A Compelling Vision of New Jersey's Clean Energy Future

Comments on New Jersey's Draft Energy Master Plan

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I. Overview

The role of the Energy Master Plan (EMP) is to provide a compelling vision of New Jersey's clean energy future, and serve as a blueprint for how to deploy clean energy resources in a manner that will most effectively reduce emissions associated with electricity consumed in New Jersey, while increasing the use of clean electricity in transportation and building sectors.

To fulfill this vision and blueprint, the EMP should be based on the BPU's Integrated Energy Plan (IEP) and its analysis of the most cost-effective pathways for achieving deep decarbonization of New Jersey and, in parallel, the regional electric grid. This analysis will show a variety of technology deployment pathways that will best reduce emissions while maintaining the balance between electricity production and consumption that is essential for reliability. In this way, it will enable policymakers to identify clean technology deployment strategies for the next decade that make the best use of today's clean energy technologies — such as solar, wind, flexible load and storage. These strategies should be designed to be highly effective at reducing carbon emissions at low and reasonable costs in the foreseeable future, and to support full achievement of the state's decarbonization and clean energy goals for mid-century, as innovation produces new clean energy technologies with even better performance and lower costs than today's increasingly competitive clean resources. The three-year cycle of the EMP, coupled with parallel cycles of updated integrated energy planning, will help ensure that the state can continue to identify and stay on the best technology pathway to achieve success, with continuous updating of policies and practices as warranted. This combination of a compelling vision, policy certainty for current investments that are best suited to driving affordable decarbonization, and guidance for the types of innovation and additional deployment that will be needed in the future, will put New Jersey on a path to success that eliminates almost all fossil fuels by 2050.

New Jersey no longer has to choose between policies that protect community health, natural resources and our climate, and those that protect our pocketbooks.

A growing number of studies[1] demonstrate that clean energy resources, if combined in an

[1] Over the past few years, policymakers and advisors in other states have used new modeling tools to identify optimized portfolios of clean energy resources that achieve a given emissions constraint, such as 80% reductions by 2050. These models simulate the energy production needed to balance load and provide reliable service over long timeframes, based on different combinations of primarily renewable resources. These studies show that an optimized mix of today's flexible clean resources — flexible load, batteries, other types of storage, demand response and transmission, can provide needed flexibility for limited time periods, while innovation in emerging "clean firm" (dispatchable) technologies can provide the flexibility needed for longer periods. Another important finding from these studies is that an optimized portfolio of clean energy resources also saves money over a gas-heavy business as usual, even assuming continued low costs for natural gas. One study of Minnesota policy and the larger electric grid found that a variety of scenarios not only achieve emissions reduction of 91% by 2050 while maintaining a reliable electric grid, they also produce savings of between $600 to $1,200 per Minnesotan household per year by 2050. See "Minnesota's Smarter Grid - Pathways Toward A Clean and Affordable

optimized portfolio of renewables, storage, flexible load and, eventually, emerging "firm clean" energy resources, can decarbonize the power sector at costs that are comparable to, or below, those that continue to rely on fossil fuels. We can reduce costs and reduce emissions if the energy master plan focuses on growing an optimized portfolio of renewable energy, flexible load, and electrification of key sectors of our economy. As new technologies evolve and costs change, future updates to this planning process will help us stay on an evolving low cost, reliable path to success, despite an unpredictable future.

Relying on clean energy to reduce costs may seem surprising to stakeholders accustomed to paying considerably more for renewable energy than for natural gas generation. But not only will a gas-heavy electric grid cost more than a well-balanced renewable energy-based future, the cost advantage of clean energy portfolios means new gas assets face the very real risk of becoming financial disasters for their investors and owners after 2030, if not sooner. Recent reports by the Rocky Mountain Institute provide new details about risks to investors. The report found that carbon-free resources are now cost-competitive with new natural gas plants and that clean energy portfolios will be cheaper than 90% of 88 proposed gas-fired projects across the U.S. As a result, natural gas investments may result in costly stranded assets. We also recognize that significant amounts of gas-fired electricity production are incompatible with the deep decarbonization needed to preserve a healthy planet and a vibrant *economy*.

To ensure continued and broad public support for clean energy and decarbonization over the next thirty years, the EMP needs to both underscore and make maximum use of these low cost solutions. They fall into the following two critically different but complementary categories:

Costs for renewables continue to fall.

