NATURAL GAS: CRUCIAL FOR NEW JERSEY'S ENERGY AND ECONOMIC FUTURE

Report Prepared for:

Affordable Energy for New Jersey

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September 2020

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EXECUTIVE SUMMARY

Last year, in response to Governor Murphy's 2018 Executive Order, the state Board of Public Utilities released its most recent New Jersey Energy Master Plan (EMP), which offers a "blueprint" to move the state to 100% clean energy by 2050. Meeting that lofty goal is a bureaucrat's dream: the EMP is stuffed with heavy-handed mandates that will force New Jersey's residents and businesses to pay billions of dollars more every year for the energy they need. Of course, that assumes there will be energy to be had, which the recent blackouts in California caused by too little available renewable energy proved to be a dangerous assumption.

The EMP intends to establish the state's environmental bona fides by replicating California's disastrous renewable energy policies and their impacts: some of the highest electricity costs in the nation and, this past summer, rolling blackouts when too little wind and solar power was generated – showed that over-reliance on wind and solar power. When having enough energy for homes and businesses depends on today's weather forecast, energy policy has gone off the rails.

Nevertheless, the EMP will require New Jersey to double-down on electricity and a "zero-carbon" economy by 2050. Not only does the plan call for billions in subsidies for electric vehicles – cars, trucks, and buses – it calls on the state to force consumers and businesses to rip out their natural gas-fired furnaces, water heaters, and even cook stoves, and replace them with electric ones.

The EMP claims this will save consumers money. But those claims are based on bogus assumptions and flawed analysis. Today, almost 2 million single-family homes and 350,000 apartments use natural gas for heat and hot water, as well as thousands of commercial businesses. Retrofitting all of those homes and businesses will cost over $65 Billion in today's dollars.

But those costs are just a start. That $65 billion doesn't include the skyrocketing electricity costs that consumers and businesses will be forced to pay for all of the additional

electricity they will need, which the Governor claims will be provided by offshore wind and solar power, along with huge quantities of costly battery storage to provide electricity at night, on cloudy days, and when the wind doesn't blow.

For example, consumers and businesses will pay almost $100 per megawatt-hour (MWh) for electricity from the 1,100 MW Ocean Wind Project, when that project is completed in 2024, and pay 2% more each year thereafter. By comparison, thanks to abundant, low-cost natural gas, last year the average wholesale price of electricity in the state was just $27 per MWh. (It has been around $20 per MWh so far this year.)

According to the EMP, this "eat your spinach" energy policy must be imposed to "solve" climate change. Currently, New Jersey's greenhouse gas emissions – around 100 million tons of carbon. That sounds like a lot, but it is less than the average *daily* carbon emissions worldwide and only about four-days' worth of carbon emissions from China. Moreover, world carbon emissions have been increasing by about 400 million tons per year. So, even if New Jersey somehow eliminated all carbon emissions tomorrow, the reduction would only offset three months of the annual *increase* in world carbon emissions. The effect on global climate would be nil. Nada. Zero. Zip.

Energy is the lifeblood of modern society. Safe, affordable, and *reliable* energy supplies are crucial for the well-being of New Jersey's residents and businesses. The EMP's mandates will end that. It will enrich the well-connected few at the expense of millions of hard-working individuals. It will lead to an exodus of businesses and industry. And it won't have any impact on climate change.

I. New Jersey's High-Stakes (and Losing) Bet on Energy

Energy is the lifeblood of modern society. Safe, affordable, and *reliable* energy supplies are crucial for the wellbeing of New Jersey's residents and businesses. Last August, for example, Californians experienced the importance of reliable electricity supplies when they were forced to endure rolling blackouts, caused by a lack of wind and solar energy resources: the wind stopped blowing and clouds over the California desert rendered solar panels useless.

When having enough energy depends on today's weather forecast, energy policy has gone off the rails. Yet, California continues its headlong race towards 100% reliance on renewable energy, turning its back on traditional – and reliable – energy resources. Several natural gas-fired generators are slated to close. Diablo Canyon, California's last operating nuclear power plant, will be shuttered in 2025, thanks to pressure from environmentalists.

Besides moving towards 100% renewable generation, a number of California cities, including Berkeley and San Jose, have banned all new natural gas hook-ups, claiming that doing so will save the planet by reducing carbon emissions and save thousands of lives by reducing local pollution.

