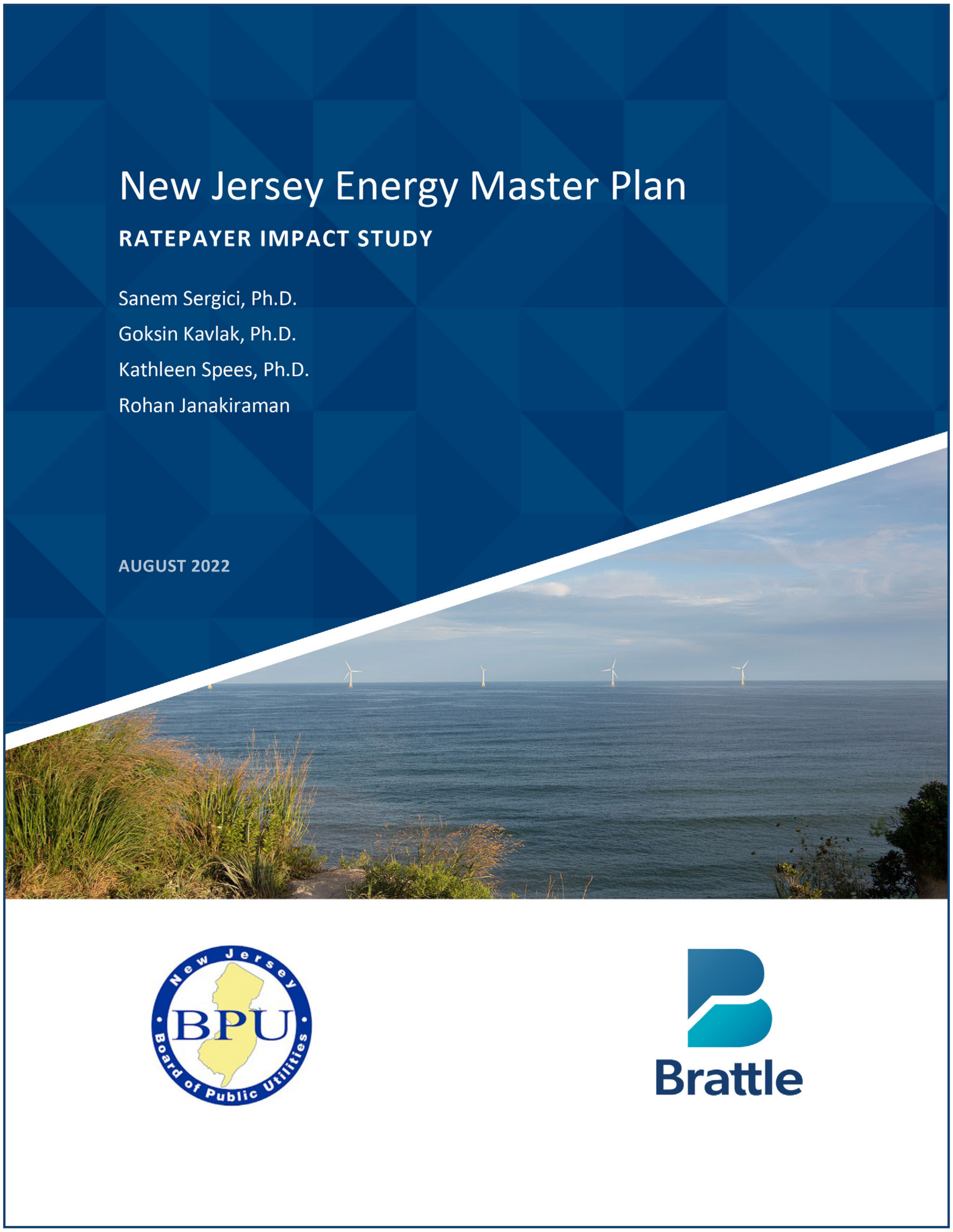
Independent Peer Review

The Brattle Group Report: “New Jersey Energy Master Plan, Ratepayer Impact Study”


New Jersey Energy Master Plan

RATEPAYER IMPACT STUDY

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New Jersey BPU Board of Public Utilities

Brattle

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August 31, 2022

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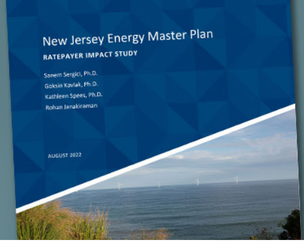

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Introduction and Summary

I have been asked by Affordable Energy for New Jersey to provide an independent review of The Brattle Group report: "New Jersey Energy Master Plan, Ratepayer Impact Study," (" Brattle EMP Report" or "the Report"), dated August 2022. The Brattle EMP Report was commissioned by the New Jersey Board of Public Utilities ("BPU") and released to the public on August 17, 2022.

The Brattle EMP Report purports to calculate the cost and rate impacts on residential, commercial, and industrial customers associated with implementation of the New Jersey Energy Master Plan ("EMP"),[1] which was published in December 2019.[2] The Report evaluates expected ratepayer energy costs in the year 2030 under three different scenarios, with each scenario reflecting differences in the percentage of zero-emissions electricity in that same year.

