The Case for Natural Gas Pipelines:

An Analysis
of Electricity and Energy Demand and Requirements
in the State of New Jersey

Author: Ellen R. Wald, Ph.D.

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Affordable Energy for New Jersey

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ADVISORS

ABOUT THE AUTHOR

Ellen R. Wald, Ph.D., is an analyst of the energy industry and the intersection of energy and global policy. She earned an AB, magna cum laude, from Princeton University and a Ph.D. from Boston University. She is currently a nonresident senior fellow at the Atlantic Council Global Energy Center, a fellow at the Canadian Global Affairs Institute, the president of Transversal Consulting and a founding partner at Washington Ivy Advisors.

Dr. Wald's past appointments include visiting scholar at University of Cambridge (U.K.), lecturer at Boston University, fellow in economic geology at the American Heritage Center at the University of Wyoming and visiting assistant professor at the University of Georgia. She is the author of Saudi, Inc., a history of the Saudi oil industry. She is also a columnist on energy markets for investing.com, where her insights are read weekly by tens of thousands of traders in multiple languages. Dr. Wald is a frequent contributor to popular discourse on energy, with columns in the New York Times, Bloomberg, Barron's and elsewhere. She appears on television and radio, including on Bloomberg, CNBC and NPR.

She can be reached at:
ellen@washingtonivyadvisors.com
ewald@atlanticcouncil.org

EXECUTIVE SUMMARY

As New Jersey continues its population and economic growth, the state will continue to see a rise in electricity demand and an increased need for heating homes and businesses. This means natural gas demand will rise in the years and decades to come. Natural gas is both the best solution as a baseload fuel for electric power and a reliable heating solution for 75% of New Jerseyans. Natural gas is affordable and relatively clean, and the state must invest in its future. The state must facilitate investment in the easy and dependable transportation of this all-important fuel through dependable and safe pipelines.

Natural gas is the best solution as a reliable and flexible baseload fuel for power generation in New Jersey. It is plentiful in the United States–at current usage rates its reservoirs will outlast the reservoirs of oil in Saudi Arabia. It is relatively clean, emitting less than 75% of the CO_2 emitted by distillate oil and less than 60% of the CO_2 emitted by coal when producing the same amount of electricity.

Pipelines are the optimal way to transport natural gas to and through New Jersey. Maritime and rail transportation are both unreliable options, primarily because of government policies–statutes and regulations. Shipping natural gas by truck is best done when the product is in its liquid form, but that is complicated and expensive because of the physics of the task. On the other hand, natural gas pipelines are reliable and safe, and they continue to become safer as the United States Department of Transportation has made clear. Moreover, the cost savings provided by natural gas pipelines are the priority of New Jerseyans, as polls have shown.

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Energy Demand Growth Expectations

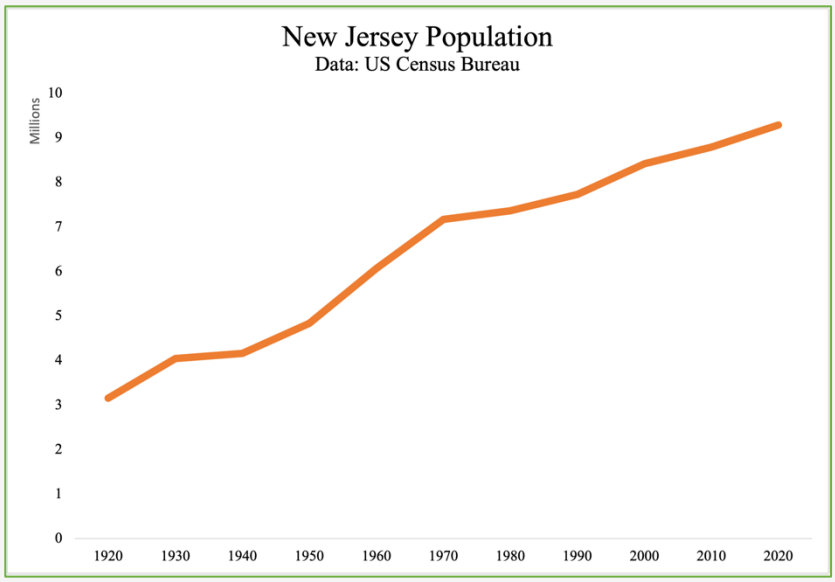
New Jersey should expect that the state's demand for natural gas will increase in the future, with a particular need for natural gas used to produce electric power. At the most basic level, New Jersey has a growing population that is ever more modern and tied to technology. Except for a blip in population growth during the Pandemic, the number of people who call New Jersey home has risen steadily in the last century.

> **Takeaway #1**:
> New Jersey population growth from 2000 to 2020 was almost 1 million, and all signs point to continued growth.

In 1920, New Jersey's population was 3.2 million people. By 1950, the population exceeded 4.8 million. By 2000, the population was more than 8.4 million people, and it

was almost 9.3 million by 2020.[1] All indications are that the population will continue to grow over the coming decades. A growing population means rising demand for energy—both electricity and heating.