The levelized cost of energy (LCOE) is widely used to compare the cost of different energy resources. For decades, the LCOE of renewables has been far above that of fossil resources. Now, however, the LCOE of the most competitive renewables falls well below that of new fossil technologies, even before tax credits.[2] While LCOE comparisons between renewables and dispatchable generating technologies are not the only metric that matters, it is indisputable that falling costs have made wind and solar technologies, in cost-effective applications and locations, cheaper than current market prices for electricity. [3] This suggests that cost is no longer the greatest barrier to renewable energy deployment. Instead, an important barrier is the current oversupply of existing, GHG emitting wholesale market coal and gas plants which, with significant renewable deployment and

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Transportation and Energy System", July 2018, prepared by Vibrant Clean Energy, LLC, for McKnight Foundation and GridLab, available at: https://www.mcknight.org/wp-content/uploads/MNSmarterGrid-VCE-FinalVersion-LR-1.pdf

See also, Williams, J.H., Jones, R., Kwok, G., and B. Haley, (2018). Deep Decarbonization in the Northeastern United States and Expanded Coordination with Hydro-Québec. A report of the Sustainable Development Solutions Network in cooperation with Evolved Energy Research and Hydro-Québec. April 8, 2018. https://www.evolved.energy/single-post/2018/04/09/Decarbonizing-the-Northeast-and-Coordination-with-Hydro-Qu%C3%A9bec.

[2] https://www.lazard.com/perspective/levelized-cost-of-energy-and-levelized-cost-of-storage-2018/

[3] See sources cited at fn. 11, below.

without significant retirements of those plants, will lead to prices and revenues below the cost of even the cheapest renewables.

Costs for clean flexible resources continue to fall and can balance new renewable supply with demand, without the use of natural gas.

Large growth in renewables and retirement of existing fossil plants will create a need for controllable, flexible resources that can ensure generation and consumption are always balanced in real time. Today, gas fired power plants contribute most of this flexibility. But the rapidly falling costs for battery storage and digital technologies that can automatically shift when and how much electricity is consumed offer increasingly cost-effective ways to provide the needed flexibility without burning natural gas. Many experts anticipate a growing supply of such clean, low cost flexible load as buildings and transportation become electrified.

It is the right mix of these two types of new, low cost and growing clean energy resources - variable renewable energy, with its production smoothed out and balanced by flexible load and storage, that offers the opportunity to deploy high levels of renewable energy, without jeopardizing reliability, and at costs that are increasingly anticipated to be below the cost of a gas-dependent business as usual power sector.

The EMP's fundamental role is to identify the best mix — the best clean energy portfolio — of these two categories of clean energy resources, together with existing and emerging dispatchable clean energy resources, to achieve the fastest decarbonization at the most reasonable costs. In this way, the EMP will play a key role in driving a true clean energy revolution in New Jersey and in the entire regional energy system. But to achieve this revolution, from clean energy being the more expensive to the least expensive choice, and from our entire electric energy system comprising dispatchable, centrally delivered fossil fuel electricity to an optimized portfolio of clean supply side and demand side resources, will require major changes in how we think about energy planning and energy policy development:

New analyses and planning tools have emerged to address precisely these problems.

Planning tools have been developed that simulate the electric grid operation every hour, each year until 2050 and beyond, ensure that the generation and consumption of electricity balance in every hour, and solve for the least cost mix of resources capable of producing these results under a variety of weather and demand conditions – while also meeting pre-specified annual and cumulative GHG emission budgets. These models enable planners to set an emissions goal for 2050 and solve for the changing mix of resources that achieves those goals at least cost/best fit. These tools will enable progress on deep decarbonization to accelerate in portions of the Eastern U.S. Such tools provide guidance to state policymakers about evolving mixes of clean energy resources that can achieve high levels of decarbonization at low or even falling costs to consumers, while economically replacing retiring fossil plants without the need for new, more expensive gas plants to maintain reliability.

Using a coordinated regional approach to assembling such clean energy portfolios allows even states and regions with more expensive local renewable resources to participate in and benefit from the development of large and diverse clean energy portfolios and thereby accelerate their own decarbonization along with that of their regional electric grid.

Regional coordination can leverage market dynamics to accelerate decarbonization.

Shared insights from the coordinated use of these new tools are particularly important for deregulated states in the eastern U.S. seeking to have a greater impact on the aggregate regional mix of resources that provides much of the power consumed in those states, and that is responsible for a significant share of total U.S. CO_2 emissions. Such states, due to their high degree of electrical interconnection, need to avoid uncoordinated aggregate investments that could create unanticipated crises - such as a massive "PJM duck curve" with high costs, challenged reliability, and delayed decarbonization. Instead, states need to find mutually beneficial investments that will be part of a growing, optimized regional clean energy system. And, since such states have wisely decided to use market forces to provide competitive aspects of electric service, rather than relying on pushing recalcitrant monopoly utility providers to try to make all clean energy investment, they can collaborate as well on creating market-friendly incentives and market dynamics that will accelerate decarbonization by driving the private sector investment, as well as supportive utility infrastructure, needed to make clean energy portfolios a reality.

Using these market dynamics to accelerate regional decarbonization will make critical market reforms easier to achieve.