California's efforts ought to be called out for what they are: an exercise in green virtue-signaling that is raising energy costs, immiserating the poor, and strangling that state's economy. Yet, New Jersey seems hell-bent on pursuing these same policies.

Last year, in response to Governor Murphy's 2018 Executive Order, the state Board of Public Utilities released its most recent New Jersey Energy Master Plan (EMP), which offers a "blueprint" to move the state to 100% clean energy by 2050. The EMP is a bureaucrat's dream, full of heavy-handed mandates that will force New Jersey's residents and businesses to pay billions of dollars more every year for the energy they need, while creating the same reliability problems that are plaguing California.

Natural gas is a crucial component of New Jersey's energy supply. Not only is natural gas used to generate more than half of the state's electricity supplies, but over 75% of all households use natural gas for space and water heating, as do many businesses. Virtually all commercial restaurants rely on natural gas.

Yet, the EMP calls for eliminating natural gas from New Jersey's energy mix, not only by shuttering clean, low-cost generating plants, but also by forcing everyone to tear out their natural gas furnaces, water heaters, and appliances, and replace them with electric ones

– along with electric cars – all powered with electricity generated from wind and solar. The costs will be staggering – *billions* of dollars every year to retrofit thousands of homes and businesses, higher electricity prices that customers will be forced to pay, and less energy security. Those higher costs will reduce economic growth and result in lost jobs.

The EMP claims that these are costs which New Jersey must bear because "the global threat of climate change is grave" and "demands swift local action and focused state leadership."[1] But regardless of whether you believe the threat is grave, insignificant, or somewhere in between, New Jersey's action will have no impact at all on world climate.

New Jersey's carbon emissions in all of 2018 were less than one day's worth of emissions worldwide.

In 2018, the state's carbon emissions totaled about 100 million tons. Although that may sound like a lot, it is less than average *daily* carbon emissions worldwide and only about four-days' worth of carbon emissions from China. Moreover, between 2008 and 2018, world carbon emissions increased by about 400 million tons per year. So, if New Jersey could somehow eliminate all of the state's carbon emissions tomorrow, the reduction would amount to offset three months of the annual *increase* in world carbon emissions.

II. Natural Gas: Clean, Abundant, Reliable, and Low-Cost

A half-century ago, policy makers were terrified that the U.S. was running out of natural gas and that, by the end of the 1970s, the natural gas "spigot" would run dry. For example, a 1974 report written by the Federal Power Commission stated that "from here on we must make do with less gas in absolute terms."[2]

But a few years later, Congress did something remarkable: it passed legislation to deregulate natural gas prices, which the government had kept artificially low. Deregulating prices unleashed the power of the market, leading to technological leaps in hydraulic fracturing and horizontal drilling. The result: the U.S. became the "Saudi Arabia of natural gas." In 2019, production averaged 89 billion cubic feet per day (Bcf/day), double the

[1] EMP, p. 11.

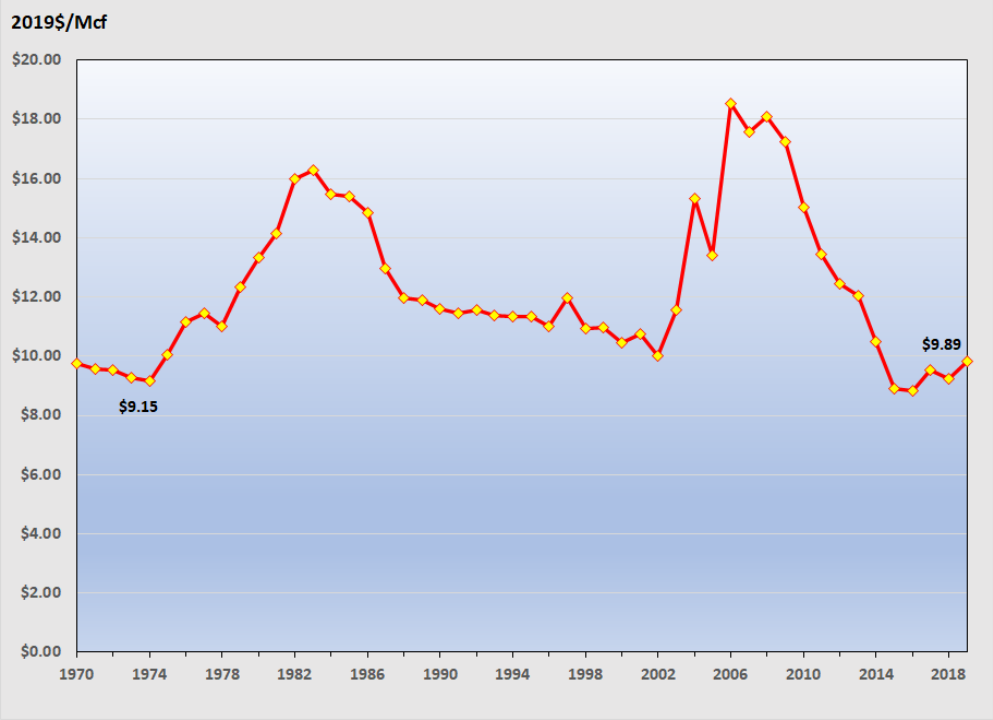
[2] Federal Power Commission, Bureau of Natural Gas, "A Realistic View of U.S. Natural Gas Supply," Staff Report, January 1974.