Image 1



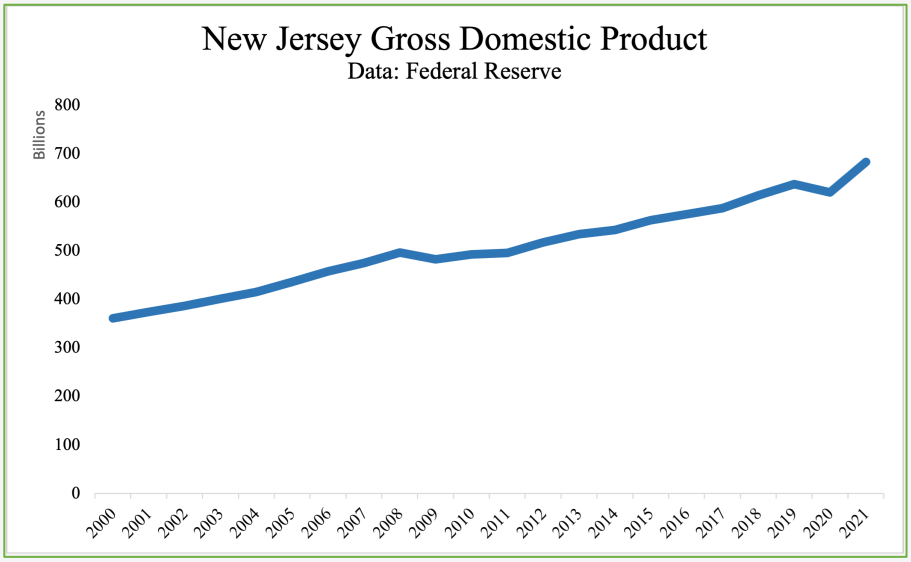
Concurrent with New Jersey's rising population, the demand for fuel has also risen; it will continue to increase. Economic development and the growth and proliferation of technology mean that each person's energy footprint is higher than in the generation preceding it.[2] With greater electricity needs, plus more economic

Takeaway #2:
New Jersey GDP growth from 2000 to 2020 was more than 70%, and all signs point to continued growth.

[1] https://www.census.gov/data/tables/time-series/dec/popchange-data-text.html accessed on February 16, 2023.
[2] See https://fred.stlouisfed.org/series/NJNGSP accessed February 16, 2023.

activity and a growing population, New Jersey will have to deliver more electricity, in addition to heating and other energy needs.

Image 2



Natural Gas Demand Expectations

In New Jersey, natural gas runs head-to-head with nuclear for the largest fuel contribution to the electric grid. In addition, natural gas is also the fuel of choice for home heating in New Jersey. Approximately three out of every four New Jersey households use natural gas as the primary heating fuel, according to the Department of Energy's Energy Information Administration (EIA).[3]

Another reason for the expected increase in natural gas demand over the coming years and decades is the push to further electrify everything that runs on a motor.

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[3] https://www.eia.gov/state/?sid=NJ#tabs-4 accessed on February 16, 2023.

From the increased use of electric vehicles; to new electric heat pumps; to the call for more electric lawn maintenance equipment (California has already banned the sale of most gas-powered mowers); to the increased number of devices and computers, electric power is needed now more than ever. While others have tried to estimate future electricity needs,[4] no estimate can be accurate. What we do know is that electricity demand will increase. As demand for electricity increases, that demand will need to be met largely from natural gas.

Takeaway #3:
EVs, electric heating, cell phones, tablets, and electric everything will create a rise in demand for natural gas-generated power.

Other sources of power cannot be relied upon to meet New Jersey's growing electricity and heating demands. They are either too expensive, unreliable or emit too much pollution. Nuclear power provides a reliable baseload source of energy for the electric grid, but the amount of power derived from nuclear plants is essentially set for the time being. The last nuclear power plant built in the US was completed in 2016, but the next youngest is 20 years older than that.[5] The expense and regulatory burden currently make it difficult to build new nuclear plants. Coal and oil are poor supplements for our electricity needs, because burning them contributes heavily to air pollution. Coal must also be transported by train, truck or barge—expensive and potentially dangerous processes. The price of oil, in particular, is volatile and can be very expensive—oftentimes rising in price just when it is needed most. Alternative energies like solar and wind simply do not provide enough power for our current or

[4] London Economics International LLC, "Final Report: Analysis of Natural Gas Capacity To Serve New Jersey Firm Customers," November 5, 2021.
[5] https://www.eia.gov/tools/faqs/faq.php?id=228&t=21 accessed on February 16, 2023.

future needs. They don't produce energy when the sun does not shine (including every night) or when the wind does not blow, and we still have no ability to store large amounts of solar or wind power when it produces in excess. Battery technology is not advanced enough to store the type and amount of electricity needed by New Jersey's grid. This grid scale battery storage is not likely to be available in the foreseeable or long-term future.

Although nuclear, coal, oil and renewables cannot be expected to meet New Jersey's future energy demand in inexpensive and clean ways, natural gas can. It is the only flexible fuel that can produce more or less power when we need it, is cost effective, minimizes air pollution, and is a reliable energy producer. And, of course, natural gas already heats our homes, keeping three-quarters of all New Jerseyans warm each winter night.