Current regional capacity markets were not designed to support the type of clean energy portfolios discussed above. Instead, they can fail to treat clean energy portfolios as virtual power plants and they delay the retirement of outdated, inefficient fossil plants, whose oversupply acts as a long-term barrier to entry for clean energy portfolios. Reform of capacity markets to support the development of optimized portfolios of clean energy resources, driven by coordinated state policies and plans, is urgently needed.

But low-cost clean energy portfolios will work primarily through current wholesale energy markets, which are relatively efficient and non-discriminatory, to make both existing and new fossil resources less preferred, for investors and developers, and to shift their focus to developing additional clean energy portfolios, for purely economic reasons. And clean energy portfolios' lower costs and enhanced reliability performance should provide a powerful demonstration of the need for deep reform in regional capacity markets themselves, supporting the state's market reform goals in ways that higher cost, stand-alone renewable investments or isolated nuclear plant support policies have not been able to. Collaborative planning and complementary clean energy portfolio policies among several states in the region can only increase the cost-effectiveness, energy market dynamics, and capacity market reform benefits of New Jersey's development of clean energy portfolios.

New policy approaches are needed.

With an EMP that lays out a blueprint and core policy proposals for achieving this kind of transformation, New Jersey is poised to act as a catalyst for decarbonization throughout the entire region and, indeed, the entire US power sector. But this will require going beyond policies used for the last twenty-five years, and especially beyond policies that were developed for vertically integrated monopoly utilities that own all their generation and operate their own control area. Instead, as a restructured state with ambitious climate goals in a region served by a large, single wholesale electricity market, New Jersey must now address a range of complex new policy challenges. New policy approaches are needed to ensure success, and to avoid unintended consequences such as, by shutting down gas plants and increasing variable renewable energy generation, inadvertently shifting emissions to increased gas use in neighboring states. Other similarly situated states with ambitious clean energy goals are looking for new policy solutions that will work in their states and in their regional grid, as well. Through the EMP, both in its role as a blueprint and in its role of kicking off robust work to develop new policies to achieve that blueprint, New Jersey has the potential to play a major leadership role in developing truly effective regional solutions that will help ensure timely decarbonization in our entire region.

Natural gas has a new role - to ebb gracefully - as electrification and cleaner alternatives grow.

As natural cost advantages and effective state clean energy policies help drive the development of new clean energy portfolios, energy markets will dispatch gas and coal plants less often. Deteriorating economics will lead to fossil plant closures. Equally important, altered economics will make proposed new gas projects less and less attractive to debt and equity investors. Similarly, new policies designed to shift building heating from natural gas toward electric systems will create a new challenge and new opportunities for regulators and management of gas utilities - how to support the transition to zero emitting alternatives in ways that respect the urgent need to decarbonize, while providing equal or better energy services to customers and communities.

II. Energy planning and policy in the emerging clean energy era

The two core roles for the EMP are to provide a comprehensive, integrated blueprint for developing a zero-carbon energy system, and to propose policy concepts that could best achieve the core elements of that system. By necessity, many of the policies needed to achieve these goals will be new, since they will need not only to support more investment in new types of clean energy resources, but to also support the right mix of a growing variety of those resources.

This means a new approach to policy is needed, one in which optimized solutions are front and center — solutions that achieve emissions reductions while preserving reliability and minimizing costs. These solutions will include new ways to identify the amount of each clean energy resource needed, along with its type, location, cost and function. This is a radical change from the historical power supply planning challenge of determining the right mix of baseload, intermediate and peaking resources, net of cost-effective energy conservation investments, and an even more radical change from assuming that the invisible hand of the market will, all by itself, get the generation mix right.

In this radically different clean energy future, planning and policy-making will be significantly different than they are now. Instead of dealing with well-known technologies and proven policies that must simply be extended, amplified or revised, New Jersey will be dealing with entirely new types of energy systems that will need entirely new types of policies to achieve them. In such a world, planning needs to anticipate the variety of futures that could realistically evolve, and understand the differences between them and what is likely to cause those differences. And, instead of picking one winning future to bet on, the state's clean energy plans need to envision pathways to a clean energy outcome that will work across all those futures. For example, effective plans will need to describe how to achieve emissions goals in a future in which offshore wind faces technical hurdles or delays; aging nuclear plants are unable to continue operating; or EV adoption is slower than expected.

Policies, in turn, need to evolve in a thoughtful and careful manner to provide the incentives and rules that will support successful deployment, of an optimal mix of clean energy resources across those different futures, rather than in just one of them. Planning and policy making in such an environment means that the planning has to precede the policy making. Otherwise it would not be possible to design policies to succeed across various optimal future scenarios revealed in the planning process. Thus, it is important to keep in mind a clear distinction between planning and policy.

