Analysis of the New Jersey Energy Master Plan

by

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Executive Summary

The New Jersey Energy Master Plan (EMP) sets forth ambitious goals for de-carbonizing energy usage in the state with a goal of achieving 100 percent fossil free electricity by 2035 while increasing electrification of homes and businesses and replacement of gas-powered cars and trucks with electric vehicles (EVs) in transportation. Development of offshore wind energy and battery storage has been adopted as an important element of de-carbonizing the electric energy sector in support of that goal.

The EMP has profound implications for reliability, affordability and emissions related to the delivery and use of electricity in the state over the next twenty years and beyond. It is the purpose of this report to analyze these elements of the EMP and to present the results for the public and policy makers to determine the technical and economic feasibility of the EMP. The following are the main findings of this study.

Reliability

NJ currently relies on natural gas for 70% of its generating assets and energy. **Phaseout of all in-state fossil fueled plants would increase reliance on imports from PJM[1] from 25% in 2025 to 50% in 2035**. PJM itself is facing increased reliability concerns, forecasting that reserve margin may fall from 23% to below the required minimum 17.8% as early as 2026. By 2030 it would fall to 3% with electrification and a low completion rate for new renewable capacity.

Affordabilty

Each component of the EMP will raise ratepayer costs through increased usage, above market subsidies for offshore wind and battery storage and higher transmission and distribution costs. **By 2035 average retail electric bills will double and then quadruple by 2045.** The cumulative EMP costs added will reach **$288 billion by 2045**, with a 2025 Present Value of $183 billion.

Emissions

Retiring all natural gas generation by 2035 will reduce in-state carbon emissions but increase emissions associated with power imports from PJM. **After a**

[1] PJM is the regional transmission organization (RTO) that coordinates the movement of wholesale electricity in New Jersey and all of parts of 12 other states and the District of Columbia

reduction from 20 million tons of CO_2 in 2025 to 13 million tons in 2035, total emissions will again rise to 20 million tons in 2045.

Ironically, eliminating fossil fuel from in-state generation would mean importing increasing amounts of power from other PJM states that is generated primarily by fossil resources, including coal units which supply more than 20% of PJM power. This belies the notion that the EMP will decarbonize electric generation.

Conclusions

Any state energy strategy must be judged on its ability to provide electricity to the state's residents and businesses that is: (1) Reliable; (2) Affordable and (3) Effective in reducing carbon emissions. Based on the analysis presented here **the current NJ EMP must be judged a failure on all three counts:**

- The proposed phase out of natural gas plants in favor of reliance on offshore wind and battery storage will increase the state's dependence on imports from PJM to an unacceptable degree. PJM itself is in danger of falling short of adequate generating capacity to serve peak demand in the coming decade and cannot be relied upon to fill NJ power needs.

- The cost of implementing the EMP would double electric rates by 2035 and quadruple them by 2045. Such costs would raise residential, commercial and industrial bills to unaffordable levels, hitting hardest those residents and businesses that can least afford it.

- Rather than achieving zero carbon energy by 2035, the EMP simply exports emissions to other states providing imported power to NJ. This does little or nothing to address global emissions or the potential impact of climate change on the residents and businesses of NJ.

While the current EMP is neither technically nor economically feasible, there is a need for an energy plan that can ensure that the state's growing energy needs can be met with reliable, affordable resources that will minimize emissions. The analysis presented in this report indicates that expansion of in-state natural gas and nuclear capacity, rather than intermittent renewables or reliance on PJM imports, would best serve the energy needs of NJ over the next twenty years.

Analysis of the New Jersey
Energy Master Plan

1.0 Introduction

The New Jersey Energy Master Plan (EMP)[2] was set forth in 2019 and set a pathway to 2050 to drastically reduce greenhouse gas (GHG) emissions from all sectors using energy in the state with the objective of achieving 100% carbon free power by 2050. Specific strategies include:

- Decarbonizing the transportation sector with a transition to electric vehicles (EVs)
- Electrification of homes and businesses
- Development of offshore wind generation
- Development of grid scale battery storage capacity

Subsequently, by executive order[3] Governor Murphy advanced the goal of achieving 100 percent clean energy to 2035. The Governor has also periodically increased the amount of offshore wind generating capacity to be installed. An initial goal of 3,500 MW by 2030 was increased to 7,500 MW by 2035 and to then to 11,000 MW by 2040 with direction to the NJ Board of Public Utilities (BPU) to study the feasibility of increasing the target even further.

Near term battery storage goals have been set to achieve 600 MW of capacity by 2021 and 2000 MW by 2030. Sales of new gasoline vehicles will be banned by 2035[4].

The EMP has profound implications for the availability, affordability and emissions related to the delivery and use of electricity in the state over the next twenty years and beyond. It is the purpose of this report to analyze these elements of the EMP and to present the results for the public and policy makers to determine the technical and economic feasibility of the EMP.

[2] Energy Master Plan (nj.gov)
[3] NJ Executive Order No. 315, February 15, 2023.
[4] NJ DEP Advanced Clean Car II Rule, December 18, 2023.