Why Natural Gas is the Best Solution for New Jersey

New Jersey requires fuel for its power grid that can be adjusted so that the grid can provide more power on particularly hot or cold days and less on more temperate days. This is the nature of power grids operating in regions with varying seasons. Renewables and other alternative energies (such as nuclear) are not sufficient to meet New Jersey's demand.

At any point in time, New Jersey may be able to use power produced from these sources, but its options are limited if it produces more power than is needed at any moment. New Jersey cannot effectively store excess power generated (batteries that large do not exist and large battery storage projects have been beset by safety

issues), and New Jersey cannot put off the power generation from these sources to another time when it is needed. Rather, New Jersey has two options for excess power generation:

1) it can let the power go to waste, dissipating it, or

2) it can export the power.

New Jersey, through the regional transmission organization (RTO) called PJM,[6] regularly trades power with regional operators in the Carolinas, Midwest, New York, and Tennessee. Excess solar, wind, hydro, nuclear or other power is traded to one of these regions, because it cannot be stored.

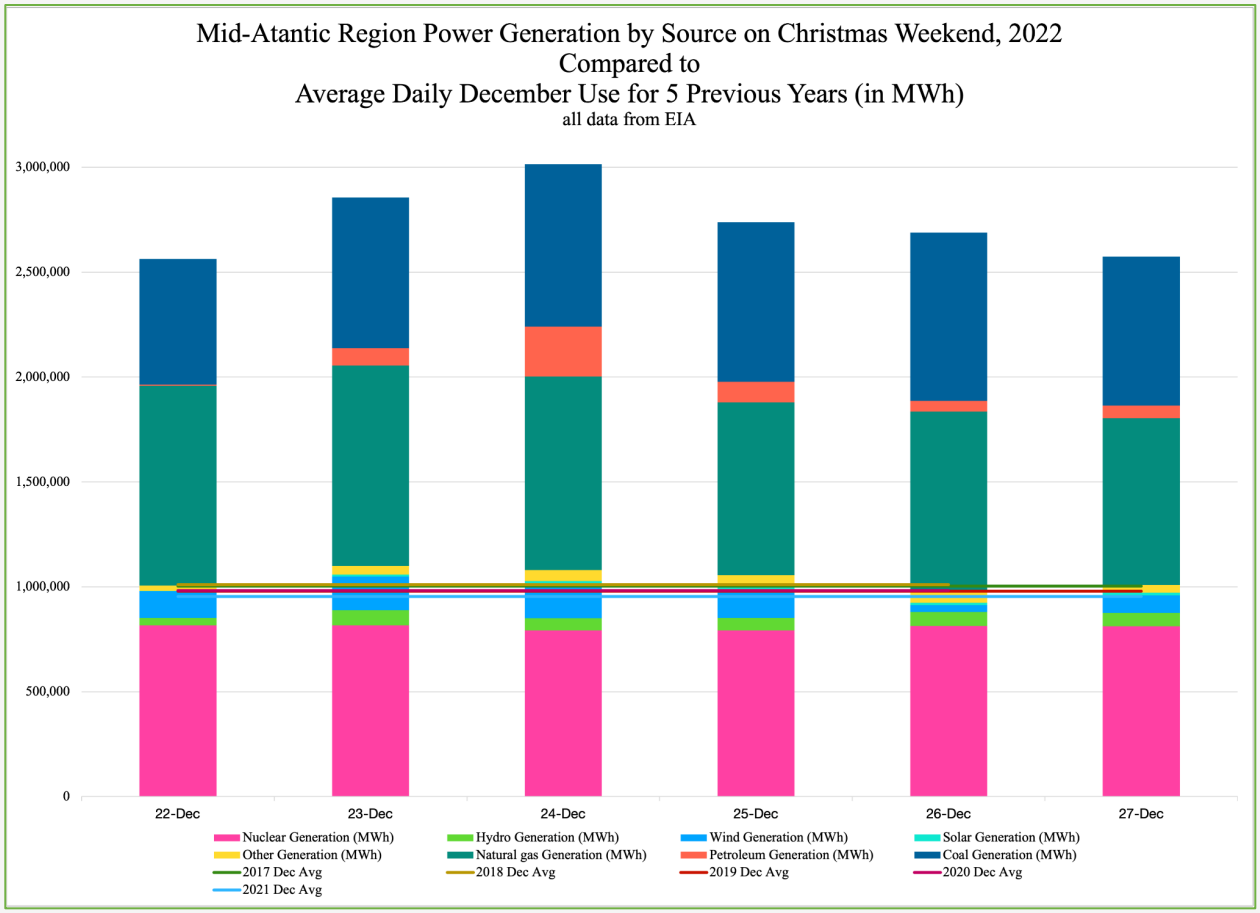
Conversely, natural gas power generation offers much greater flexibility. The power plants can be fed with more or less natural gas to fluctuate with rises and falls in demand. This is also the case for oil and coal, but those are less desirable fuels. The Christmas holiday of 2022 provides a particularly good example for why natural gas is the best fuel to provide New Jersey with the flexible power generation it needs. Christmas that year was on a Sunday. That weekend was very cold in the northeast and much of the country. People were home with their families, and they were heating their homes. Electricity use was generally high as people were using devices, ovens, stoves, refrigerators and electric (and traditional) heaters. The Mid-Atlantic region and most of the country saw significant rises in power usage as well as demand for heating.