A plan is a well-considered approach or strategy for achieving one or more goals in the real world. A policy is one or more means, promulgated by a duly authorized government authority, to either mandate or incentivize the achievement of those goals or some interim step on the way to their achievement. A plan is like a selected route on a map, policies are specific set of orders or actions needed to get the troops moving on that route. A plan is like a blueprint, while policies are the contracts with the building trades that specify how the building will actually be built, by who, and subject to what performance and compliance requirements. Critically, policies should specify how to modify the blueprint and the contracts themselves if a better building material or design becomes available during construction.

While a plan can be put together by a committee representing various state agencies, many of the specific policies needed to implement the plan generally can only be made under specific statutory authority by various agencies through means that afford due process to affected parties and the public. Given the diversity of responsibilities and skills among the various agencies, it will be critical to ensure the ongoing coordination and collaboration, where necessary, among state agencies to ensure these policies work together to achieve the state's goals. Coordination and alignment within the administration, as well as with key stakeholders, will be equally necessary for new policies that need new statutory authority from the legislature.

These distinctions are recognized in the legislation that authorized the EMP and sets out its process, contents and purposes. For example, under the EMP statute each plan must:

- Look ahead ten years, but be updated and modified at least every three years

- Include long-term objectives, but provide for the interim implementation of measures consistent with those objectives
- Be distributed to the Governor, each department or commission with energy regulatory authority, and the Legislature, so they can all consider how best to implement the plan's interim measures as part of their ongoing policy-making responsibilities, and otherwise align their policies with the plan's objectives

Governor Murphy's Executive Order 28 similarly recognizes the difference between clean energy plans and specific clean energy policies. In EO 28, he recognizes that the role of the EMP is to set forth a strategic vision for New Jersey's energy future, not to be a sort of master inter-agency proposed rule. EO 28 refers to that strategic vision as a "comprehensive blueprint" — that is, one that identifies the most effective steps the state can take to curtail the serious impacts of global climate change, and integrates them in a manner that will actually function well in the real world. In addition, the governor calls for the EMP to include key proposed policies, for implementation over the next ten years, that are needed to achieve the 2050 goal that all energy production in New Jersey be 100% clean by 2050, as well as specific policy proposals to "incentivize the use of clean, efficient energy and electric technology alternatives in New Jersey's transportation sector and at New Jersey's ports," with similar recommendations for continued development of solar and wind in New Jersey. Thus, both the EMP statute and the EO focus on planning to inform and guide current and future policymakers in implementing specific policies needed to achieve the energy and related environmental goals of the state.

That plan is required to have two main components: the first is to be a blueprint — an efficient, achievable, affordable, safe and reliable combination of various clean energy resources that can best be relied on, at this time, to shift the state, "away from reliance on outdated technologies that contribute to global climate change and towards clean energy sources." In addition, the EMP needs to include proposals for key policies to achieve these goals that can be implemented, by the current and future Governor's, agencies and legislature, in the next ten years. The blueprint and the specific proposals need to be crafted with the understanding that the EMP as a whole, including both these aspects, is dynamic. That is, it requires updating and revision every three years, as technologies, costs and opportunities evolve. And, critically, it needs to be robust enough to maintain business, consumer and political support during multiple future administrations and legislatures.

Developing a dynamic blueprint for a clean energy system

Clean electricity resources behave in fundamentally different ways from the "outdated technologies" that the state's, the nation's and the world's electricity production must quickly shift away from to avoid the worst risks of climate change. Historical, GHG emitting electricity technologies were all designed to be able to start, increase, maintain, decrease and stop energy production on command. This common design characteristic allowed them to be used in parallel to continually match varying electricity consumption, which is the fundamental requirement for electric system reliability. As a result, it was relatively easy to switch from coal to gas or fossil thermal plants to fossil combustion turbine plants — all that changed was the fuel and the shape of the combustion technology, but the critical controllability remained the same, and in many cases, improved.

None of the clean electricity technologies that are available at large scale today have this same feature of continuously controllable output. Some, such as wind and solar, are intermittent and variable, and can only be controlled when wind or sunshine are available. Some have a limited duration of availability, such as energy storage and demand response, which can only be called upon after they have had enough time to charge up and can afford to discharge (or reduce consumption), and then can only be deployed until they are discharged or can no longer afford not to consume energy. Some, such as nuclear, can operate for a long period of time, but can be economically and physically limited in their ability to increase, decrease, or stop energy production.

These limitations mean that using clean energy to provide the same level of reliability as the outdated fossil electric technologies requires just the right mix of very different types of clean energy resources — enough wind, enough solar, enough storage, enough flexible load, and enough clean but controllable resources to always be able to balance electricity production and consumption. And, while the outdated fossil technologies conveniently bundled electricity production and control together in each power plant, the clean energy system of the near future will need to synthetically integrate unbundled energy production (from wind, solar, nuclear) with unbundled energy control and balancing (from batteries, thermal and mechanical storage, flexible load) while also integrating innovative emerging "clean firm" technologies[4].