The EMP details strategies to achieve 100% clean power by 2050. It includes specific goals of developing 7,500 MW of offshore wind energy, 17,500 MW of solar photovoltaics (PV), and 2,500 MW of energy storage, all by 2035.[3] It also includes a goal of electrifying end-uses (primarily space and water heat) in most residential and commercial buildings with heat pumps, as well as accelerating energy efficiency efforts. Additionally, Senate Bill 2252 requires the state have at least 330,000 electric vehicles ("EVs") registered by 2025 and two million EVs by 2035. Finally, the EMP calls for investments in low- and moderate-income communities, environmental justice communities, and development of what is termed "the Clean Energy Innovation Economy."

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The Brattle EMP Report suffers from numerous flaws. **First, the Report ignores all direct customer costs needed to achieve the EMP goals**, such as:

1. the actual installation costs for heat pump space and water heaters
2. the costs associated with electric service upgrades (e.g., from 100 amp service to 200 amp service for older residential homes, as well as upgrades necessary for multi-family buildings)
3. the costs of heat pump boilers used in commercial and industrial applications,
4. the costs of residential and commercial EV charging equipment
5. the costs to upgrade local distribution systems to handle the additional peak demand associated with electrification and home vehicle charging, and so forth.[4]

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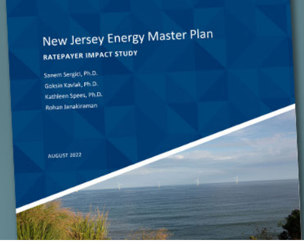
† Dr. Lesser is the president of Continental Economics, Inc. He has previously testified on behalf of the New Jersey Board of Public Utilities in several proceedings.

1 Brattle EMP Report, at iii.

2 The EMP and related documents are available at: https://nj.gov/emp/

3 EMP, at 13.

4 The Brattle EMP Report also ignores the indirect costs to New Jersey residents associated with recovery of foregone gasoline tax revenues, and foregone sales tax revenues stemming from the state's current exemption from sales taxes for EVs. Presumably, if S2252's mandates are met, the state will need to replace these lost revenues in some manner. However, estimating the impacts of such indirect costs on residents and businesses is reasonably considered to be outside the scope of estimating direct costs to residential consumers and businesses.



As explained in Section II of this review, these costs are likely to be many billions of dollars, as the EMP itself recognizes.

Second, the Brattle EMP Report provides an analysis for just one year: 2030, which is disingenuous. A comprehensive analysis would consider the impacts of customers for all years through the year 2050, which is the key year for meeting the EMP’s emissions reductions goals. Although the Report calculates ratepayer costs under an “Ambitious Pathway” scenario (in which the 2050 emissions reductions goals are assumed to be met by 2035[5]) the report omits detailed annual cost impacts by year that would provide New Jersey policy makers much more useful information, especially if those costs accelerate after 2030. It also strains credulity to conclude that accelerating energy efficiency and zero-emissions generation programs to achieve 2050 emissions goals by 2035 years will lower costs to ratepayers, as the Report’s results appear to show.

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The 2030 analysis also fails to consider an alternative: what happens if the goals of the EMP are not realized in 2030? For example, the Report assumes that the EMP’s aggressive energy efficiency objectives are all met. Even if some policies are legally binding, as noted on page 2 of the report, that does not mean the goals of those policies will be achieved. For example, New Jersey failed to meet one of its first goals in the EMP - 600 megawatts of energy storage by the end of 2021[6]. Additionally, energy efficiency savings estimates often ignore “takeback” effects, in which the relative decrease in the cost of providing an end use (e.g., space heating, air conditioning) lead to consumers increasing their consumption of that end use.[7]

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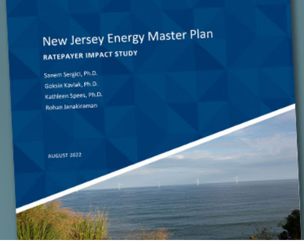
Third, the Brattle EMP Report’s estimates of future wholesale and retail electricity costs appear to be inaccurate and are opaque. Given the fact that the EMP is designed to “electrify” the NJ economy by replacing fossil-fuel end uses with electric ones, notably space and water heat, vehicles, estimates of the future electricity prices that will be paid by New Jersey ratepayers is a critical component of the analysis. (Curiously, the Report shows that, under the EMP and “Ambitious” pathways, consumers will spend less money per year

5 Brattle EMP Report, at iv.
6 Source: Tom Johnson, “Crucial part of green future gets legislative push”, NJ Spotlight, June 22, 2022.
7 The Report appears to assume there are no such impacts. Ibid, at 31.



if they do not switch to electric heat, even without considering the costs of heat pumps.)

According to the Report, the source of the PJM wholesale price forecasts is a report prepared for the BPU by Levitan & Associates ("Levitan Report") that evaluated responses to the state's second offshore wind solicitation for between 1,200 and 2,400 MW of offshore wind.[8] The energy price projections shown on pager 40, Table 20 of the Levitan Report show small increases in prices through 2030, but rapid increases in prices thereafter through 2050. Moreover, the Levitan Report shows an average energy price in 2021 of about $31/MWh, whereas the actual load-weighted average wholesale energy price in PJM was $39.78/MWh in 2021[9] and averaged over $67/MWh through the first seven months of this year.[10] Similarly, the Brattle EMP Report assumes an average transmission rate of ~$26/MWh,[11] but never provides any discussion of how that value was arrived at. Current average transmission rates differ substantially for residential customers who take Basic Generation Service[12] from the four different electric utilities, ranging between approximately $10/MWh and $55/MWh.