Takeaway #4:
Natural gas is a flexible baseload fuel that can be fed to the power plant in greater or lesser amount depending on demand.

[6] https://www.pjm.com

The graph below shows the mix of power generation for the Mid-Atlantic region over the Christmas holiday in 2022. The bars represent the power generation mix for that time in 2022. The horizontal lines represent average December use in the region for 2017 through 2021. Notice that nuclear and the renewable energies only suffice to cover the needed power for a typical December day over the previous five years. They are not sufficient to cover the energy needs during a cold spell.

Image 3



About half of the days require more power in the grid than a typical day. On those days, legacy fuels such as natural gas, oil and coal are necessary, and natural gas is by far the most preferred of these options. Natural gas, oil and coal are flexible fuels that can be fed to the power plants in greater or lesser amounts depending on demand. It is necessary to have these options. Natural gas is the best of these options, but when there is not enough natural gas—when it is cold and when not enough natural gas is imported into the New Jersey region because of transportation restrictions such as insufficient pipeline capacity—the power producers must use oil and coal which pollute more and can be significantly more expensive.

Takeaway #5:
Restricting the availability of natural gas forces power plants to burn more coal and oil at the expense of the environment.

The evidence that natural gas is superior to oil and coal is substantial. From the Department of Energy's own website:

> *Burning natural gas for energy results in fewer emissions of nearly all types of air pollutants and carbon dioxide (CO_2) than burning coal or petroleum products to produce an equal amount of energy.*[7]

[7] https://www.eia.gov/energyexplained/natural-gas/natural-gas-and-the-environment.php accessed on February 16, 2023.

The EIA further explains that when natural gas is used, about 117 pounds of CO_2 are produced per million British thermal units (MMBtu, a measure of energy). Comparatively, the numbers are more than 200 pounds CO_2 per MMBtu of coal and more than 160 pounds per MMBtu of distillate fuel oil.[8] Moreover, natural gas is abundant domestically. According to the EIA, the United States has almost 3 quadrillion (3,000,000,000,000,000) cubic feet of recoverable natural gas. At the current rate, the United States is expected to have enough natural gas for about another century,[9] which is three decades longer than Saudi Arabia's oil resources are expected to last.[10]

Takeaway #6:
Natural gas is relatively clean. When producing the same amount of electricity, natural gas emits:

- 75% less CO_2 than distillate oil
- 60% less CO_2 than coal.

Takeaway #7:
Natural gas is plentiful in the U.S. U.S. natural gas reserves will outlast the oil reserves in Saudi Arabia.

Pipelines are the Best Way to Transport Natural Gas

Natural gas can be transported four ways—by ship, by rail, by specialized tanker truck or by pipeline. Pipeline transportation is the best option. The particular issues presented by transporting natural gas are explained by Penn State University's Global Energy Enterprise:

> *As a gas, the low density of natural gas presents special challenges for transportation. Because of its*

[8] Ibid.

[9] https://www.eia.gov/tools/faqs/faq.php?id=58&t=8 accessed on February 16, 2023.

[10] https://www.nytimes.com/2018/05/08/opinion/saudi-aramco-ipo-independence.html accessed on February 16, 2023.

volume, it is not easily stored or moved by vehicle. For transportation across land, natural gas is usually moved through a network of pipelines. For transport across bodies of water, it is liquefied and carried by ship.[11]

Below is a look at each mode:

Ship

Natural gas is often transported internationally by ship. For instance, Qatar is often among the world's top natural gas exporters, and it exports much of its natural gas by ship. The process is more complicated, because it must be shipped in the form of liquified natural gas (LNG). Gas becomes liquified when it is cooled to -260° Fahrenheit (-162 C). At this temperature, LNG takes up one six hundredth of the volume of the gaseous version.

To transport natural gas by ship, it first must be transported to a port, liquified at a liquefaction facility, loaded as a liquid onto the ship, transported to its destination, unloaded to a re-gasification facility, turned back into a gas, and transported

Takeaway #8:
Liquified natural gas (LNG) is the preferred way to transport natural gas by ship, train or truck, because LNG takes up 1/600 the volume of the gaseous version. LNG means cooling the gas to an incredibly low -260° Fahrenheit.
Pipelines do not require this process.