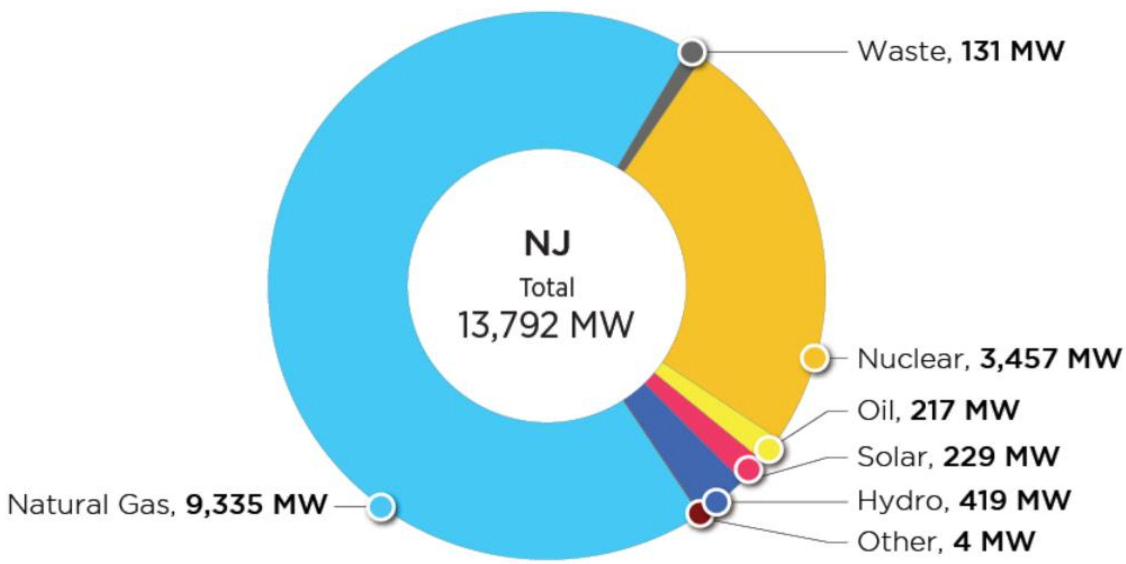
2.0 Reliability Analysis

The EMP must ensure that generating resources are available to reliably provide NJ ratepayers with an adequate supply of electricity during peak demand conditions and for power needs throughout the year. These issues are discussed below.

2.1 Capacity

Currently NJ has a mix of generation resources as shown below.

Figure 2-1 – NJ Electric Generating Capacity 2024[5]



From this chart one can readily see the challenge posed by the EMP objective of eliminating all fossil fuel generation by 2035 while ensuring reliability of supply. As indicated, the state is heavily reliant on natural gas plants which comprise almost 70% of in-state capacity. Nuclear provides an additional 25%. Renewables make up less than 5% of capacity.

Since 2017 there has been a total elimination of coal units (2000 MW) and 650 MW of nuclear capacity at Oyster Creek so that NJ is increasingly reliant on imports from PJM to meet summer peak demand which is currently more than 18,000 MW so there is an in-state shortfall of about 25% in capacity needed during peak summer demand conditions.

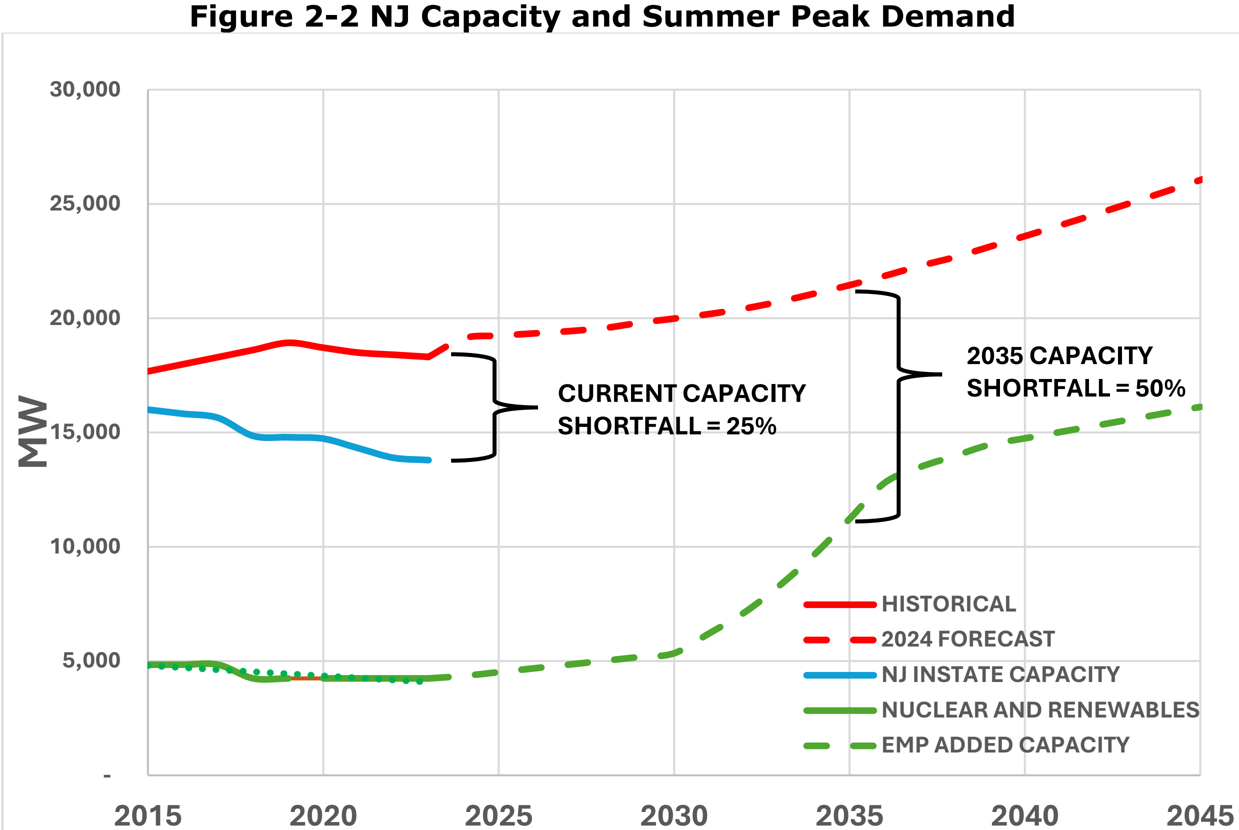
[5] NJ State Infrastructure Report, PJM June 2024.

The EMP envisions that offshore wind (OSW) and battery capacity will make up for the phase out of natural gas in NJ. If the OSW goals were met, 7500 MW would be in service by 2035. But, because of its intermittent nature, PJM credits only 47% of this nameplate rating for capacity credit. Similarly, 4 hour battery storage receives only 55% credit. Solar resources are given only 5% capacity credit as their maximum output occurs off-peak[6].