average production 30 years ago. What is more, during that same period, proved reserves of natural gas tripled.

These vast supplies of natural gas resulted in lower prices. In New Jersey, the price of natural gas used to generate electricity fell from $10 per thousand cubic feet (Mcf) in 2005 less than $3/Mcf in 2019 – *before* taking inflation into account. The decrease in natural gas prices, coupled with increasing efficiency of new natural gas-fired generating plants, helped lower wholesale electric prices.

For example, not only was the average inflation-adjusted price paid by New Jersey residential customers just half the average price in 2008, it was lower than prices in every year since 1974 (Figure 1). Similar savings accrued to commercial and industrial customers.

Figure 1: New Jersey Residential Customers – Avg. Price of Natural Gas ($2019/Mcf)



Those lower natural gas prices reduced costs for New Jersey consumers to heat their homes and businesses, run their restaurants, and manufacture goods. Compared with natural gas prices in 2008, New Jersey customers and electric generators saved over $4.5 billion in 2019 alone, money that was available to grow existing businesses, create new ones, and create more New Jersey jobs.

In 2019, NJ consumers and businesses saved over $4.5 Billion thanks to lower natural gas prices when compared to 2008.

The increased reliance on natural gas has also benefitted the environment: natural gas-fired generators have replaced old, inefficient, smoke-belching coal plants, reducing not only carbon emissions, but air pollutants like sulfur dioxide and oxides of nitrogen that have been linked to heart and lung disease.

III. The Economic Realities of Eliminating Natural Gas Consumption

The fourth strategy goal of the EMP calls New Jersey building to be decarbonized and electrified by 2050. The EMP recognizes that "Decarbonizing the building sector will be a substantial undertaking because New Jersey is already highly developed, and the transition to electrification will depend on technologies that are still maturing." In other words, New Jersey consumers are going to pay – and pay heavily – as they are forced to replace natural gas with electricity.

The EMP claims that this mandated fuel switching will save New Jersey consumers money because the EMP all of those natural gas furnaces will be replaced with heat pumps.[3] The projected savings are based on a 2018 report prepared by the Rocky Mountain Institute (RMI) , which also wrote the EMP.[4] (That RMI report didn't actually model retrofit costs in New Jersey. Instead, the nearest city was Providence, RI.) Oddly enough, the RMI report showed that retrofitting with an electric heat pump cost consumers thousands of dollars *more* over a 15-year period.)[5]

Heat pumps are often touted as a "miracle" technology that extracts more energy than it uses, which means consumers can save thousands of dollars. But like other miracle cures, reality is far messier. Heat pumps do not violate the laws of physics. Although they extract heat from the air, they do not produce more energy than they use.

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3 EMP, p. 158.

4 Sherri Billimoria, et al., "The Economics of Electrifying Buildings," Rocky Mountain Institute 2018 (RMI Heat Pump Study).

5 Additionally, the RMI Study assumed a natural gas distribution company residential tariff for Providence (p. 63) is greater than the actual costs charged by New Jersey companies, such as PSE&G and New Jersey Natural Gas.

Average cost to retrofit a New Jersey home with a heat pump system: $23,000

An air-source heat pump works like a refrigerator in reverse: it extracts heat from outside air and sends it inside.[6] The colder the outside air, the less heat there is to extract. Hence, in dead winter, when temperatures are coldest and space heating demand is greatest, heat pumps are least efficient and produce the least amount of heat. That is also why many homes need to install several heat pump units to provide sufficient heat.