[11] https://www.e-education.psu.edu/eme444/node/347 accessed on February 20, 2023.

to its destination.[12] This process adds time and cost and is limited by access to a regasification facility, which is not available everywhere. According to the Department of Transportation, there are no LNG regasification facilities (import terminals) in New Jersey. The closest LNG regasification facilities are in Massachusetts and Maryland, so that would still require further transportation of the gaseous form of natural gas to arrive at New Jersey.[13]

Moreover, the transportation of domestically produced natural gas (or LNG) to New Jersey by ship is complicated by a statute often referred to as the Jones Act. Also known as the Merchant Marine Act of 1920, the law states, among other things, that shipping between U.S. ports must be conducted by U.S. flagged ships.[14] Due to the lack of appropriately fitted ships and U.S. regulations, the Jones Act makes it nearly impossible to rely on shipping of LNG between states, so states like New Jersey cannot rely on maritime shipping to access America's abundance of natural gas. Rather, maritime shipping would require a state like New Jersey to import LNG from countries like Russia and Qatar.

Takeaway #9:
The Jones Act makes it nearly impossible for New Jersey to receive U.S.-produced natural gas—in any form—by ship. Therefore, maritime shipments would require importing energy from countries like Russia and Qatar.

[12] In some cases, the liquefaction or regasification facilities are located farther inland. In such cases, the natural gas may be transported over land as LNG for part of its journey. Typically, the liquefaction and regasification facilities are located at or near ports.

[13] https://www.npms.phmsa.dot.gov/Documents/LNG_AR_Eastern.pdf accessed on February 19, 2023.

[14] 46 USC § 50102

Rail

The Biden administration has opposed transportation of LNG by rail because of safety concerns.[15] Originally, the Trump administration had permitted this type of transport in 2020, but this action raised concerns among a coalition of state attorneys general. Serious safety concerns remain about transporting natural gas in liquid form over rail, and the future legality and possibility of LNG shipments by rail is still uncertain. This is not something upon which policy or business decisions can rely.

Truck

Shipment of natural gas by truck is also extremely complicated. Because it is hard to keep the cargo cold enough to remain in liquid form, the process of shipment requires specialized tanks and actually allows vapors of natural gas (while it is at the boiling point between liquid and gas) to escape the tank, thus leaving the rest of the tank's cargo as a liquid. Transportation by tanker truck is possible but not ideal.

Pipeline

Pipeline is the preferred mode of transporting natural gas, both for economic and safety purposes. The engineering behind these natural gas pipelines can be understood by looking at the importance of compressing the gas along the route of the pipeline to ensure continued expedited movement of the gas. Thus, natural gas

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[15] https://www.federalregister.gov/documents/2021/11/08/2021-23132/hazardous-materials-suspension-of-hmr-amendments-authorizing-transportation-of-liquefied-natural-gas accessed February 20, 2023.

pipelines have compressor stations along the route that serve to receive the transmission flow, increase the pressure which has decreased over the last span of pipeline, and then send out the newly re-pressurized gas to continue its journey.

Takeaway #10:
Pipelines are a safe way to transport natural gas. In 2021, there were only 0.013 serious incidents per 1000 miles of natural gas pipeline.

The U.S. Department of Transportation Pipeline and Hazardous Materials Safety (PHMSA) regulates pipeline safety across the country and works with state regulators to ensure the highest standards of safety are in place. According to the Department of Transportation, pipelines are the safest way to transport natural gas. Federal regulations require multiple levels of safety procedures and protections for pipelines operating in the United States. Some of these include corrosion protection, right-of-way patrols, regular leakage surveys, odorization, 24-hour pressure and volume monitoring and integrity management in high impact areas.[16] According to PHMSA, pipelines have gotten safer. The number of serious incidents per 1,000 mile of gas transmission lines has been declining since 2005, with a sharp decline after 2010. In 2021, there were only 0.013 serious incidents per 1000 miles of natural gas pipeline.[17]

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[16] Pipeline Basics & Specifics About Natural Gas Pipelines, Pipeline Safety Trust, https://pstrust.org/wp-content/uploads/2015/09/2015-PST-Briefing-Paper-02-NatGasBasics.pdf, accessed March 7, 2023.

[17] "Gas Transmission Serious Incidents per 1,000 Miles," US DOT Pipeline and Hazardous Materials Safety Administration, https://portal.phmsa.dot.gov/analytics/saw.dll?Portalpages&PortalPath=%2Fshared%2FPDM%20Public%20Website%2F_portal%2FGT%20Performance%20Measures&Page=Serious%20Incident%20Rate%20and%20Cause, accessed March 7, 2021.

New Jersey Residents Want Natural Gas

In January of 2023, National Research Inc. conducted a statewide survey of New Jerseyans about their notions and preferences for energy.[18] The numbers overwhelmingly support increased commitment to and investment in natural gas infrastructure and supply. Here are some of the most relevant data:

- 62% of New Jerseyans saw natural gas very favorably or somewhat favorably.
- Every demographic surveyed—men and women of all ages and all types of suburbanites—expressed favorable impressions of natural gas. Even suburban women in New Jersey were 55% in favor of natural gas.
- When asked for the best energy source for New Jersey, a plurality of respondents (32%) said natural gas.
- Oil (3%) and coal (2%) were the least favored energy sources even though those are the sources that would be needed in the event of a natural gas shortage.
- Women 35+ said they preferred natural gas more than any other energy source (35%).
- New Jerseyans do not want higher utility bills. 68% responded that they strongly or somewhat oppose an increase in power bills to, "move toward more wind and solar power."
- Support for solar and wind energy faltered in the face of rising costs. 73% of African American men backed away from support for wind and solar when

[18] National Research Inc., New Jersey Statewide Survey, Mixed Mode Survey, Fielded: January 12, 14-17, 2023.

confronted with an increase in utility bills. 70% of liberals changed their minds as well. Put simply, New Jerseyans prioritize affordability. Even those, like liberals, who might traditionally claim support for solar and wind chose affordability over renewables when given the option.