As a result, even if the EMP is successful in installing 7500 each of OSW and battery storage by 2035, this will only replace about 7000 MW of the existing 9335 MW of natural gas capacity. At the same time, peak demand will have grown to 21,000 MW due to increased electrification.

The chart below shows the growing mismatch between in-state capacity and in-state summer peak requirements.

Figure 2-2 NJ Capacity and Summer Peak Demand



As indicated, the current 25% (6000 MW) shortfall will grow to 50% (10,000 MW) by 2035 as a result of the EMP policy of replacing dispatchable fossil plants with

[6] PJM Tariiff Request for Reliability Resource Requirement, FERC Docket ER25-712-000, February 11, 2025

intermittent renewables. This 10,000 MW shortfall would persist through 2045 as demand grows at a rate equal to or greater than in-state renewables are added under the EMP.

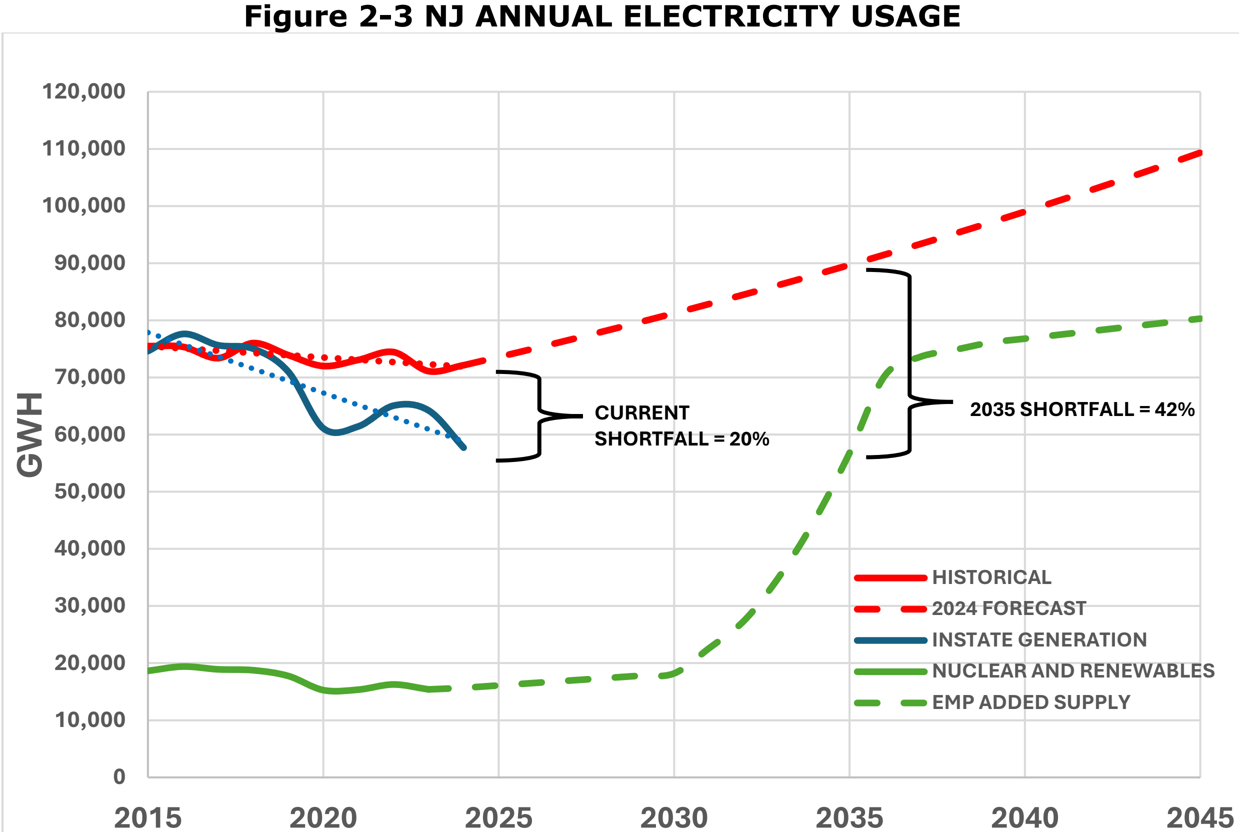
2.2 Generation

In 2024 NJ consumed 72,000 GWH of electricity in the residential, commercial and industrial sectors. Since 2015, this level of usage has declined from 75,000 GWH due to efficiency improvements in appliances and business applications. However, the EMP focus on increased electrification and EV usage is now projected to result in a 2%/year increase in electric consumption over the next 20 years[7].

As noted, the EMP envisions that new renewable resources, primarily offshore wind, would be built to serve this need while at the same time phasing out fossil fuel plants in order to achieve 100% carbon free generation by 2035.

The following chart illustrates that there is an increasing shortfall in the ability to meet NJ demand with in-state generating resources.

Figure 2-3 NJ ANNUAL ELECTRICITY USAGE



[7] PJM Load Forecast Report, January 2025.

As shown, prior to 2017 and the shutdown of all coal plants and Oyster Creek, NJ was self-sufficient in electric energy. Since then, the state is increasingly dependent on PJM and in 2024 more than 20% (14,000 GWH) of power demand was supplied by imports from other states in the PJM grid. This dependence on PJM imports is expected to grow as total usage increases due to electrification.

If in fact the 2035 EMP goal of elimination of all natural gas generation and the increase in offshore wind and other renewable capacity were achieved, NJ would be even more dependent on PJM imports to meet the additional demand created by the EMP goal for increased electrification. By 2035 the shortfall would more than double to 42% (35,000 GWH) and this shortfall will persist through 2045 and beyond .

Ironically, eliminating fossil fuel from in-state generation would mean importing increasing amounts of power from other PJM states that is generated primarily by fossil resources, including coal units which supply more than 20% of PJM power. This belies the notion that the EMP will decarbonize electric generation.