A 2013 report prepared for the U.S. Department of Energy's National Renewable Energy Laboratory 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.[7] (Moreover, as shown in Figure 1 above, the average cost of natural gas for residential consumers has decreased by about 20% since 2013.)

1. Retrofit Costs

Furthermore, this higher operating cost did not account for the cost of retrofitting a home to install the heat pump. The RMI study *assumed* it would cost $7,500 to retrofit a home with a heat pump, versus $3,300 to replace an existing gas furnace.[8] 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.[9] 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 RMI Study ignored supplemental heating entirely.

Next, consider the costs of accomplishing these retrofits. According to the U.S. Census, there were about 3.6 million housing units in NJ, including over 1.9 million single family

6 Ground-source heat pumps extract heat from underground. Although they are more efficient than air-source heat pumps, they cost much more.

7 R. Johnson, "Measured Performance of a Low-Temperature Air Source Heat Pump," Report prepared for National Renewable Energy Laboratory, September 2013, p. ix.

8 RMI Study, p. 65.

9 Diversified Energy Specialists, "Case Study: Massachusetts Air-Source Heat Pump Installations, 2014-2019," Report prepared for National Oil Heat Institute, November 19, 2019.

homes and 350,000 townhomes.[10] If we ignore the costs of replacing heating systems in the 1.3 million multi-family units, that leaves about 2.3 million single family homes and townhouses.

According to the EMP, 75% of New Jersey residences are heated with natural gas, with another 10% heated with oil or propane, or 85% of the housing stock. That means about 2 million heat pump retrofits. Even if one accepted the RMI Study's assumptions and analysis, that implies the cost of retrofitting those homes would cost $15 billion. Of course, all furnaces wear out and must be replaced eventually. But if it costs $3,300 to install a new gas furnace, then the net additional cost of installing new heat pump is $4,200 ($7,500 - $3,300). That means an *additional* $8.4 billion that owners of single family and townhomes would have to pay. Using the average *actual* retrofit cost of $23,000, then the *additional* costs single family and townhome owners would pay increases to about $40 billion.[11]

Estimating the costs to retrofit apartment buildings is far more complex. A 2019 report prepared for the Natural Resources Defense Council (NRDC) estimated retrofit costs for a variety of multi-family buildings between $7 per square foot $15 per square foot, assuming an average apartment size of 1,000 square feet.[12] These cost estimates mean that retrofitting the 1.3 million multifamily units in New Jersey would cost between $9 and $20 billion. Hence, in total, the EMP's retrofit goal could cost New Jersey residential homeowners upwards of $60 billion. That is $2 billion per year for the next 30 years, not accounting for inflation, to meet the 2050 goals – over $200 per resident, each and every year, for the next 30 years.

The total cost to retrofit all NJ households with electric heat pumps and hot water heaters, as called for by the EMP, could easily top $60 billion – $2 billion each year until 2050.

[10] Source: U.S. Census Bureau, Selected Housing Statistics, Table DP04. A townhome is known as an "attached" structure.

[11] Equals: ($23,000 - $3,300) × 2 million.

[12] Steven Winter Associates, Inc., "Heat Pump Retrofit Strategies for Multifamily Buildings," Report prepared for NRDC, April 2019, p. 17.

As those late-night television commercials used to say, "Wait, there's more!" The EMP calls for replacing all residential gas appliances, including water heaters, gas stoves, and gas dryers.

Although there are no data on the percentage of households with gas hot water heaters in New Jersey, a 2009 survey for Massachusetts households found that 89% of all households heated with gas or oil, similar to the 85% of households in New Jersey.[13] That same study found that 82% of all households heated water with gas or oil.[14]

The average installed cost of a heat pump water heater ranges between $2,500 and $3,800.[15] Using the low-end value and assuming a saturation rate of 80% for the 2.25 million New Jersey single family and townhomes, the retrofit cost would be $4.5 billion. And, although the costs of electric ranges and dryers are relatively low, around $500 - $1,000 each, many older homes do not have adequate wiring to replace existing gas-fired ones. Thus, replacing millions of gas stoves and dryers with electric ones is likely to cost billions of dollars more.