- 78% of New Jerseyans oppose a ban on natural gas. New Jerseyans understand the benefit of natural gas.
- 77% of New Jerseyans support the construction of a natural gas pipeline that would lower energy costs by thirty percent.
- 80% of New Jerseyans support the construction of a natural gas pipeline that would, "significantly reduce overall emissions."

Takeaway #11:
New Jerseyans want cost effective power.
A plurality of respondents think natural gas is the best source of energy for New Jersey.
All demographics support the construction of natural gas pipelines when faced with cost savings.

It is clear that New Jerseyans prioritize their own and their family's economic well-being, and they do so by a fairly wide margin. They want a healthy and clean environment, and, most of all, they want affordable access to power. In short, they want natural gas and that means pipelines.

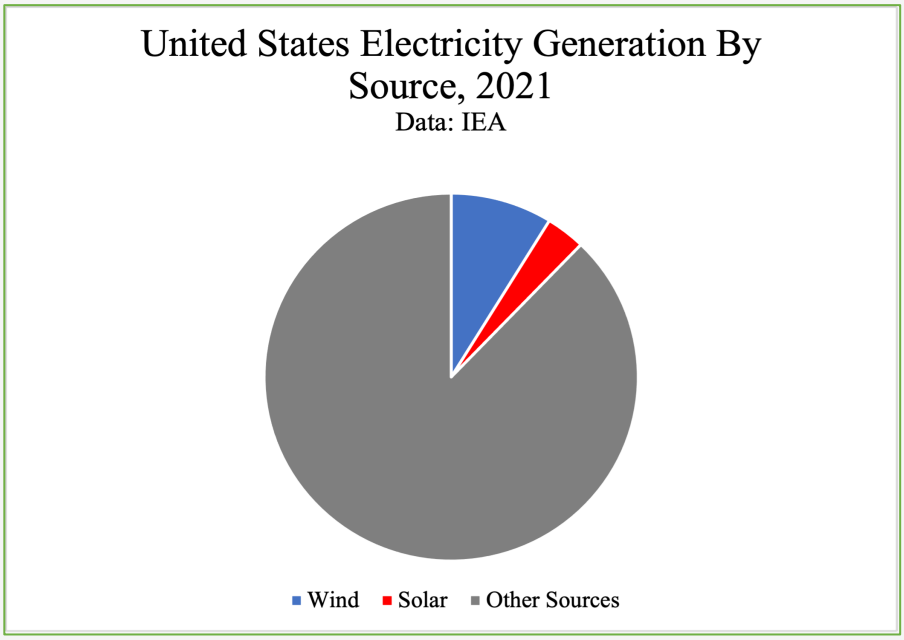
The Technology is Not Available to Replace Legacy Fuels with Alternatives

According to the International Energy Agency (IEA), as late as 2021, wind and solar power only contributed 8.8% and 3.4%, respectively, of the total United States

power production.[19] According to the EIA, "Nonhydroelectric Renewables" (mostly wind and solar) contributed 2.9% of power production in New Jersey in November, 2022.[20] Comparatively, natural gas contributed 47.9% of power production in New Jersey in November, 2022.[21] Wind and solar cannot replace the power generated by natural gas. There is not enough wind and solar power generation to meet demand.

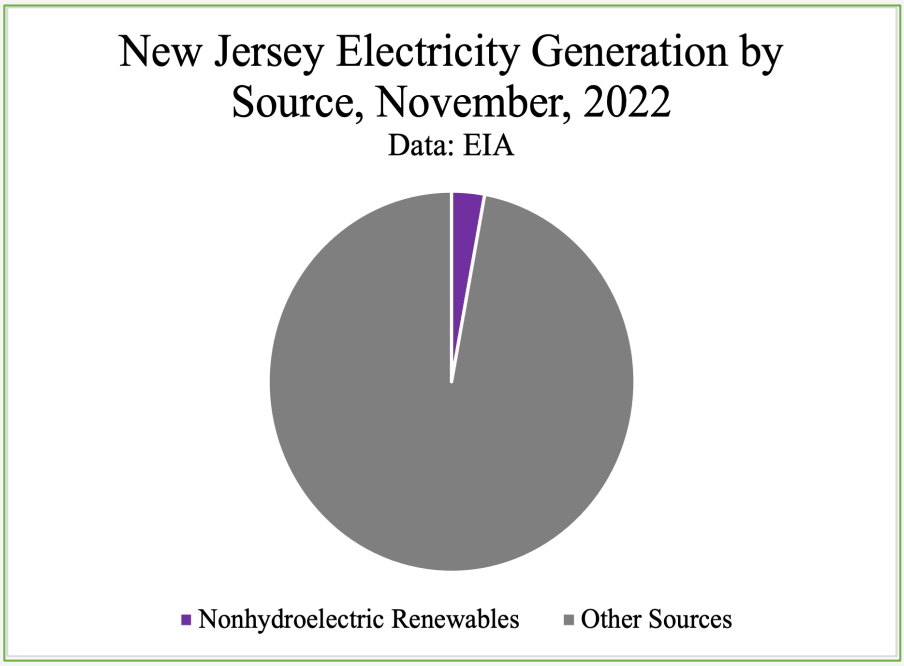
Takeaway #12:
To reach the point where wind and solar could provide sufficient energy, we would need to blanket the land with turbines and solar panels. New Jersey would no longer look like New Jersey.