2.3 PJM Reserve Margin

PJM has raised concern with eroding capacity margins in its system due to the combined effect of fossil plant retirements, their replacement with proposed intermittent renewable resources with low completion rates and greatly increased load growth due to electrification and data center expansion. PJM forecasts indicate that reserve margins will fall below the minimum required 17.8% as early as 2026. By 2030 it would fall to 3% with electrification and a low completion rate for new renewable capacity[8].

Table 2-1 PJM Reserve Margin Forecast

Reserve Margin	2023	2024	2025	2026	2027	2028	2029	2030
Low New Entry								
2023 Load Forecast	23%	19%	17%	15%	11%	8%	8%	5%
Electrification	22%	18%	16%	13%	10%	7%	6%	3%
High New Entry								
2023 Load Forecast	26%	23%	21%	19%	17%	16%	17%	15%
Electrification	25%	22%	20%	18%	15%	14%	14%	12%

[8] Energy Transition in PJM: Resource Requirements, Replacement & Risks, PJM February 24, 2023.

The result of these retirements and replacement by intermittent renewables has been to raise prices for firm dispatchable capacity in the PJM system. The last auction for capacity in 2025/2026 resulted in an nine-fold increase in NJ capacity prices to $270/MW-day from $29/MW-day in the 2024/2025 auction[9]. This increase will raise NJ electric bills by 20% beginning in July 2025.

To address this concern with decreased reserve margins and increased capacity prices, PJM has obtained Federal Energy Regulatory Commission (FERC) approval for a Reliability Resource Initiative (RRI)[10] which will enable them to fast-track projects that meet schedule and reliability criteria. Most of the projects are expected to be dispatchable natural gas units gas outside NJ. This short-term fix would not address concerns with reserve margins in the period beyond 2030 during which NJ would increasingly need to rely on PJM imports.

[9] PJM Capacity Auction Results, 2025/2026

[10] PJM Tariiff Request for Reliability Resource Requirement, FERC Docket ER25-712-000, February 11, 2025

3.0 Cost Analysis

The various elements of the EMP will each add costs to ratepayer bills, through increased power usage, above market subsidies for renewable energy and increased transmission and distribution charges.

3.1 Electrification

From 2015-2023 average power usage declined 8-12% among residential, commercial and industrial customers due to increased efficiency in appliances, business and industrial applications. This has limited bill increases even as prices per kwhr have increased by a similar margin.

The EMP emphasis on increased electrification would see average usage increase by 2%/yr as homes and businesses convert gas heating, cooling and cooking to electricity and gas vehicles are replaced by EVs. Also increased demand for data centers will add to industrial usage. As a result, this usage will increase across all customer sectors by 20% in 2035 and by 47% in 2045. This increased usage will boost average bills by the same percentages even before increases in prices per kwhr are accounted for.

3.2 Offshore Wind

In support of the EMP, the NJ Offshore Wind Economic Development Act[11] (OWEDA) authorized the Board of Public Utilities to award contracts for Offshore Renewable Energy Credits (ORECs) to developers at above maket prices for power from approved offshore wind (OSW) projects over a 20 year term. This above market guaranteed pricing represents a ratepayer subsidy to support OSW projects in NJ.

Since 2019, BPU has issued OSW Solicitations and awarded ORECs at prices with increasing Levelized Cost of Energy (LCOE) from $98/MWH (2019) to $165/MWH (2024). In the Third (2023) and Fourth (2024) Solicitations BPU included an inflation adjustment factor which could automatically increase these OREC prices by 15% so that the approved OREC prices could reach as high as $190/MWH.

Despite this increasing subsidization of OSW, the approved developers have all thus far either cancelled their contracts or requested delays due to adverse economic conditions. The Fourth Solicitation was cancelled without awards

[11] Offshore Wind Economic Development Act, P.L. 2010, as amended 2023.

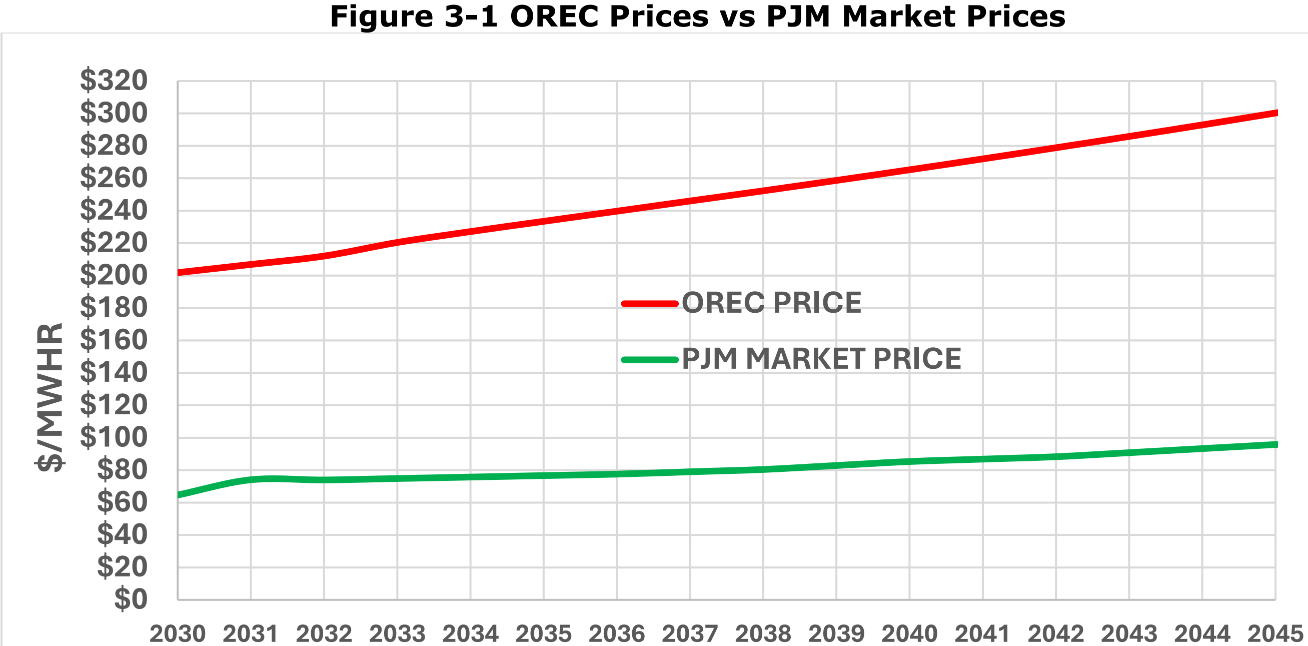
because the bidders withdrew or requested OREC prices that were too high. Although the Fourth Soliciation bids have not been revealed, it is expected that they were at least $192/MWH with the inflation adjustment[12].