> **"...the Brattle EMP Report ignores the need for much greater reserve margins to ensure reliable electric service that arise because of the inherent intermittency of wind and solar generating resources...Although the Report provides a forecast of statewide electric consumption, nowhere does it provide a forecast of peak electric demand."**
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As discussed in Section 3, the Brattle EMP Report ignores the need for much greater reserve margins to ensure reliable electric service that arise because of the inherent intermittency of wind and solar generating resources. In other words, there must be sufficient generating capacity or energy storage in reserve to meet reductions in wind and solar availability, such as on a calm night, as well as prolonged unavailability, such as a multi-day period of cloudy days and little or no wind. This is a critical weakness because electric utilities must be able to meet peak demand. For example, with extensive electrification, electricity demand will peak in winter during the early morning and early evening hours, when little, if any, solar generated electricity will be available. If little or no wind generation is available, then backup generation must be available.[13] Although the Report provides a forecast of statewide electric consumption, nowhere does it provide a forecast of peak electric demand.

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8 Levitan & Associates, "Evaluation Report: New Jersey Offshore Wind Solicitation #2," prepared for the New Jersey Board of Public Utilities, May 25, 2021.

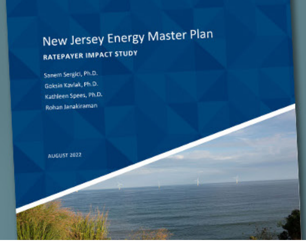
9 Source: PJM State of the Market Report 2021, March 2022, at 173, Table 3-52. The table shows real-time locational marginal prices ("LMP") for the different PJM load zones and the overall average for PJM as a whole. The zonal prices for New Jersey ranged between $34.13/MWh and $38.80/MWh. LMPs do not include prices for installed capacity, ancillary services, and transmission charges.

10 Source: PJM Dataminer 2, Real time locational marginal prices.

11 Brattle EMP Report, at 63.

12 Customers on Basic Generation Service purchase electricity from the utilities. Transmission charges for customers who purchase from competitive electric suppliers typically are not disclosed by those suppliers.

13 Under a similar 100% emissions-free generation scenario, the New York State Reliability Council determined the state would need a required reserve margin of over 100%, compared to the current reserve margin of about 20%. See NYSRC, "Reliability Challenges in Meeting CLCPA Requirements," Aug. 2, 2021, citing New York Department of Public Service and New York State Energy Research and Development Authority (NYSERDA), "Initial Report on the New York Power Grid Study," Jan. 19, 2021, appendix E.



Fourth, the Brattle EMP Report's comparisons between internal combustion vehicle ("ICV") energy use and cost versus those of electric vehicles ("EVs") fails to account for well-documented decreases in battery efficiency in cold and hot weather, and the assumed savings for EVs is based on what appear to be overly optimistic forecasts of electricity rates. The Report assumes no change in average efficiency of all ICVs remains constant at a 2020 level (24 mpg) and compares the costs for gasoline in 2030 for such vehicles to the costs of electricity for EVs that are all assumed to operate at a 2030 efficiency level (3.1 miles/kWh), based on projected efficiency improvements. This is a classic "apples-to-oranges" error. As the ICV stock turns over, the average efficiency of those vehicles increases. Furthermore, the average efficiency of EVs will be lower than the assumed value for just 2030.

The Report also fails to account for basic economic interactions of supply and demand. For example, if 30% of the entire vehicle stock is assumed to be EVs by 2030 under both the "EMP Achievement" and "Ambitious" Pathways, then the demand for gasoline will decrease, putting downward pressure on retail gasoline prices in the state. The Report never discusses these types of supply and demand interactions. Instead, it limits itself to various sensitivity studies.

Furthermore, the Report assumes no increase in fuel efficiency for internal-combustion vehicles and thus holds gasoline consumption constant at 511 gallons annually.[14] Yet, by 2030, turnover of the ICV fleet will result in increased fuel efficiency and lower consumption. According to the U.S. Energy Information Administration's ("EIA") 2022 Annual Energy Outlook, fuel economy for new gasoline vehicles will be about 45 miles per gallon.[15] (The EIA assumes virtually no change in the efficiency of EVs through 2050.) Hence, the Brattle EMP Report implicitly assumes there is no changeover in the stock of ICVs between 2020 and 2030, which biases the Report's estimate of expenditures on gasoline upwards.

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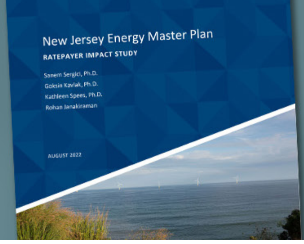
Fifth, all of the Brattle EMP Report's results are expressed in real (inflation adjusted) 2022 dollars based on an assumed 2% annual inflation rate through 2030.[16] Hence, charts such as Figure 3 (page 19) understate what customers are actually likely to pay in nominal 2030 dollars after the effects of inflation are included. Although there are valid reasons for using inflation-adjusted dollars in some analyses, in this instance, claims that consumers will "pay less" for energy are easily misconstrued. Moreover, because current inflation rates are much higher than 2% and are expected to remain elevated, at least for the next several years, the 2% average annual inflation rate assumption is problematic.