IV. Mandated Electrification of Buildings Will Raise Electricity Costs and Create Reliability Issues

The EMP's goal is to convert all fossil energy use to electricity generated from renewable power, primarily wind and solar power. Forcing all homes and businesses to replace their natural gas furnaces, water heaters, stoves, and so forth to electricity will increase electricity demand.

Although the EMP claims that electricity demand will only double, that surely *underestimates* the increase in electricity demand: today, in 2018, end-use electricity consumption accounted for less than 15% of total end-use energy consumption in the state; transportation alone accounted for over 45% of New Jersey energy consumption.[16] Even with more energy efficient buildings and appliances, which the EMP also mandates, replacing all of that fossil fuel consumption with electricity is going to increase electricity

[13] Opinion Dynamics Corporation, "Massachusetts Residential Appliance Saturation Survey," Volume 1, Report prepared for the Cape Light Compact, National Grid, NStar Electric, Unitil, and Western Massachusetts Electric, April 2009, p. 22.

[14] Ibid, p. 36.

[15] Source: https://www.remodelingexpense.com/costs/cost-of-heat-pump-water-heaters/

[16] Source: U.S. Energy Information Administration (EIA), State Energy Profiles, New Jersey.

consumption … a lot. That increase in electricity demand will lead to higher electricity costs for consumers and businesses, along with more California-style blackouts.

1. Electricity Prices Will Skyrocket

New Jersey consumers and businesses already pay high electricity – about 30% higher than the overall U.S. average.[17] That represents an improvement since 2010 – thanks to lower natural gas prices – when electricity prices in New Jersey were almost 50% higher than the U.S. average.

But instead of relying on abundant and low-cost natural gas, the EMP calls for reliance almost entirely on wind – especially offshore wind – and solar power, along with battery storage to address the inherent variability of those resources.

The EMP acknowledges that its unrealistic goals will cause electricity prices to increase, stating:

> 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.[18]

Then again, the EMP claims that the increase in energy spending under its "least-cost" strategy will be "only" 10% higher than under a business-as-usual scenario –$2.8 billion per year (2018$). But fear not, the increase in costs will be only $2.2 billion per year (2018$) by 2050.[19] All told, between 2020 and 2050, the EMP calls for New Jersey consumers and businesses to pay over $65 billion (2018$) in higher costs for appliances and electricity.[20]

Although $65 billion may sound like a lot of money, that figure surely *underestimates* the true cost increases. As discussed previously, just replacing all gas-fired and oil-fired furnaces and water heaters is likely to cost consumers and businesses $65 billion.

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17 Source: EIA, Electric Power Monthly.

18 EMP, p. 30.

19 Ibid, p. 282.

20 Id., p. 267. Results interpolated each year, because the EMP does not provide annual cost values. If inflation is assumed to average 2.0% per year, the actual cost in current year dollars will be over $90 billion.

But there are still more costs. The "least-cost" scenario assumes that the state's three operating nuclear plants will be allowed to continue operating even after their licenses expire. Environmentalists already forced the early shutdown of the Oyster Creek Nuclear Plant in 2018, even though that plant's operating license extended to 2029. 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, which began operating in 1986, is scheduled to close in 2046. So, by 2050, none of the state's nuclear plants are likely to be operating. The EMP evaluated that scenario and concluded the additional costs would increase by $7 billion per year over the "least-cost" scenario by 2045.[21]

The EMP's plan to rely heavily on "distributed" solar power, that is, solar panels installed on rooftops, will require a complete – and costly – overhaul of the electric grid. In total, the EMP envisions 6,000 megawatts (MW) of rooftop solar by 2050, along with around 25,000 MW of utility-scale solar. (By comparison, the Salem and Hope Creek nuclear plants have a capacity of about 3,600 MW.) In addition, the EMP calls for almost 11,000 MW of offshore wind power.[22]

The state has already authorized the 1,100 MW Ocean Wind, which is scheduled to begin generating electricity in 2024. Under the 20-year power purchase contract approved by the New Jersey Board of Public Utilities, the initial price of the power generated will be $98.10 per megawatt-hour (MWh). The price will increase by 2% per year so that, in the last year of the contract, the price will be over $145/MWh. By comparison, the average wholesale price of electricity in PJM – the regional electric organization that oversees the wholesale electricity market and operation of the regional power system – was $27.32/MWh.[23] For the first half of 2020, the average price was even lower, $19.40/MWh.[24] New Jersey residents and businesses will be forced to pay those higher costs, which will raise their electric bills and stifle economic growth.