For this synthetic bundling of energy control and energy production to work reliably and at low cost, it is critical to get the right amounts of all these resources in the right locations. Too many or too few of any of them, or too many in one location with the same sunshine and wind patterns, will cause reliability to plummet and costs to soar. This means that sophisticated electric system modeling — such as is being carried out now under New Jersey's Integrated Energy Planning (IEP) process — is a critical step of the EMP process.

This modeling is analogous to a team of expert architects using Computer Aided Design (CAD) software to develop the blueprint of a complex, multi-part project. This kind of IEP modeling can perform three functions that are essential elements of the EMP process:

1. Identify alternative scenarios — that is, different combinations of clean energy resources, in various locations — that can achieve the state's emission reduction goals while balancing energy production and consumption, and compare their costs and other impacts.
2. Identify key technology barriers or cost and performance characteristics that limit the cost-effectiveness of a particular scenario.
3. Explore certain assumed policies that could alter the technology deployment, cost, reliability or other characteristics of one or several scenarios.

[4] Nestor A. Sepulveda, Jesse D. Jenkins, Fernando J. de Sisternes, Richard K. Lester, "The Role of Firm Low-Carbon Electricity Resources in Deep Decarbonization of Power Generation", Sepulveda et al., Joule 2, 2403–2420, November 21, 2018, Elsevier Inc., https://doi.org/10.1016/j.joule.2018.08.006. See also, "Future cost-competitive electricity systems and their impact on US CO2 emissions," Alexander E. MacDonald, Christopher T. M. Clack, Anneliese Alexander, Adam Dunbar, JamesWilczak and Yuanfu Xie, Nature Climate Change, Published online: 25 January 2016.

An example of the first function would be modeling a scenario with as much of New Jersey's clean energy supply as possible located within the state, and another scenario that seeks to minimize costs by adding a substantial share of our new renewable energy supply in electrically connected locations outside of the state, while deploying the bulk of the flexible load and storage needed to balance the region's growing renewable resource mix within the state. Comparing these scenarios would provide insight into approaches that could best maintain affordability at high levels of renewable energy, avoid "leakage" of GHG emissions to other regions caused by New Jersey's reducing its own gas generation and increasing renewable generation, and grow large amounts of new in-state jobs in developing and providing flexible load, energy storage and the controllable electrification of current fossil fuel uses. The second function might include comparing scenarios that assume continued operation of New Jersey's nuclear plants through 2050 with one or more scenarios in which the plants must retire in the mid-2020s due to severe mechanical or economic challenges. The "nuclear exit" scenarios would then explore the potential for portfolios of clean energy resources, optimized for low cost and maximum energy production, to effectively replace the nuclear plants while continuing to support declining GHG emissions. Function 3 might include one or more scenarios in which a highly effective electrification policy and the large-scale adoption of controllable electric vehicle charging in New Jersey are combined, and compare them with scenarios with more conservative assumptions about the scale or controllability of the EV charging infrastructure.

The right approach to such scenarios is not to "pick a winner" scenario and bet on it. Instead, it is to identify trade-offs and synergies across scenarios and use those insights to develop strategies and policies that are most likely to achieve the state's GHG emission reduction and clean energy goals across a wide variety of possible futures. For example, analysis based on the scenarios suggested above could identify cost and other parameter assumptions under which the cost and emissions impacts of the loss of existing nuclear plants could be offset by an optimized mix of new renewable generation and new flexible clean resources that would support increased variable generation without an increase in gas generation. As an example of such as scenario, new renewables could be procured by New Jersey in other parts of PJM, and balanced through increased controllable EV charging in New Jersey. New Jersey would benefit economically and with substantial in-state job growth from rapid development of EV charging. To prepare for a range of possible futures, New Jersey policy makers might conclude that an optimal set of policies would include:

- developing new means to incent significant clean energy procurement by New Jersey entities in other parts of PJM, in addition to continued development of offshore wind and in-state solar;
- developing new means to incent rapid adoption of EVs and controllable charging systems that would be convenient for large numbers of EV owners and still allow charging during periods of maximum offshore wind and solar electricity production;
- and exploring alternative low-cost, high volume storage and flexible load technology opportunities in the state, in case the evolving EV ecosystem does not respond to those policies as intended, or in case flexible load turns out to be more cost-effective than a policy to control when EV owners decide to charge their batteries.

In our CAD analogy, this is like the architects saying "if your building faces this kind of risk in the future, you'll need this feature. But if it faces this other risk, it will need this other feature. And if this feature becomes popular, you'll need room for a lot more of it. Here's a blueprint that lets you be prepared for all of those futures, without having to bet your success on just one of them."