Finally, and perhaps most importantly, the Brattle EMP Report lacks transparency and result reproducibility. As stated previously, actual numerical values are not provided in any of the charts showing energy costs for residential and commercial/industrial customers.

14 Brattle EMP Report, at 67.
15 US EIA, Annual Energy Outlook 2022, Table 40.
16 Brattle EMP Report, at 62.



In many cases, the report fails to provide references to data sources. Nor, in many cases, does the Report provide a basis for the assumptions made. Whereas the Report provides numerous charts showing ratepayer costs, there are no tables that provide the actual costs. As shown in the charts in Appendix F.1, the estimated ratepayer costs under the "Ambitious Pathway" appear to be slightly lower than the "EMP Achievement Pathway." Why this is so is unclear.

Moreover, there are no available electronic workpapers that would enable independent review of the calculations. Other assumptions are never explained. This lack of modeling transparency is especially concerning because it prevents independent replication of the Report's analysis and conclusions. The lack of transparency violates basic norms for peer review. If New Jersey intends to spend billions of taxpayer dollars and will require individuals and businesses to invest billions of dollars of their own money to implement the EMP, such a lack of transparency should be concerning.

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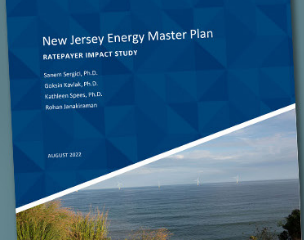
The Brattle EMP Report states, "Board Staff and Brattle acknowledge that the EMP will undoubtedly play a major role in reducing emissions and the adverse effects of climate change, including public health impacts and extreme weather events."[17] The Report shows that, in 2030, the EMP will reduce greenhouse gas emissions by 7 million metric tons below projected emissions under the "Current Policy" Pathway.[18] By comparison, the BP Statistical Review of World Energy 2022 estimated total world energy-related carbon emissions to be about 39 billion metric tons in 2021.[19] Hence, the estimated EMP Pathway carbon reductions in 2030 represent the equivalent of about 1.5 hours of world emissions. As such, the EMP will have no measurable impact on world climate and will not "play a major role" in reducing the adverse effects of climate change.

The Brattle EMP Report Ignores All Direct Customer Costs

The Brattle EMP Report focuses solely on the costs that will be paid by consumers and businesses for the electricity, natural gas, and gasoline they will purchase under the EMP. To their credit, the authors of the Report admit that the analysis excludes all of the direct costs the EMP will require, notably the costs to electrify homes, apartment buildings, and businesses, as well as customer costs to improve building energy efficiency and purchase an electric vehicle.[20] However, in excluding these costs, the ratepayer "savings" provided by the EMP and "Ambitious" pathways are easily misconstrued.

Home electrification will occur by replacing existing fossil-fuel space and water heat (primarily natural gas, but also some heating oil and propane) with electric heat pumps. Based on a study by the Rocky Mountain Institute, the EMP assumed the cost of retrofitting a

17 Ibid, at 32.
18 Ibid, at 59, Figure 14.
19 BP Statistical Review of World Energy 2022, at 14.
20 Brattle EMP Report, at iii.

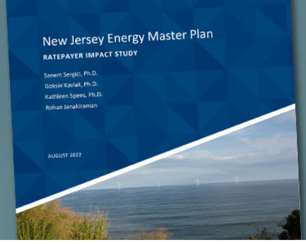


single-family home with a heat would be $7,500, versus $3,300 to replace an existing natural gas furnace, based on the costs to retrofit homes in different cities, none of which were located in New Jersey.[21] However, a study prepared by Diversified Energy Specialists examined actual heat pump conversion costs for over 600 homes in Massachusetts over the five-year period 2014-2019.[22] (The average installed cost of a heat pump water heater ranges between $2,500 and $3,800.[23]) That study found the average cost to convert a home was almost $23,000 for an average size home of 1,500 square feet, triple the assumed cost in the RMI study. Moreover, over 90% of the homes evaluated retained a supplementary heat source, including wood stoves, electric resistance heaters, and natural gas furnaces. The Report ignores all supplementary heating costs.

In estimating ratepayer impacts, the Brattle EMP Report states that it assumes natural gas furnace efficiency of 73% in 2030,[24] while later claiming to use an average efficiency between 80% and 83%.[25] (The actual efficiency rate used in the Report's analysis of ratepayer costs for natural gas is thus unknown.) Furnace efficiency is a crucial component for comparing electric and natural gas heating costs. For example, a 2013 report prepared for the U.S. Department of Energy's National Renewable Energy Laboratory (NREL) compared the annual cost of heating with a heat pump versus other fuels for a home in Connecticut, and found that the cost of electricity for the heat pump was greater than the cost of a modern 90% efficiency natural gas furnace.[26] Moreover, given an average lifetime for a natural gas furnace of between 15 and 20 years,[27] in 2030, most consumers using natural gas furnaces will have replaced them with more efficient models.