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21 Id., p. 277.

22 Id., p. 268.

23 Monitoring Analytics, 2019 State of the Market Report for PJM, Vol. 1, March 2020, p. 16, Table 8. Including the price for capacity (in effect, iron in the ground to ensure adequate resources at all times), the average price in 2019 was less than $39/MWh.

24 Monitoring Analytics, 2020 Quarterly State of the Market Report for PJM: January through June, August 13, 2020, p. 15. Including capacity, the price was just over $29/MWh.

The 1,100 MW Ocean Wind project's purchase price starts at $98/MWh, three times larger than the average wholesale price of power in 2019.

What's worse, detailed statistical analysis of the performance of offshore wind farms in Europe over the last decade shows that the units are plagued with operational problems and extended outages, leading to an average decrease in output of about 4% each year – almost half after 10 years, and higher than expected operating costs. And because of the way the Ocean Wind contract is structured, Ørsted, the project owner, will be able to walk away from the project once it becomes uneconomic to operate, leaving New Jersey ratepayers and taxpayers to pay the decommissioning bill.[25]

Although solar power has decreased in cost, it is still expensive, with rooftop solar being more costly than larger, utility-scale plants. Furthermore, as the EMP notes, electrification of the New Jersey economy will mean that electricity demand peaks during the winter,[26] when solar power provides the *least* amount of electricity. In the U.S. as a whole, including the desert southwest, average capacity factors (i.e., the percent of hours when a unit is actually generating electricity) for solar power in the December – January period were less than 15%.[27] So, the demand for electricity will be greatest when the EMP's largest single source of electricity will produce the least amount of power. Consequently, as discussed below, the EMP will require large amounts of costly backup power, which the plan envisions will be storage batteries.

Another cost that is rarely mentioned is that adding massive amounts of rooftop solar resources will require costly upgrades to local distribution systems – the poles and wires that run down the street. These systems were not designed to take power generated from a central station and distribute outward to homes and businesses. They were not designed to have decentralized power emanating from everywhere. Although small amounts of rooftop solar can be accommodated on circuits, accommodating large

[25] For a much more detailed discussion of offshore wind development off the Atlantic coast, see Jonathan Lesser, "Out to Sea; The Dismal Economics of Offshore Wind," Manhattan Institute, August 2020.

[26] EMP, p. 54.

[27] Source: EIA, Electric Power Monthly, Table 6.07.B, "Capacity Factors for Utility Scale Generators Primarily Using Non-Fossil Fuels," June 2020. For all of 2019, the average capacity factor in the U.S. was less than 25%.

quantities (say most of the homes along a given circuit) require upgrades to ensure that local distribution systems are safe and reliable. In some cases, those upgrades are relatively inexpensive; in other cases, they are costly, perhaps $500,000 per circuit.[28] The overall cost would likely by billions of dollars in distribution system upgrades, which would be paid by ratepayers.

2. Reliability Will Suffer – the California Problem.

As the recent experience in California showed, over reliance on intermittent wind and solar power can result in blackouts. In California, a lack of wind and clouds over the desert, coupled with high summer temperatures, forced CALISO, the state's high-voltage grid operator, to institute rolling blackouts so as to avoid a complete collapse of the grid.

As a member of PJM, which encompasses 14 mid-Atlantic states, New Jersey is in a better position than California. If the state were to run short of power from wind and solar facilities, other generators in PJM would be available to make up the shortfall.

Over-reliance on wind and solar power caused the recent blackouts in California. Gas-fired generators are the lowest cost guarantors of electric reliability.

But the EMP finds membership in PJM problematic and recommends the state explore withdrawing from PJM.[29] The reason: PJM dispatches its power system based on least-cost, and not based on environmental impacts.[30] In other words, PJM meets the demand for electricity using the lowest-cost generating resources, which reduces costs to consumers and businesses. As the EMP states, "New Jersey must be free to choose a suite of generation resources that meet state policy goals."[31]

Although a full discussion of how PJM operates and the implications of New Jersey withdrawing from PJM are beyond the scope of this briefing paper, the bottom line is that withdrawal would reduce reliability and increase costs for consumers and businesses.

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28 For a detailed study of three circuits, see Kelsey Horowitz, et al., "The Cost of Distribution System Upgrades to Accommodate Increasing Penetrations of Distributed Photovoltaic Systems on Real Feeders in the United States," National Renewable Energy Laboratory, April 2018.