Similarly, the goal of the IEP process should be to identify the least-cost / most-benefit solutions across a number of very different futures, and then select a strategy and blueprint that allows the state to achieve its goals in as many of those futures as possible, while minimizing the risk of policy reversal and rejection in future EMPs. To be effective, the strategy and blueprint will need to be informed regularly by updated and increasingly robust IEP modeling and analysis, increasingly done in collaboration with other like-minded states in the region.

Finally, consistent with the previous section's message that planning is not policy making, none of the three bulleted planning insights above represents a specific policy. Instead, they each represent an opportunity for innovative and creative clean energy policy making, likely using a suite of very different policy options and a series of technically astute stakeholder processes to further refine and develop them. This process could be stimulated and informed by well-considered recommendations or proposals, in the EMP, of policies that could support success across a variety of futures, but those proposals should be viewed as the starting point of policy making, rather than as the final outcome.

Indeed, in many of the most promising areas for reducing GHG emissions that will require deploying new technologies, thereby creating new jobs and entire new business sectors, it is simply too early to define policies that will achieve these goals. Instead, it is critical to understand the factors, in terms of the costs and capabilities that will enable these technologies to achieve widespread deployment and to interact with each other in a complementary, synergistic manner. Planning processes, like the IEP and the EMP cycle, provide an important and unique opportunity to generate such insights. Policy development can build on those insights, but needs to focus on issues that optimization models cannot – namely, the most efficient ways to actually get the best mix of technologies deployed. Most of these technologies involve complex business and social ecosystems – such as the relationships between car manufacturers, car users, highway design, commuting and travel decisions, and electric infrastructure and control systems – that must themselves evolve in appropriate manners for the technologies to succeed. Therefore, perhaps the most important policy questions for clean energy development are about how to best grow the new technology ecosystems that are critically needed for businesses to create value for customers and investors by deploying the new clean energy resources.

A concrete example of such a complex ecosystem is what it will take for controllable EV charging systems, together with distributed battery storage and flexible load from increased electrification of transportation, home and business heating, and manufacturing — and to help balance high levels of renewable energy in New Jersey and other parts of the interconnected region. Policies for these issues need to be based on insights from modeling, to be sure, but also on expert insights into the technical issues, the pros and cons of approaches undertaken in other states, and the unique needs and circumstances of New Jersey.

It would be premature for the Energy Master Plan to recommend detailed policy solutions or approaches for such new technologies and their complex business and social ecosystems. The administration would be better advised to begin a series of clean energy technical conferences, to evaluate the insights gained through the IEP process, explore alternative approaches to implementation, and provide technically astute stakeholder processes to further refine and develop approaches. Conferences could occur outside of any agencies' rule-making process. Well-developed ideas would then become proposed policies for the appropriate implementing agency and rule-making process, always with an eye on what will produce the most rapid decarbonization, with the greatest value for electricity consumers, and with the greatest additional benefits for the state. A summary of such topics and the type of policy development processes that may be most appropriate for each is described in a later section.

By contrast, some ongoing clean energy deployment pathways require primarily incremental policy changes, and are ripe for specific policy guidance in the EMP, followed by agency implementation, with or without a need for new rule-making. Solar development offers a good example of incremental policies that should be addressed in the EMP, as will be described below.

Specific EMP tasks and recommendations

For the EMP to succeed, it needs to do more than just approach clean energy planning and policy with the right vision, tools and policy-making process, as recommended above. A number of critical tasks must be done properly, as well. This includes:

a. Set appropriate GWRA emissions targets

The EMP should describe how New Jersey will achieve the 80% GHG emission reduction goal of its GWRA statute and zero emission from in-state electricity generation goal of Executive Order 28. First, the plan should address reducing emissions from in-state electric generation, transportation and building systems, key components of a larger plan[5] to meet the GWRA mandate to reduce all Statewide emissions by 80% by 2050. The plan should also describe how to go even further, and achieve zero emissions from in-state electric generation by 2050, as required in Executive Order 28. The EMP should identify policies for both goals that avoid "leakage", that is, the simple shifting of GHG emissions from New Jersey to other states.

The plan should also describe how to comply with the second element of the GWRA emissions goal, reducing emissions from "electricity generated outside of the State but consumed in the State," by 80% from 2006 levels by 2050. This requirement should be addressed in a manner consistent with the GWRA's directive for the state to collaborate with other states, regionally and nationally to effectively address the risks of global warming. Accordingly, the plan's primary objectives should include a regional strategy to

[5] S3207 (signed by the Governor in July 2019) amends the GWRA and *requires* NJDEP (in consultation with other agencies) to promulgate regulations designed to achieve the 2050 goals. The timeline in the act now requires that within twelve months, DEP will publish a report detailing measures to accomplish the goals of the GWRA, and within eighteen months of the report will promulgate and adopt implementing regulations.