Image 4



[19] https://www.iea.org/countries/united-states accessed on February 20, 2023.
[20] https://www.eia.gov/state/?sid=NJ#tabs-4 accessed on February 20, 2023.
[21] Ibid.

Image 5



To reach the point where wind and solar could provide sufficient energy, we would need to blanket the land with turbines and solar panels. New Jersey would no longer look like New Jersey. The vista from the Shore would be spotted with wind turbines. The physical disruption needed to increase wind and solar power in that way would be far more drastic and disruptive than building new natural gas pipelines, which are not scars upon the landscape.

Even if we covered the land and the coastline in wind turbines and solar panels, New Jersey would still need fossil fuels to meet demand. Wind does not always blow. Sun does not always shine (especially at night). When the elements don't cooperate, those sources cannot provide power, and there is currently no effective way to store power for such times. In other words, no battery has been invented to store that

amount of power to provide wind and solar electricity when the wind does not blow and when the sun does not shine.

Even California, which often obtains a majority of its daytime power from a combination of wind and solar, still burns fossil fuels. In addition to producing its own solar and wind power, California imports renewable power from nearby states such as Wyoming. But at night, when there is no sunlight—and especially when the wind is less powerful—California burns natural gas and coal to keep the lights on.

This is because no one has discovered a way to store wind and solar power effectively and efficiently when it is generated for times when it is needed. We don't have those batteries, and we do not know if or when we will. The same can be said for nuclear and hydropower—we cannot effectively store excess power production—but neither of those sources of electricity ever drop to zero production like wind and solar.

Wind and solar are not flexible sources of power. They cannot be adjusted to increase electricity production when demand calls for it or decrease electricity production to conserve when it is not necessary. On the other hand, natural gas is a flexible source of power. It can be conserved for when it is needed, allowing power production to meet demand. When there is excess wind and solar power, the only options are to export it on the interchange (if someone else wants it) or to let it go to waste.

Takeaway #13:
Solar and wind power cannot be adjusted to meet demand, and excess solar and wind energy cannot yet be effectively stored. But natural gas is a flexible source of energy that can be safely and effectively stored.

Natural gas can easily be stored for later use, as long as transportation systems are in place.

Another drawback of wind and solar power is the destruction they cause to animals' natural habitats. New Jersey has seen a spate of deaths among whales in the ocean around its Shore since December, 2022.[22] These are most likely connected to the installation of wind turbines off the coast. Wind turbines have also been blamed for the deaths of thousands of birds including protected birds like bald eagles. Migratory animals are particularly susceptible to death and injury from wind turbines, as the turbine blades regularly slice apart birds in mid-flight. Solar panels are also destructive both because large arrays require that the natural habitat be completely bulldozed and because the intense heat caused by the reflection in solar thermal installations, in particular, often burns birds as they fly by. Wind and solar power do not come without very real harms to our planet and the animals we share it with.

A Warning: The Folly of New England's Natural Gas Pipeline Policy

New Jersey only need look to nearby states to see the importance of investing in natural gas pipeline infrastructure. In particular, the New England region presents a stark warning. Due to a series of policy decisions, New England states have made it nearly impossible to build new natural gas pipelines in the region. As a result, when temperatures dip, which they often do in New England, the region faces significant challenges meeting demand for power and heating with natural gas. During these

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[22] https://www.nj.com/news/2023/02/another-dead-whale-washes-ashore-in-ny-nj-region.html accessed on February 21, 2023.

periods, power plants in the region must burn oil and coal. The increased costs associated with these fuels are passed down to residents in their utility bills.

The nonprofit regional transmission organization for New England, ISO-New England, has called attention to this problem, stating that:

> *During the last few years, inadequate infrastructure to transport natural gas has at times affected the ability of natural-gas-fired plants to get the fuel they need to perform. This energy-security risk has become a pressing concern in New England, considering the major role natural-gas-fired generation plays in keeping the lights on and setting prices for wholesale electricity.*[23]

There have been major environmental and cost benefits for New England over the last few years. The lack of new infrastructure—which is the fault of policy decisions by the legislatures and regulators—has meant shortages in the winter, higher utility bills for residents and a reliance on oil and coal when the weather changes.