In addition to the ratepayer subsidy, developers could expect to receive Federal tax credits under the 2022 Inflation Reduction Act (IRA)[13] allowing them to recover a minimum of 30% of their capital cost from US taxpayers, with potential increases up to 40% or 50%.

With the election of President Trump and a Republican-controlled Congress, it is expected the IRA tax credits for OSW will be repealed in 2025. Developers would then need an additional $50-60/MWH in OREC prices to make up for the loss of the Federal tax subsidy and maintain economic viability of the project.

Thus, it is assumed that OSW projects, in order to go forward under the EMP would require OREC prices at a LCOE of $250/MWH or more. The following chart illustrates how the expected OREC prices compare the wholesale prices for power available from the PJM grid over the period 2030-2045[14].

Figure 3-1 OREC Prices vs PJM Market Prices



Thus, ratepayers will be required to pay three times the market price for OSW power. As the amount of OSW in service increases to 7500 MW in 2035 and 11,000 MW in

[12] Economic Analysis of the Atlantic Shores South Offshore Wind Project, Whitestrand Consulting, August 2024.
[13] Federal Inflation Reduction Act, 2022
[14] Evaluation Report NJ Offshore Wind Solicitation #3, January 10, 2024, Levitan and Associates, Inc.

2040 per the EMP, ratepayer bills will increase due to OSW subsidies by 33% in 2035 and 89% by 2045.

3.3 Battery Storage

Due to the intermittent nature of wind and solar generation, the EMP envisions utilizing increasing amounts of grid scale Battery Electric Storage Systems (BESS) to store power during off-peak periods for discharge at peak demand. The EMP called for 2000 MW of BESS by 2030 and it is assumed that further storage capacity would keep pace with OSW wind development.

BESS developers receive revenue for capacity payments and from the arbitrage between buying power for charging at low prices and selling it when prices are higher during peak periods. The Levelized Cost of Storage (LCOS) represents what the BESS developer would require to cover capital, operating costs and return on investment. For a 100 MW 4 hr utility BESS unit, Lazard estimates the LCOS at $233/MWH[15] in 2024. Projecting this value over the period 2030-20245, the cost of adding battery storage in accordance with the EMP would add 11% to average customer bills in 2035 and 25% in 2045.

3.4 Transmission

The existing transmission network is not designed to accommodate the energy injections at its eastern-most edge associated with a large amount of offshore wind power or to support increased electrification in the local distribution system. OSW related upgrades to the transmission system have been estimated to add $15/MWH in 2035 and $35/MWH in 2045[16]. Accommodating electrification to support increased loads is expected to increase costs for transmission and distribution by 2%/yr. Together these increased costs are expected to add 19% to average bills by 2035 and 45% by 2045.

3.5 Cumulative Impact

The cumulative impact of these cost elements on average residential, commercial and industrial electric bills over the next 20 years are shown below.

[15] Lazard Levelized Cost of Storage Analysis Version 9.0, June 2024.
[16] Impact of NJ Offshore Wind Program on State Electric Rates, Whitestrand Consulting, November 2023.