29 EMP,

30 EMP, p. 108.

31 Ibid.

Instead of reducing risk by relying on generating plants in 14 states – the overarching purpose of creating PJM – withdrawal would increase risk – and costs – by requiring New Jersey to "go it alone."

The EMP envisions massive increases in battery storage, including using electric vehicles as storage. (The EMP also calls for massive subsidies for EVs to speed along the process of electrifying the *entire* transportation sector.) The problem is that relying on batteries to ensure reliability is hugely expensive, far more so than using gas-fired generators that can ramp up quickly to meet sudden increases in demand or the loss of other generators.[32]

3. The Bottom Line: Higher Energy Costs and Less Reliability

Eliminating natural gas from New Jersey's energy mix will be an exercise in economic suicide. The EMP admits costs will increase, but "only" by several billion dollars per year. Not only does the EMP underestimate those costs, but the plan ignores the economic impacts of higher electricity costs: a failing economy and thousands of lost jobs.[33]

Retrofitting homes and businesses with electric heat pumps, as the EMP envisions, is likely to cost upwards of $60 billion over thirty years. To that will be added billions of dollars to retrofit local distribution systems to accommodate rooftop solar and the increased electricity demand. Then there are the higher costs of renewable generation itself. Instead of relying on low-cost electricity generated from natural gas, the EMP will require reliance on higher cost solar and, especially, offshore wind. That reliance on solar and wind will require expensive battery storage systems to provide back-up power on cloudy, windless days, raising costs even higher.

In 2018, New Jersey consumers and businesses spent about $5 billion on natural gas and $33 billion in total on end-use energy.[34] The EMP will require they spend far more –

[32] The EMP also recommends a "clean peak" standard, under which *peak* electric demand would be required to be met with wind and solar generation, and battery storage (EMP, p. 147). The obvious problem with such a standard is that wind and solar may not be available (see California!) when electricity demand peaks.

[33] For a discussion of job losses caused by higher electricity prices, see Jonathan Lesser, "Renewable Energy and the Fallacy of 'Green' Jobs," *The Electricity Journal* 23 (Aug/Sept. 2010), pp. 45-53. That article estimated the impacts of higher electric prices in Pennsylvania, calculating a loss of 6.4 jobs per million dollars of higher electricity costs. If that same value was applied to New Jersey, a $2 billion annual increase in electricity costs would mean the loss of almost 13,000 jobs.

[34] Source: EIA, State Energy Data System.

a minimum of $2 billion extra per year, and likely $3-4 billion extra per year. Where will the money come from?

The EMP discusses a myriad of subsidies and private investments. But the money will not fall from the sky. Subsidies must be paid – whether by electric ratepayers or taxpayers in general. Private investors will require a return on the money they invest, and those returns will be paid by electric ratepayers and taxpayers. To believe that subsidizing all of the required investments and infrastructure needed to eliminate natural gas use – and all fossil fuels – will somehow improve economic growth in the state is economic tooth-fairyism.

Furthermore, if everything runs on electricity, then the economic and social damage from extended electric outages, such as after a hurricane or major winter storm, will increase. In New York City, for example, it took weeks to restore electricity after Tropical Storm Isaias struck in early August of this year. In 2012, Hurricane Sandy left over 8 million New Jersey customers without power, and service was not restored fully for weeks. If consumers are completely reliant on electricity – including their vehicles as the EMP demands – losing service will have much greater costs.

V. Eliminating Natural Gas Use: The EMP's Bureaucratic Fantasy vs. Economic and Environmental Reality

The EMP further claims that electrifying buildings will improve air quality and provide valuable health benefits. Although the EMP provides no estimates, it cites to a 2016 study prepared by the American Lung Association (ALA) which claimed $4.6 billion in annual health and climate benefits from electrifying all vehicles.[35] The EMP then claims that of those $4.6 billion in overall benefits from electrifying vehicles, $3 billion is associated with health benefits, including reduced heart and lung disease.[36]

Although the EMP did not quantify the health benefits of replacing all gas appliances in all residential and commercial buildings, a recent study prepared by researchers at UCLA for the Sierra Club estimated those benefits for California, finding that, if all residential gas appliances (furnaces, water heaters, and stoves) were replaced with electric alternatives, the benefits would total $3.5 billion per year.[37]

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35 EMP, p. 59, and endnote v.