Additionally, many older homes have a 100 amp electric service panel. Installing an electric heat pump for space heat and a second heat pump for water heat., as well as home EV charging,[28] means homeowners (and many apartment building owners) will be required to upgrade their service panels to at least 200 amps. The estimated costs for a residential service panel upgrade from 100 to 200 amps range between $1,500 and $2,800.[29] The Brattle EMP Report also ignores the costs of installing a home Level 2 charger for an EV. Those costs range between $1,700 and $2,700.[30] The Brattle Report also ignores all direct consumer costs for new energy efficiency measures, such as furnace upgrades and insulation. Ignoring all of the direct costs to consumers and businesses associated with electrification does not allow for an accurate comparison of total costs.

21 Sherri Billimoria, et al., "The Economics of Electrifying Buildings," Rocky Mountain Institute, 2018.
22 Diversified Energy Specialists, "Case Study: Massachusetts Air-Source Heat Pump Installations, 2014-2019," Report prepared for National Oil Heat Institute, November 19, 2019.
23 Source: https://www.remodelingexpense.com/costs/cost-of-heat-pump-water-heaters/
24 Brattle EMP Report, at 68.
25 Ibid, at 48, footnote 76.
26 R. Johnson, "Measured Performance of a Low-Temperature Air Source Heat Pump," Report prepared for National Renewable Energy Laboratory, September 2013, p. ix.
27 Carrier Corporation, "How Long Does a Furnace Last?" undated.
28 A typical Level 2 charger draws between 40 and 60 amps.
29 Remodeling Calculator, "2022 Cost to Replace an Electrical Panel." A recent report states that Siemens and ConnectDER have developed a charger that connects directly to a home's electric meter, eliminating the need for a service upgrade. The unit is supposed to go on sale in 2023. This technology does not eliminate the need to upgrade electric services for heat pump space and water heaters.
30 Audrey Ference, "Electric Car Charger Installation in Your Home: True Costs—and What You Need to Know," realtor.com, March 3, 2022.



Reporting Only Estimated Costs in 2030 Does Not Provide a Comprehensive Analysis of Ratepayer Costs

The EMP is intended to achieve the state's emissions reduction goals by 2050. Focusing on projected ratepayer impacts during a single year, long before those goals are realized, does not provide a complete picture of ratepayer impacts. Moreover, under the "Ambitious Pathway" scenario, which assumes the EMP's emissions goals are achieved by 2035, it would be more reasonable to determine ratepayer impacts through that year.

For example, Senate Bill 2252 mandates that at least 330,000 EVs be registered in the state by 2025 and three million by 2035. The latter is almost two and one-half times more EVs than assumed in the Brattle EMP Report for 2030. (Through March 2022, cumulative sales of EVs in the state since January 2011 totaled 56,331.)[31] Presumably, three million EVs will have a significant impact on total electricity demand, which is likely to affect electricity rates. For example, with three million EVs, it is more likely that local distribution systems of the four electric utilities will require extensive upgrades to handle the additional peak demand from charging stations.

Similarly, the operating licenses of New Jersey's two remaining nuclear plants, Salem and Hope Creek, will have expired before 2050. The Salem Nuclear Plant's two operating units, which began generating electricity in 1976 and 1980, respectively, are scheduled to shut down in 2036 and 2040, respectively, when they will be 60 years old. The Hope Creek Nuclear Plant,

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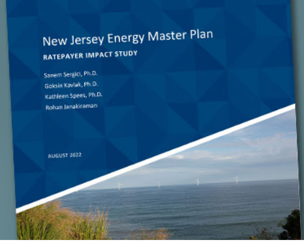
which began operating in 1986, is scheduled to close in 2046. The EMP evaluated that scenario and concluded the additional costs would increase by $7 billion per year over the "least-cost" scenario by 2045, in other words, a $9 billion per year increase in energy costs.[32] Although it is possible that the operating licenses of these plants will be extended a second time, it is surely reasonable to evaluate the impacts on ratepayers of the state having to replace the electricity generated by those plants, which in 2021 totaled approximately 28 TWh, equal to approximately 46% of total in-state generation.[33]

Similarly, page 40, Table 20, of the Levitan Report, from which the Brattle EMP Report's electricity price projections are taken, and which form the basis for the latter's estimates of ratepayer costs in 2030, shows rapid increases in those prices after 2030 and through 2050. Moreover, the Levitan Report shows an assumed average wholesale electric price in 2021 of about $31/MWh in PJM, whereas the actual average price in PJM

31 Alliance for Automotive Innovation, Electric Vehicle Sales Dashboard.
32 EMP, at 277.
33 Source: U.S. Energy Information Administration, Electricity Data Browser.



in 2021 was $39.78/MWh,[34] about 30% higher. Through the first seven months of this year, the average real locational marginal price ("LMP") was $67/MWh.[35]

Given that the initial price for the Levitan report is below actual prices by between 10% and 20%, the use of the Levitan Report's projected prices in 2030, which are around $35/MWh in nominal dollars and between $60/MWh and $65/MWh in 2050 is suspect and appears to underestimate wholesale prices in 2030 and beyond. Based on the assumed 2% inflation rate, the Brattle EMP Report thus assumes that, in 2030, the average wholesale price in 2030 in inflation-adjusted terms will be $29.87/MWh, almost $10/MWh less than the actual wholesale price in 2021.[36] The Report also uses an average electric cost of $168/MWh in 2020 (2022$) and assumes prices will increase by only 5% in inflation-adjusted terms by 2030.[37]

Similarly, by focusing solely on 2030 estimates before significant additions of offshore wind will take place, the Brattle EMP Report likely underestimates the going-forward costs to ratepayers owing to future upgrades to the transmission system. Moreover, it is unclear whether the Report accounts for other states' efforts to pursue emissions reductions, develop offshore wind and solar, and so forth. To the extent that other PJM states pursue similar policies, the impacts on the availability of imported electricity and transmission costs will change.[38] All of these issues are important considerations in order to evaluate the long-term impacts of the EMP on ratepayers.