Figure 3-2 Average Annual Residential Bill

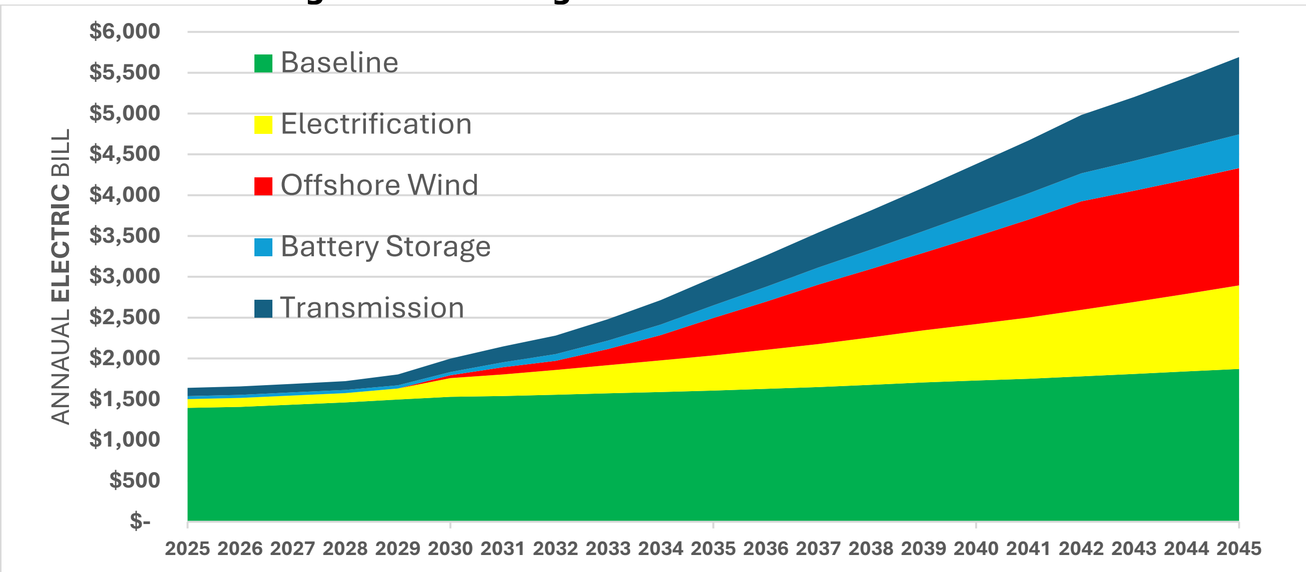


Figure 3-3 Average Annual Commercial Bill

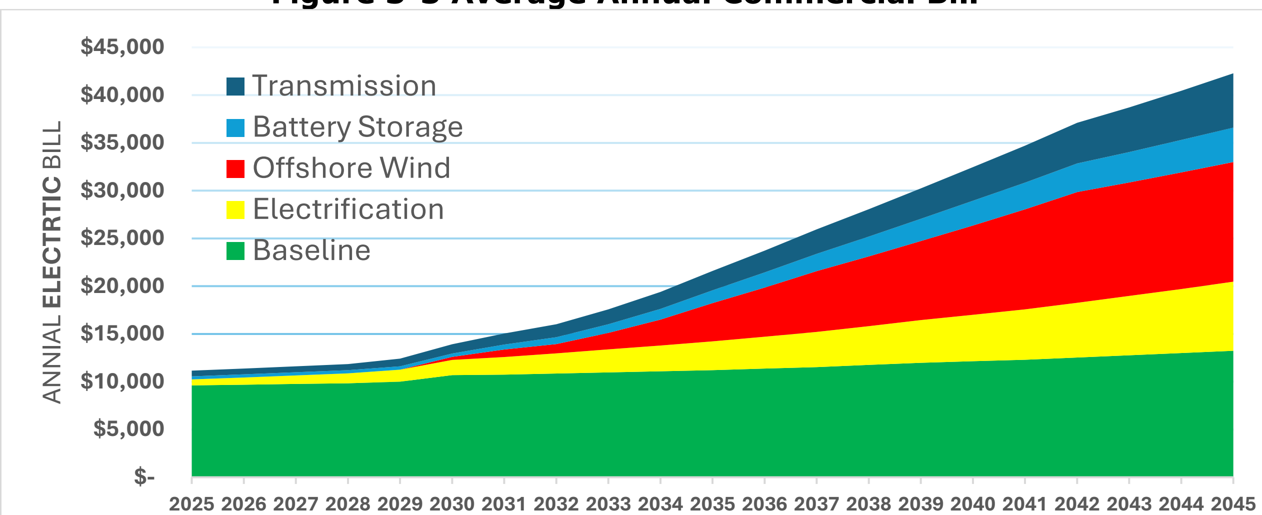
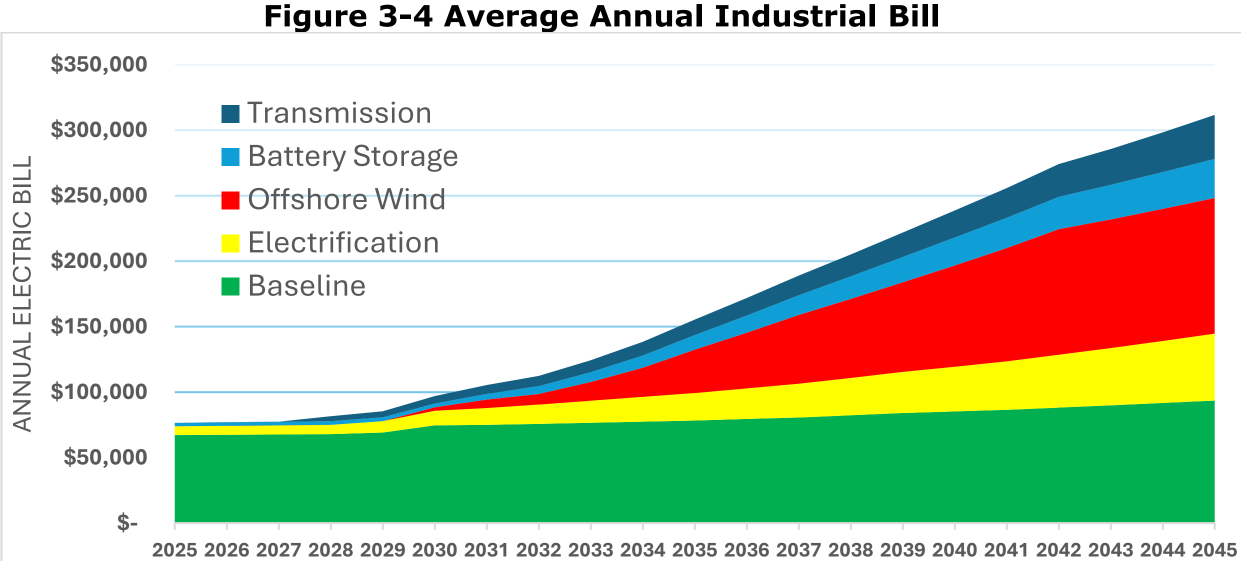


Figure 3-4 Average Annual Industrial Bill



The average annual bills will increase for each customer class is as follows:

Thus, the ratepayer subsidies for OSW is the most costly element of the bill increase, followed by electrification, transmission upgrades and battery storage.

Table 3-1 Average Electric Rates and Bills

	Cents/kwh			Annual Bill		
Customer Class	**2025**	**2035**	**2045**	**2025**	**2035**	**2045**
Residential	20.54	30.73	47.98	$ 1,395	$ 2,991	$ 5,692
Commercial	16.04	25.45	40.89	$ 9,618	$ 21,594	$ 42,282
Industrial	13.31	22.15	36.44	$ 67,252	$ 155,441	$ 311,791