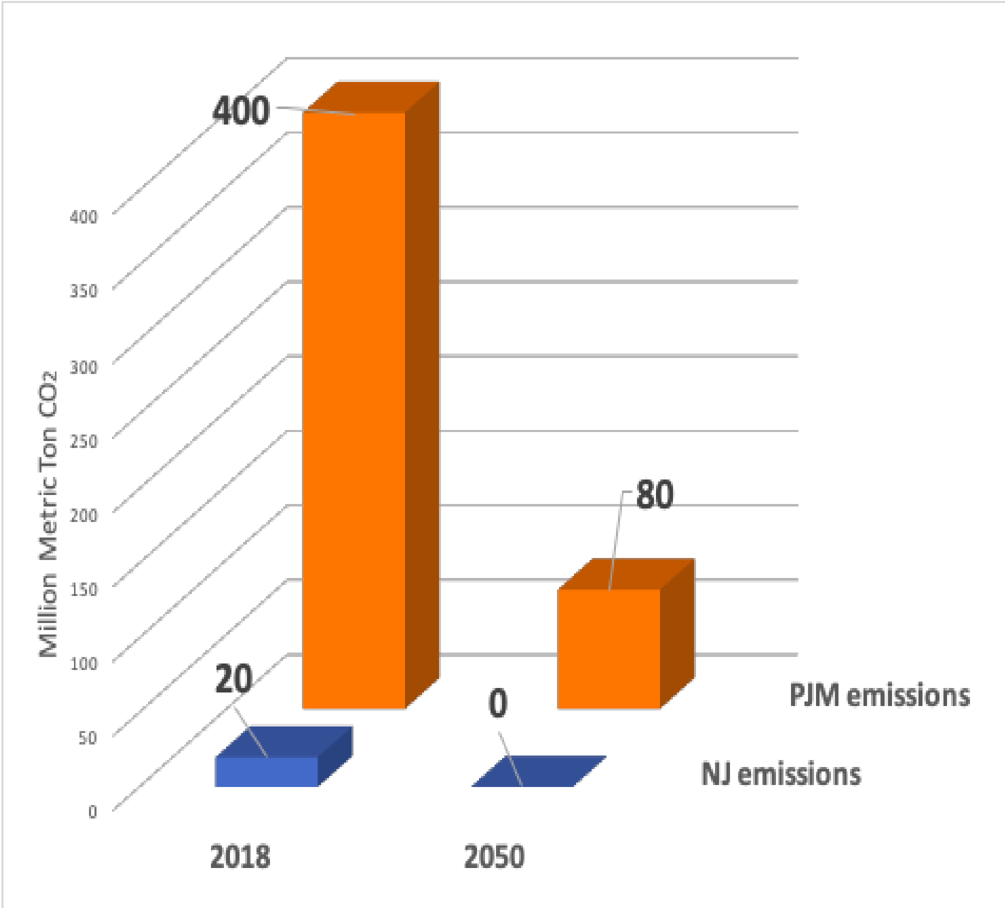
work with other states to decarbonize electricity in the PJM electric grid by 80% or more by 2050.

Even without the GWRA's clear requirement, regional decarbonization would be the right policy. It is increasingly clear that an optimized regional mix of clean energy resources will reduce energy costs to consumers over business as usual, while decreasing emissions, maintaining a reliable electric grid and improving health outcomes in overburdened communities. To realize these consumer and environmental benefits, states must coordinate using comparable planning and analysis tools, and each must base their clean energy policies on a shared understanding of how to develop efficient regional portfolios of just those mixes of clean energy resources that will result in lower costs, higher reliability, and more rapid decarbonization for each of them - while avoiding costly, incompatible clean energy investments and inadequate regional clean energy infrastructure. The fact that the GWRA requires this kind of collaboration and coordination makes it all the more urgent to undertake and do well.

New Jersey has a golden opportunity to leverage a thoughtful EMP based on credible analysis of the regional electric grid and entice other states within the PJM footprint to coordinate on their clean energy planning. Through coordination, state policies can accelerate the development of the right mix of renewable resources and new flexible clean resources to replace coal and gas plants. Regional work is needed to unleash lower-cost clean energy resources by removing key market barriers. A regional strategy has the potential to reduce emissions by an order of magnitude greater than New Jersey can accomplish within its borders, while greatly reducing the cost of electricity throughout the PJM region.

Figure A illustrates the emissions reduction potential of a regional strategy, compared to a state-only strategy. The blue bars depict a reduction of emissions from New Jersey's consumption of electric generation from about 20 million metric tons in 2018 to zero in 2050. In contrast, the diagram depicts emissions from electric generation within the PJM footprint declining by 80% by 2050, from about 400 million in 2018. A decrease of 20 million metric tons pales in comparison to the opportunity to reduce emissions by 320 million metric tons within the region.