Transmission and Reserve Charges

The Brattle EMP Report assumes a transmission charge of $26/MWh in inflation-adjusted dollars, which the Report claims is the current price for transmission.[39] The Report fails to provide the underlying data for this assumption.

In actuality, transmission prices paid by New Jersey ratepayers differ significantly by utility. The electric tariff for PSEG, which is the largest electric utility in the state, serving over half of all residential customers, shows transmission charges of $31.90 for residential Basic Generation Service ("BGS") customers with electric space heat and $55.33/MWh for other residential customers,[40] whereas Jersey Central Power & Light's current transmission charge is $10.06/MWh[41] and Atlantic City Electric's residential transmission charge is $25.60/MWh.[42] Rockland Electric's transmission charges for residential electric customers are currently

34 Source: PJM State of the Market Report 2021, March 2022, at 173, Table 3-52. The table shows real-time locational marginal prices ("LMP") for the different PJM load zones and the overall average for PJM as a whole. The zonal prices for New Jersey ranged between $34.13/MWh (Atlantic City Electric) and $38.80/MWh (Rockland Electric). The average price in the PSEG zone was $35.78/MWh and the average price in the Jersey Central Power & Light zone was $34.52/MWh. Furthermore, LMPs do not include prices for installed capacity, ancillary services, and transmission charges.

35 Source: PJM Dataminer 2, Real time locational marginal prices. LMPs do not include the costs of ancillary services (e.g., spinning and non-spinning reserves, voltage regulation).

36 A more fundamental issue is that, as renewable generation makes up an increasingly larger share of total generation and fossil fuel plants retire, the wholesale electric market is likely to collapse. The reason is that renewable resources like wind and solar have zero marginal costs. Thus, wholesale prices will be close to zero when these resources are producing at capacity and extremely high when they are not available. (A complete discussion of wholesale market issues is beyond the scope of this review.) See, Paul Joskow, "Challenges for Wholesale Electricity Markets with Intermittent Generation at Scale: The US Experience," MIT Center for Energy and Environmental Policy Research, January 2019.

37 Brattle EMP Report, at 42, Table 11.

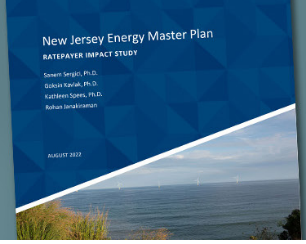
38 The EMP also recommends that the state study withdrawing from PJM. EMP, at 108 ("New Jersey is committed to exploring all possible options, including leaving the PJM capacity market, to ensure that the state can realize a clean energy future at reasonable prices.")

39 Brattle EMP Report, at 63.

40 Public Service Electric & Gas Company, Tariff of Electric Service, Sheet 76. PSEG has few customers with electric space heat. Moreover, and ironically given the electrification goals of the EMP, the company encourages customers to switch to natural gas space and water heat.

41 Jersey Central Power & Light Company, Tariff for Service, Sheet 8.

42 Atlantic City Electric Company, New Jersey Electric Tariff, Section IV, Rate Schedule RS.



$29.26/MWh.[43] If one calculates a weighted average, based on the total number of residential customers for each utility as reported in their most recent FERC Form-1 filings, the overall transmission rate is approximately $38/MWh.[44] Thus, the $26/MWh average value appears to underestimate average transmission costs by about 45%.

The Brattle EMP Report also is silent on the issue of costs associated with higher reserve margins needed to back up intermittent wind and solar generation and meet peak electric demand, especially in winter. Electrification of space and water heat, as well as electrification of transportation, will increase peak electric demand in the state. As the Appendix to the 2019 Integrated Electric Plan ("IEP") states, "In the future, the defining reliability periods may be when renewables have unusually low output, and when that low output is sustained for unusually long periods."[45] Although both the EMP and the IEP on which the EMP is based discuss peak electric demand and the importance of using energy efficiency to reduce peak demand, nowhere do these reports present an actual forecast of peak demand in New Jersey. Nor does the report ever discuss how demand charges for commercial/industrial customers were forecast.

As the EMP itself states, "In a scenario in which all incremental investment in electricity generating capacity in New Jersey goes to renewable resources, the need to balance electricity demand and supply in a grid dominated by renewable energy leads to significant storage requirements and high costs in 2050."[46] The Brattle EMP Report projects total electric consumption to grow by 21% to about 84 TWh.[47] By comparison, under the "Least-cost" scenario, the EMP shows 8,732 megawatts ("MW") of battery storage in 2050 providing less than 0.1 TWh of electricity.[48] The 2,500 MW of battery storage mandated by 2035 would provide less than 0.02 TWh of electricity, about two hours of average forecast electricity consumption. If peak electric demand in winter was twice average demand, that battery storage would provide only one hour of back up electricity. However, the costs of the additional reserve margin required to ensure reliability are not discussed in the Brattle EMP Report. [49]

Furthermore, barring future technological breakthroughs, battery costs are likely to increase, as they have already. Electrification and the push for EVs is increasing the demand for the raw materials needed, such as lithium carbonate. A recent report by the U.S. Geological Survey stated that the U.S. average price more than doubled to $17,000 per ton, while lithium hydroxide prices in China more than trebled between January and November 2021.[50] Moreover, as the costs of electricity and fossil fuel increase, so will the costs to both process the raw materials needed for batteries and to manufacture the batteries themselves.