36 *Id*., p. 51.

37 Yifang Zhu, et al., "Effects of Residential Gas Appliances on Indoor and Outdoor Air Quality and Public Health in California," UCLA Fielding School of Public Health, April 2020, p. 7.

According to data published by the U.S. Census, about 8.8 million California homes are heated with natural gas or propane, about 67% of the housing stock.[38] That's a little lower than the 75% of the homes in New Jersey, but New Jersey has only one-fourth the number of housing units as California. Adjusting the ALA study's estimated annual benefits to reflect New Jersey implies that electrifying all residential households that use natural gas would provide around $300 million in benefits from premature deaths and lung disease.

There are numerous analytical problems with the UCLA study.[39] For example, the study did not actually measure indoor air quality and pollutant levels in any residential buildings, but simply assumed those levels. The study also relied on previous research that effectively assumes there is a one-to-one relationship between pollutant levels and disease or death; in other words, breathing even a single particle of carbon monoxide or particulate matter has adverse health impacts.[40]

Moreover, if the additional electricity New Jersey will require from eliminating natural gas usage is purchased from PJM, then air pollution levels are likely to increase. The reason is that, rather than burning natural gas in an efficient furnace or water heater that converts over 90% of the natural gas burned into useful energy, natural gas will be burned in electric generating plants having far lower efficiencies, plus additional efficiency losses from transmitting that power to New Jersey. In 2019, natural gas accounted for over 36% of all electricity generated in PJM; coal accounted for almost one-fourth of all electricity generated in PJM.[41] Hence, the most likely result of eliminating natural gas use in buildings will be to increase air pollution emissions. In effect, New Jersey will substitute a smaller amount of local emissions for *greater* quantities of emissions west of the state – which because of prevailing west to east winds will then drift over the state.

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38 Source: U.S. Census Bureau, Selected Housing Characteristics – California.

39 See Steve Goreham, "A Critique of Residential Gas and California Air Pollution Paper: Poor Policy for California," Climate Science Coalition of America, June 2020.

40 For a discussion of emissions differences between electric vehicles and new gasoline-powered ones, see Jonathan Lesser, "Short Circuit: The High Cost of Electric Vehicle Subsidies," Manhattan Institute, May 2018. This study provides a more detailed critique of the underlying models linking pollutants to adverse health.

41 Monitoring Analytics, PJM State of the Market Report, Volume 1, p. 111.

Annual carbon emissions from residential and commercial natural gas consumption amounts to about six hours of world carbon emissions.

As for reductions in carbon emissions, in 2019, residential and commercial natural gas consumption totaled about 390 billion cubic feet. When burned, natural gas releases 117 pounds of carbon dioxide (CO_2) per 1,000 cubic feet. Hence, in 2019, residential and commercial use of natural gas contributed about 23 million tons of CO_2 emissions, roughly one-fourth of the state's overall CO_2 emissions. That is equivalent to six *hours* of world CO_2 emissions. Thus, under the EMP, New Jersey homeowners and businesses will be required to spend billions of dollars per year to replace their natural gas appliances to reduce world CO_2 emissions by a negligible amount. Moreover, because global climate change is, by definition, an issue that affects the entire world, the benefits of few hours' worth of reduced CO_2 emissions will accrue to everyone else outside of New Jersey. Unilateral actions by New Jersey, or even the entire U.S., will have no measurable impact on global temperatures and climate.[42]

Thus, the EMP's claim that mandating that residential and commercial buildings switch from natural gas to electricity will "save" the environment and combat climate change are nonsensical. The evidence that replacing gas furnaces, water heaters, and stoves will improve local air quality and thus prevent death and disease is based on unsubstantiated assumptions. Moreover, the EMP never even considers the additional pollution from the increased electricity New Jersey will require, which will be generated from natural gas and even coal.

While the environmental benefits will be illusory, the economic costs will be only too real. The adverse economic impacts on individuals and businesses from the billions of dollars they will be forced to spend to install heat pumps, electric water heaters, and electric stoves, and the higher prices for electricity that will result from increased electric demand and reliance on costly offshore wind and solar power, will reduce economic growth and cause the loss of thousands of jobs.

Ultimately, the EMP's building electrification mandate will benefit a well-connected few, while the costs will be borne by millions of hard-working residents and businesses. New Jersey should abandon this inefficient and unfair policy goal.

[42] For a discussion, see note 40.