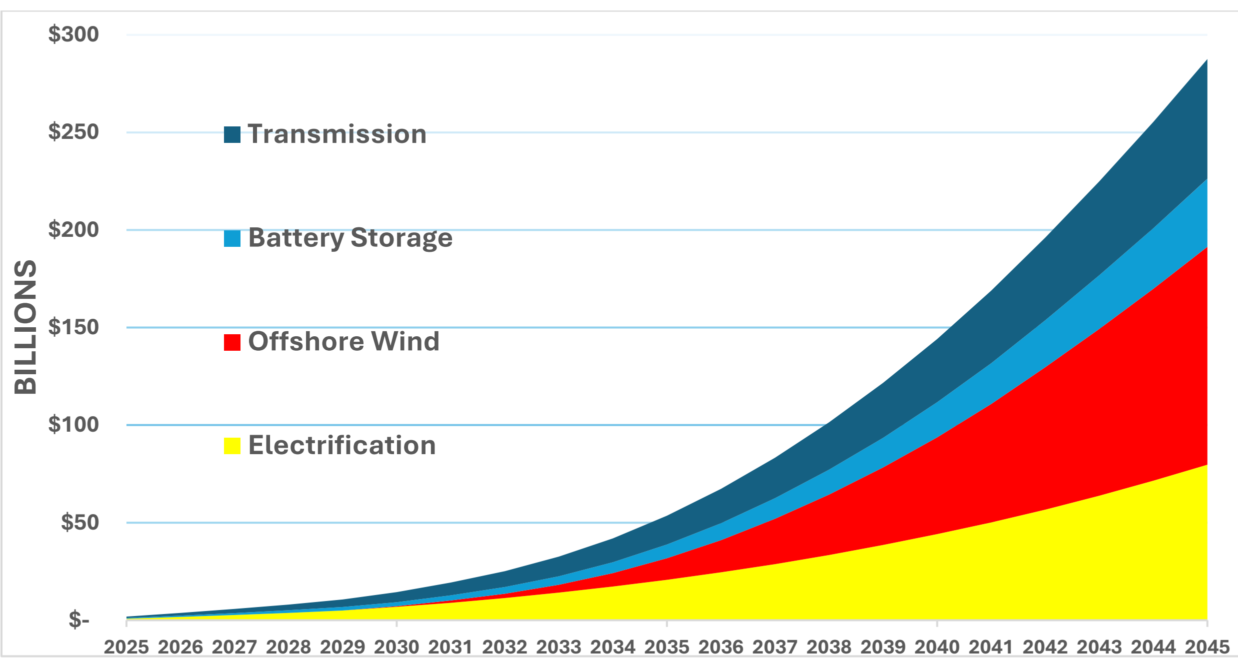
As indicated average bills will more than double by 2035 and more than quadruple by 2045. Aside from normal inflation, these increases are due to the various elements of the EMP which contribute these percentages to the cost of retail electricity.

Table 3-2 Effect of EMP Elements on NJ Ratepayer Bills

	Average Bill Increase	
EMP Element	**2035**	**2045**
Electrification	27%	55%
OSW	33%	89%
Battery Storage	11%	25%
Transmission	19%	45%
Total	90%	214%

Thus, the ratepayer subsidies for OSW is the most costly element of the bill increase, followed by electrification, transmission upgrades and battery storage.

Figure 3-5 Cumulative EMP Ratepayer Costs



As indicated in the chart above, combined they will add $288 billion in subsidies and costs to be borne by ratepayers over the next 20 years. This has a Present Value (PV) in 2025 of $183 billion.

While the electrification and shift to renewables may result in some offsetting savings in gas and petroleum use, the capital costs of switching from gas to electric appliances and heating systems and EVs, which are not included above, are expected to outweigh such savings and add to total EMP costs.

For example, the cost of replacing a residential gas heating furnace with an electric heat pump is estimated at $16,000[17]. Annual gas savings are less than $500/yr[18], meaning the payback period exceeds the useful life of the heat pump which is up to 15 years, even before electricity costs are included. A typical heat pump uses 5475 kwh/yr[19]. At the 2025 NJ average residential rate of 20 cents/kwh, the annual cost for using the heat pump would be $1100, more than twice the gas savings. At the projected 2035 rate of 31 cents/kwh the operating cost of the heat pump would be $1700/yr and in 2045 $2600 at the projected rate of 48 cents/kwh.

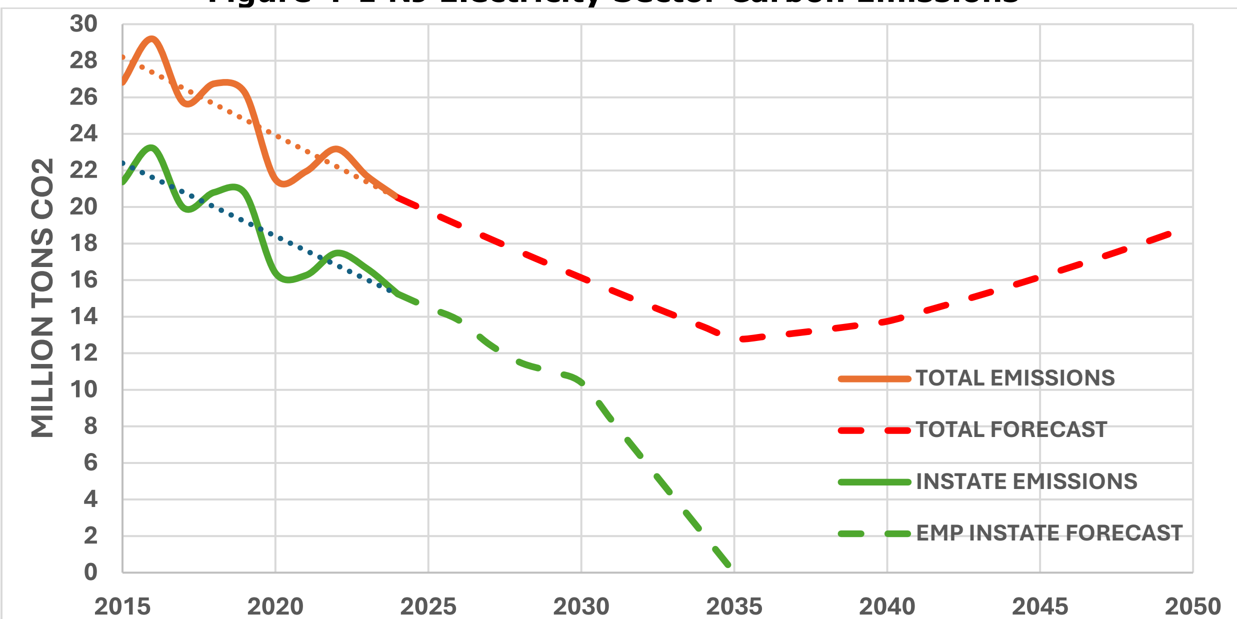
Similarly, the cost of an EV exceeds the cost of a comparable internal combustion engine (ICE) vehicle for a passenger car by $10,000[20] and the cost of installing a home charger is about $2000[21]. For a car driven 12,000 miles /yr at 25 mpg, the savings on gasoline at $3/gallon would be $1440/yr. At an expected electric power mileage of 0.40 kwh/mile[22] annual charging usage would be 4800 kwh/yr. At the 2025 NJ average residential rate of 20 cents/kwh, the annual cost for driving an EV would be $960, a net savings of only $480/yr, with a payback of 25 years, far beyond the useful life of the EV or charging system. At the projected 2035 rate of 31 cents/kwh the cost of driving the EV would be $1500/yr and in 2045 $2300 at the projected rate of 48 cents/kwh, thus exceeding any expected gas savings.