The alternative to battery storage will be reliance on additional fossil-fuel generation as back-up or what are called "Dispatchable Emissions-free Resources" ("DEFRs"). DEFRs are envisioned to be turbines that run purely on hydrogen produced by electrolysis, with the electricity for the electrolysis sourced from surplus

43 Rockland Electric Company, Electricity Tariff, Sheet G1.31.

44 Source: Individual utility FERC Form-1 filings, at 300-301. The calculation assumes that residential customers who purchase electricity from competitive electric suppliers pay the same transmission charges as BGS customers.

45 New Jersey 2019 IEP, Technical Appendix, at 101.

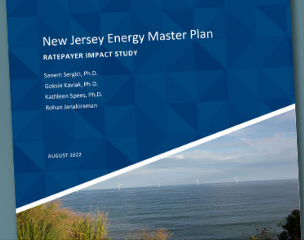
46 EMP, at 274.

47 Brattle EMP Report, at 54, Table 17.

48 Ibid, at 274-275. The actual value is not shown on the chart.

49 Under a similar 100% emissions-free generation scenario, the New York State Reliability Council determined the state would need a required reserve margin of over 100%, compared to the current reserve margin of about 20%. See NYSRC, "Reliability Challenges in Meeting CLCPA Requirements," Aug. 2, 2021, citing New York Department of Public Service and New York State Energy Research and Development Authority (NYSERDA), "Initial Report on the New York Power Grid Study," Jan. 19, 2021, appendix E.

50 U.S. Geological Survey, Mineral Commodity Summaries, "Lithium," January 2022.



wind and solar generation. No such DEFRs exist today nor do any large-scale scale electrolysis plants exist.[51]

The Brattle Report's EV and ICV Comparison Cost Analysis is Flawed

If one compares the projected electricity and natural gas costs between the "Current Pathway" and the EMP or "Ambitious" Pathways, the overall costs increase, from $16,022 million in 2020 (in 2022$) ($11,593 electric + $4,029 natural gas) to $18,735 million (2022$) ($14,825 electric +$3,910 natural gas) for the EMP Pathway, and $18,773 million (2022$) ($14,947 electric + $3,827 natural gas) under the Ambitious Pathway. Thus, by 2030, the Brattle EMP Report projects an annual increase of about $2.7 billion in electric and natural gas costs, a 17% increase in inflation-adjusted terms. For the "Current Pathway," the Report forecasts total costs of 17,971 million (2022$) ($13,680 electric + $4,291 million natural gas). Thus, the EMP and Ambitious Pathways will have increased electric and natural gas costs for consumers and businesses by approximately $1 billion per year in 2030. (The Report never provides any estimates of the changes in total residential, commercial, and industrial customers, so the per-customer impacts cannot be calculated independently.)

> **"The Report assumes the average fuel efficiency of ICVs in 2030 will be the same as the estimated average value of 24 miles/gallon in 2020. However, the Report then compares gasoline expenditures to electric costs based on forecast future battery EV efficiency in 2030 of 3.1 miles/kWh. These assumptions are inconsistent."**
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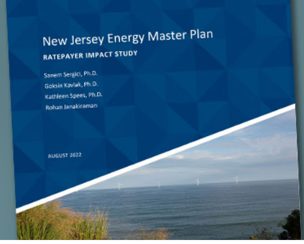
>
> AFFORDABLE ENERGY *For* NEW JERSEY

Although the Brattle EMP Report estimates an inflation-adjusted price of $3.16/gallon for gasoline in 2030,[52] the Report never identifies total spending for gasoline in 2030 or spending on gasoline and diesel fuel for commercial and industrial customers.

However, from the charts, it appears that the forecast savings for customers are the result of much lower spending to charge an EV versus spending on gasoline.[53] Specifically, the Report states that EV operating costs are "roughly" 50% lower for than operating costs for an ICV.[54] (The Report assumes that low-income consumers drive exactly the same amount per year as non-low-income consumers. If low-income consumers typically rely more on public transportation than non-low-income consumers, then this assumption is not justified.)

To estimate the cost savings from switching from an ICV to an EV, the Brattle EMP Report uses inconsistent assumptions. The Report assumes the average fuel efficiency of ICVs in 2030 will be the same as the estimated average value of 24 miles/gallon in 2020.[55] However, the Report then compares gasoline expenditures to electric costs based on forecast future battery EV efficiency in 2030 of 3.1 miles/kWh.[56] These assumptions are inconsistent.

51 For a discussion, see Jonathan Lesser, "The Biden Administration's Offshore Wind Fantasy," Manhattan Institute, February 2, 2022.
52 Brattle EMP Report, at 64.
53 Ibid, at 21 (Figure 4) and 23 (Figure 5), respectively. Actual per-customer numerical values for spending are not shown anywhere in the Report.
54 Ibid, at 21.
55 Ibid, at 68.
56 Id.