Again, it is useful to look at the Christmas holiday of 2022, when cold weather highlighted some of the problems that New England faces as a result of policy decisions that prevent new natural gas pipeline construction. Below is a graph of power generation by source for that holiday period in New England.

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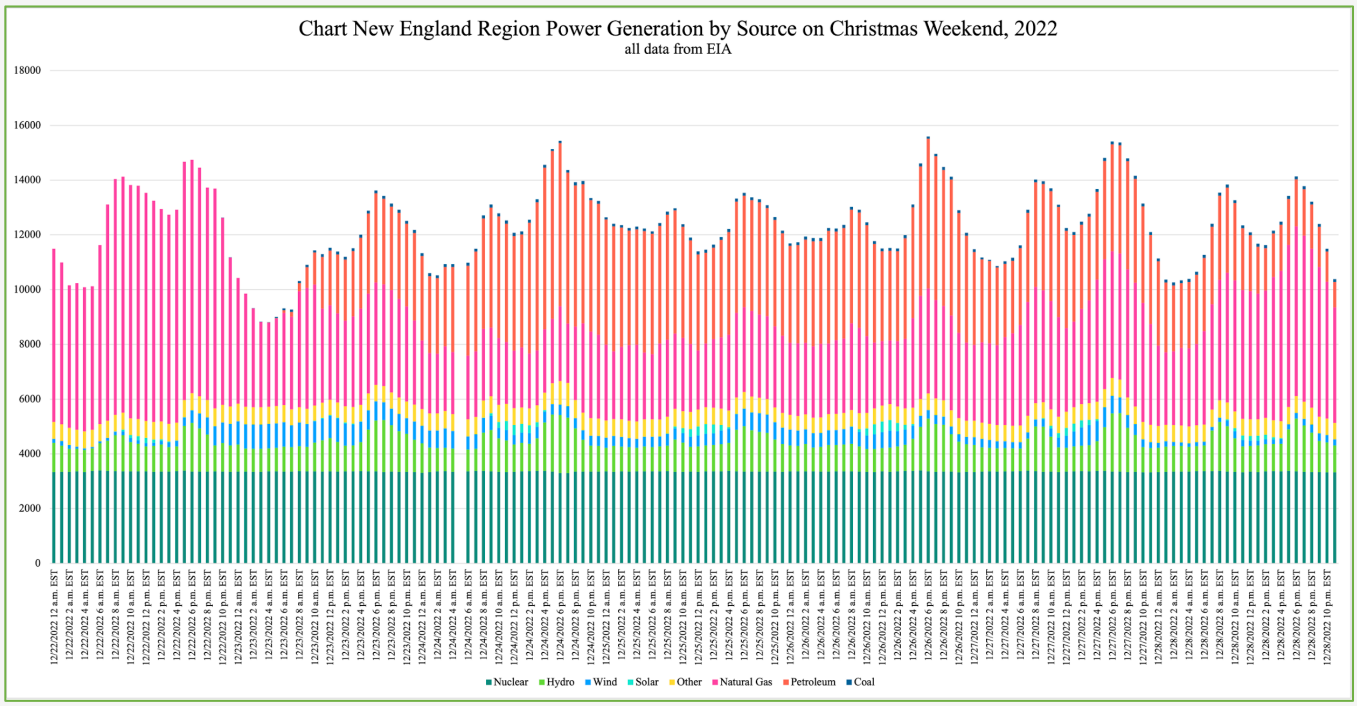
[23] https://www.iso-ne.com/about/what-we-do/in-depth/natural-gas-infrastructure-constraints accessed on February 21, 2023.

Image 6



Starting from the bottom of the graph, nuclear provides a steady baseload of power, but it is not enough to meet the demand in New England. Hydro, wind, solar and other also provide power, but still not enough. Natural gas is the most important baseload fuel. On the left of the graph, it shows that natural gas met demand on December 22. Natural gas is a flexible fuel that can be fed to the power plants in greater amounts when needed and less when demand wanes.

New England's problems that December began when the temperatures dropped on the morning of December 23. With people home for the holiday, there was a large demand for both electricity and heating. Due to insufficient pipeline capacity in the region, they could not obtain enough natural gas to both power the electric grid and heat the homes and businesses. At that point, the region was required to burn large

amounts of oil and even some coal. Petroleum and coal joined natural gas as the flexible fuels to meet demand. Costs for end users (the residents of New England) rose, and pollution was exacerbated.

CONCLUSION

The New England scenario, drawn out to its long-term conclusion, would lead to high utility bills, darkness and cold. Demand will grow as the population and economy continue to grow and as more electricity is needed to power ever more things—EV's, computers, phones, home theaters, electric heaters, etc. Yet, alternative energies are not sufficient to fuel this growth and to power a New Jersey of the future. Only legacy fuels such as oil, coal and natural gas provide the flexibility to adjust production based on need. And of those, only natural gas is desirable from an economic and environmental standpoint. But New Jersey must be prepared for and commit to continually improving its natural gas delivery and transportation infrastructure. This means new pipelines. Any other decision is akin to sentencing New Jerseyans to expensive utility bills, darkness and cold.