[17] How much does a Heat Pump Cost?, Liam McCabe, Energysage, February 1, 2024.
[18] American Gas Association, January 26, 2024.
[19] How much energy Does a Hear Pump Use?, Liam McCabe, Energysage, March 22, 2024.
[20] Edmunds.com, May 8, 2024.
[21] JD Power, September 24, 2024.
[22] US Department of Energy, www.fueleconomy.gov

4.0 Emissions Analysis

Based on the forgoing analysis of electric generation and usage in NJ, projections of resultant carbon emissions can be made. The following chart displays how CO2 emissions have trended in recent years for the NJ electricity sector, including emissions associated with total NJ power usage and those related to in-state generation.

Figure 4-1 NJ Electricity Sector Carbon Emissions



Over the period 2015-2024, total and in-state emissions have declined due to retirement of older fossil plants including phase out of all coal generation in NJ by 2023. In 2024 in-state resources produced about 500 lbs/MWH[23] of CO2 emissions. By contrast PJM average emissions were almost 50% higher at 730 lbs/MWH[24], owing to a great share of fossil generation, including coal plants, that comprised 20% of PJM generation. Thus, reliance on PJM will limit the extent that NJ can reduce overall emissions.

If in fact the EMP goal of phasing out all in-state fossil generation by 2035 were achieved, in-state emissions from in-state sources would be eliminated as shown. However, total emissions would only be reduced by 35% (from 20 to 13 million tons/yr) by 2035. Moreover, increased reliance on PJM for import of power would see total emissions rise to almost 20 million/tons by 2045, approximately equal to emissions expected in 2025.

[23] Energy Information Agency (EIA) Annual Emissions Report, 2023
[24] PJM Emissions Report, PJM Inside Lines, March 28.2024

Thus, the EMP, while eliminating in-state emissions, results in only a temporary decline in total emissions which will be reversed by increased electrification and increased emissions in neighboring states providing power to NJ.

5.0 Conclusions

Any state energy strategy must be judged on its ability to provide electricity to the state's residents and businesses that is: (1) Reliable; (2) Affordable and (3) Effective in reducing carbon emissions. Based on the foregoing analysis the current NJ EMP must be judged a failure on all three counts:

- The proposed phase out of natural gas plants in favor of reliance on OSW and battery storage will increase the state's dependence on imports from PJM to 50% of capacity and 42% of energy needs by 2035. This is an unacceptable degree of dependence on PJM which is itself in danger of falling short of adequate generating capacity to serve peak demand in the coming decade and cannot be relied upon to fill NJ power needs.
- The cost of implementing the EMP would more than double electric rates by 2035 and more than quadruple rates by 2045. Such costs would raise residential, commercial and industrial bills to unaffordable levels, hitting hardest those residents and businesses that can least afford it.
- Rather than achieving zero carbon energy by 2035, the EMP simply exports emissions to other states providing imported power to NJ. After a partial reduction by 2035, total emissions will rise as PJM imports increase. This does little or nothing to address global emissions or the potential impact of climate change on the residents and businesses of NJ.

In any event, the EMP is not going to achieve its objectives. Recent developments have revealed that goals for OSW development in NJ will not be met. BPU approved projects have been cancelled or delayed such that there is no active OSW construction. The BPU Fourth Solicitation was cancelled in January 2025 so there is no pipeline of projects in the planning and permitting phase. Thus, the OSW targets for 2030, 2035 and 2040 are all expected to be missed with the likelihood that no OSW will be developed in NJ before 2045, if ever. Similarly, targets for battery storage and transmission expansion will not be met nor will they be needed without OSW.

While the current EMP is neither technically nor economically feasible, there is a need for an energy plan that can ensure that the state's growing energy needs can be met with reliable, affordable resources that will minimize emissions. The forgoing analysis indicates that expansion of in-state natural gas and nuclear capacity, rather than intermittent renewables or reliance on PJM imports, would best serve the energy needs of NJ over the next twenty years.

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The Author

Edward P. O'Donnell is a principal in Whitestrand Consulting LLC. He has spent 35 years in the nuclear power industry as an engineer, manager and executive with responsibilities for design and licensing of numerous plants in the US and abroad. He was also responsible for corporate planning and rate matters for a NJ nuclear utility and has testified in utility rate proceedings before the NJ BPU.

He was responsible for managing the successful sale of nuclear units in NJ and PA and as a consultant for advising clients on the sale and purchase of nuclear plants. In this role he forecasted future costs and performance of plants for re-financing as merchant power suppliers in a de-regulated electrical energy market and performed analyses of the economic viability of nuclear plants in comparison with alternative fossil and renewable energy facilities.

Mr. O'Donnell holds an M.S. in Nuclear Engineering from Columbia University and has been a licensed Professional Engineer in NJ. He is also a registered Enrolled Agent, authorized to represent individual and business entities before the IRS on tax matters.

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