According to the EIA, fuel economy for new gasoline vehicles will be about 45 miles per gallon in 2030.[57] Over time, as the vehicle stock is replaced, the average fleet MPG should thus increase. The Brattle EMP Report ignores this impact.

At the same time, the Report appears to assume (again, none of the calculations are available) that all EVs on the road in 2030 will have 2030-level efficiencies. However, if customers are purchasing EVs each year, then it is appropriate to use the average efficiency of all EVs assumed to be on the road in 2030, rather than using an estimated efficiency value for new EVs only. Alternatively, the Report could compare costs based on the 45 mpg efficiency of a new ICV versus the 3.1 miles/kWh value of an EV.) Hence, the Report has made a classic "apples-to-oranges" comparison that overstates customer savings from using an EV by overestimating annual expenditures on gasoline and underestimating expenditures on electricity used for EV charging. Furthermore, the projected EV efficiency value used in the Report is based on normal weather conditions and does not account for the significant decrease in battery efficiency in extreme cold and heat.[58] That also contributes to the overestimated savings from the purchase of an EV.

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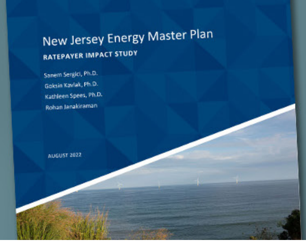
To take a numerical example, annual expenditures on gasoline at a price of $3.16/gallon, for a vehicle averaging 24 mpg and driven an assumed 12,274 miles/year is just over $1,600. At 45 mpg, however, the annual spending falls to $900. A new EV with an efficiency of 3.1 miles/kWh driven the same number of miles will use 3,959 kWh per year. At a delivered cost of electricity of $177/MWh (2022$), the annual cost would be $700. The Brattle EMP Report uses the $900 savings value ($1,600 on gasoline less $700 for EV charging). The estimated savings compared to a new ICV would be $200. If the average efficiency were of the EV were decreased by 20% to 2.5 miles/kWh, the annual cost would increase to $868, virtually the same as for a new ICV.

Furthermore, the Brattle EMP Report assumes EV owners never charge their EVs outside home charging stations, and thus bases the $700 annual cost on the prevailing residential rates. However, costs for commercial charging stations typically are much higher, estimated to be between $0.30/kWh and $0.80/kWh, depending on the charging network used and the charging speed (DC chargers are more costly than Level 2 chargers).[59] Presumably, consumers who travel will find themselves charging EVs at commercial charging stations. Given the higher rates charged by these stations, the overall charging cost per year will increase.

This combination of low retail electric prices that do not account for the required increase in capacity reserve margins to back up intermittent wind and solar generation, together with the inconsistency between basing ICV gasoline costs on 2020 vehicle efficiency while basing EV costs on 2030 efficiency levels, as well

57 US EIA, Annual Energy Outlook 2022, Table 40.
58 American Automobile Association, "AAA Electric Vehicle Range Testing," February 2019.
59 Jim Gorzelany, "What it Costs to Charge an Electric Vehicle," Myev.com, undated.



as assuming consumers never use commercial charging stations while traveling, means the Report's comparisons of expenditures on gasoline and electricity for EVs is biased: gasoline costs are overestimated and EV costs are underestimated. Notably, the Report's conclusion that consumers' costs will decrease are driven by EV adoption, the estimated difference between annual expenditures on gasoline and electricity for EV charging is the source of the estimated annual reduction in costs below those in 2020 shown in Appendix F.1.

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The Brattle EMP Report's Results are Not Transparent and Not Reproducible

Perhaps the most troubling aspect of the Brattle EMP Report is that the results are not transparent. For example, Appendix F (pp. 77–91) contains numerous charts of annual expenditures for different types of customers for the different electric and natural gas utilities. But nowhere in the report are the actual numerical values ever provided. Nor does the Report ever specify the actual calculations used. Hence, it is not possible to verify the costs that are shown.

The lack of transparency violates basic norms for peer review, as well as public policy development. If New Jersey intends to spend billions of taxpayer dollars every year to reduce greenhouse gas emissions and intends to force individuals and businesses to invest billions of dollars of their own money to meet those goals, then analyses that purport to demonstrate the cost savings consumers and businesses will supposedly realize should be transparent and verifiable independently. The Brattle EMP Report fails on both counts.

Dr. Jonathan Lesser is the President of Continental Economics, Inc., and has over 35 years of experience working for regulated utilities, government, and as an economic consultant. He has addressed critical economic and regulatory issues affecting the energy industry in the U.S., Canada, and Latin America, including gas and electric utility structure and operations, cost-benefit analysis, mergers and acquisitions, cost allocation and rate design, asset management strategies, cost of capital, depreciation, risk management, incentive regulation, economic impact studies, and general regulatory policy.

Dr. Lesser has prepared expert testimony and reports in cases before utility commissions in numerous states; before the Federal Energy Regulatory Commission (FERC); before international regulators in Belize, Guatemala, Mexico, and Puerto Rico; in commercial litigation cases in Arizona, Vermont, and Washington State; and before Congress and numerous state legislative committees on energy policy and regulatory issues.