems we face.

Integrated Energy Plan

The Integrated Energy Plan is the largest and most ambitious plan that the Board is undertaking and is being 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 their 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 Draft EMP, NJBPU is working 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. To the greatest extent possible, the Integrated Energy Plan will also use the results of NJPBU's additional and ongoing studies as inputs to the data modeling.

These scenarios will provide 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 will be developed throughout the summer and fall of 2019 and its findings will be incorporated into the Final EMP due in December 2019.

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. The less energy demanded, the less energy is needed to generate, store, and distribute. NJBPU is conducting a study to determine the energy savings targets for full economic, cost-effective potential 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; and the timeframe for achieving the reductions. 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. Energy efficiency can reduce 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. to conduct the Energy Efficiency Market Potential Study. 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.

Optimal Energy developed a baseline forecast and then disaggregated energy usage by customer segment and end use, producing a more robust study. Optimal Energy was able to create a comprehensive list of the energy efficiency measures necessary to capture all electric and natural gas efficiency opportunities suitable for deliverable within our state. After performing an economic potential analysis that will outline the theoretical cost-potential available, they formulated a pragmatic, actionable estimate of potential that can be achieved given actual conditions.

Optimal Energy 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 state's regulated utilities.

Per the Clean Energy Act, the final Energy Efficiency Market Potential Study was approved by the Board in May 2019 and will inform the final EMP.

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.

NJBPU contracted the Center for Advanced Infrastructure and Transportation at Rutgers University to perform the energy storage analysis as required by the Clean Energy Act. This study was divided into three tasks, including:

- *Energy Storage Technology Evaluation.* This evaluation informed the Board about the current state and anticipated development of energy storage technology. This included a baseline study and load forecasts to best strategize how to optimize integration of this technology.
- *Energy Storage Economic Assessment.* This assessment involved the economic issues surrounding energy storage integration including a Cost-Benefits Analysis, the effect on rate payers, optimal amounts of storage, the impacts on renewable energy and EV adoption, and optimal points of entry onto the grid (e.g., customer-sited or utility scale). Additional attributes studied included flexibility, reliability, resilience, security, and sustainability.
- *Regulatory and Public Policy Analysis.* This analysis considered state policies regarding the regulated energy distribution systems, federal policies regulating the competitive energy markets in the PJM Interconnection, and the transmission systems. The analysis examined potential barriers to implementing energy storage and identified policy paths forward.

Per the Clean Energy Act, the final Energy Storage Analysis report is anticipated to be released this June and will inform the final EMP and the GWRA Plan.

Solar Energy Transition

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 Solar Renewable Energy Certificate 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. Upon completion of the study, NJBPU must issue a written report to the governor and the Legislature to meet certain policy objectives, including:

- Continually reducing, where feasible, the costs of achieving the state's solar energy goals;
- Providing an orderly transition from the SREC program to a new or modified program;

- Developing megawatt targets for grid connected and distribution systems, including residential and small commercial rooftop systems, community solar systems, and large-scale behind the meter systems;
- Establishing and updating market-based maximum incentive payment caps periodically for each of the above categories of solar electric power generation facilities;
- Encouraging and facilitating market-based cost recovery through long-term contracts and energy market sales; and
- Facilitating a process to encourage methods such as competitive procurements and long-term contracts to ensure cost recovery for solar projects where necessary.

NJBPU is currently working with Cadmus Group and Sustainable Energy Advantage to formulate this 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 will include a robust stakeholder process to ensure thorough participation and engagement among a diverse set of stakeholders. Cadmus Group will develop 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. Preliminary findings will inform the Implementation Roadmap and the final report will inform the Climate Master Plan.

Optimal Voltage Study

As required by the Clean Energy Act, in May 2019 the Board ordered the electric distribution companies 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.

The utilities' studies will additionally consider voltage optimization, in which customers would install a device on their buildings that regulates the voltage entering the building.

Per the Clean Energy Act, the Optimal Voltage Study is due in 2020.

Offshore Wind Strategic Plan

Offshore wind is a highly promising opportunity for New Jersey to produce in-state renewable energy, create ongoing, unionized 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.

NJBPU will soon make an award for the solicitation for the first 1,100 MW of offshore wind, and plans to install 3,500 MW by 2030. To support NJBPU's efforts growing the offshore wind industry, NJBPU has retained Ramboll in consultation with Stantec, BVG, InGroup, and Rutgers University to provide a framework for the development of offshore wind generation beyond the first 1,100 MW solicitation. Importantly, the first solicitation includes transmission, but there was large stakeholder interest in separating transmission and generation for future projects. NJBPU is preparing for a separate transmission study to inform later options. The Offshore Wind Strategic Plan process is working with stakeholders, including the energy industry, commercial and recreational fishing industries, environmentalists, and others to ensure that the wind farms do not interfere with shipping routes, sensitive marine areas or bird migration routes.

The Offshore Wind Strategic Study is due in September 2019 and will inform the Implementation Roadmap and the Global Warming Response Act Plan.

Microgrid Study

Microgrids are energy systems with power generating capability, and often an energy storage system, that can work 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 or contributing load when necessary.

NJBPU funded Town Center Distributed Energy Resource (TCDER) feasibility studies in 13 municipalities, 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. The next round of funding will be determined at the end of April. 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 U.S. DOE for a microgrid financing study which will produce a financing tool for microgrid developers.

The Microgrid study will inform the final EMP, the Implementation Roadmap, and the GWRA Plan.

Alternative Fuel Vehicles

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.

The Board has received a $100,000 grant from the U.S. DOE to develop a program to bring plug-in electric vehicles (PEV) to low- and moderate-income and environmental justice communities who are often disproportionately burdened by harmful air pollution. The grant will be used to retain a consultant to develop the program. The Board will issue an RFP to state universities to develop the program in collaboration with local community groups.

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