Figure A. Comparison of 100% reduction of electric generation emissions in New Jersey with 80% reductions in PJM as a whole



This much more material and significant goal is not only worthy of aspiration, it is entirely consistent with the GWRA's guidance, which calls for New Jersey to work with other states, regionally and nationally to address the problem of global warming:

> "as a State, there are specific actions that can be taken to attack the problem of global warming, through reductions of greenhouse gas emissions in the State and ***participation in regional and interstate initiatives*** to reduce these emissions ***regionally, nationally, and internationally***."[6] (italics added)

b. Assure GWRA emission compliance targets are set, projected and measured accurately

The GWRA requires New Jersey "to establish a greenhouse gas emissions reduction program to limit the level of Statewide greenhouse gas emissions, and greenhouse gas emissions from electricity generated outside the State but consumed in the State, to the 1990 level or below, of those emissions by the year 2020, and to reduce those emissions to 80% below the 2006 level by the year 2050." This language requires New Jersey to reduce

[6] N.J.S.A. 26:2C-37

two different sources of emissions to 80% below the 2006 level by the year 2050: 1) Statewide greenhouse gas emissions, and 2) greenhouse gas emissions from electricity generated outside the State but consumed in the State. It is unclear whether it allows the reductions required for those two different sources to be combined into a single budget and then be reallocated among the two different sources. For example, if emissions due to imports fall by 1 million more tons than the budget established by the GWRA requires, such a reallocation would allow in-state emissions to exceed their GWRA budget by 1 million tons. Exceeding the GWRA's clear in-state emission targets in this manner may not be appropriate, either as a matter of law or of policy.

To ensure the state's energy policies actually achieve these compliance targets, the EMP must lay out accurate and verifiable methods to (a) set the GWRA targets and (b) to monitor and ensure success in achieving the 2050 goals set forth in the Act. In earlier GWRA reports, the State did not establish an emissions target for electricity generated outside the State but consumed in the State (hereinafter called "imports"), perhaps because earlier plans assumed that imports in 2020 and 2050 would be zero. The State then created a larger budget for in-state emissions (25.4 million metric tons CO2e) by adding the 2050 emissions budget for imports, 2.34 million metric tons, to the in-state emissions budget of 23.06 million metric tons. This larger budget is almost certainly erroneous, at minimum due to its unrealistic and unreasoned assumption that imports would be zero, and very likely also due to its problematic assumption that reducing GHGs from imports somehow makes it permissible for the state to violate the GWRA requirements for in-state emission reductions by several million metric tons per year.[7] This creative approach to GHG accounting is ill-advised for several reasons:

- The IPCC warnings suggest that New Jersey should consider establishing even stricter targets by 2050, with a goal of becoming carbon neutral. Expanding the emissions budget by 10% would be a significant step in the wrong direction.
- A plan designed to achieve zero imports would put New Jersey on an excessively high cost pathway — especially now that renewables and regional clean energy portfolios are promising lower costs than business as usual — that would pose significant risks to public support, economic development and jobs.
- An 80% reduction of emissions in the PJM region is almost certainly more feasible and achievable than zero imports, especially given the abundance of low cost renewable projects in PJM, the ability to select the most complementary and optimal mix of them across a broad region with diverse sunshine and weather patterns. The complementary flexible resources, flexible load, storage and electrification, can all be

[7] According to the 2012 update, emissions from imports in 2006 were 11.7 million metric tons CO2e. Reducing this amount by 80% leaves a 2050 budget for imports of 2.34 million metric tons. If electricity imports emission reduction requirements are not deemed to be fungible with in-state emission reduction requirements, then the total emissions budget within New Jersey borders would be 23.06 million metric tons in 2050, rather than 25.4 million metric tons derived by assuming all GWRA requirements are fungible and further assuming away all imports of electricity. This 3.06 MMT limit would apply to all emissions from transportation, residential and commercial buildings, industrial, highly warming gasses, waste management and other difficult sectors. See Michael Aucott et al., Rutgers University, *2012 Update to New Jersey's Statewide Greenhouse Gas Emission Inventory* (2015), http://climatechange.rutgers.edu/docman-list/special-reports/354-2012-update-to-new-jersey-s-statewide-greenhouse-gas-emission- inventory/file.

developed in New Jersey, which has a strong comparative advantage for such resources due to its high population density and disproportionate share of electric load, vehicle miles traveled, and buildings.

- Finally, increasing the in-state emission budget above the level required by the GWRA, while avoiding taking on a leadership role in decarbonizing the entire PJM region, would be tragically irresponsible from an environmental perspective. Global warming, as the GWRA recognizes, is not about showing off a state's own achievements - it is about doing everything achievable and influenceable, in the state and in the region, in the next several decades to preserve the unique climate balance that has allowed our own species to evolve and prosper, and to avoid destroying vast amounts of the global ecosystems we continue to depend on.

Consistent with all of the above reasoning, we read the GWRA as requiring a separate emissions budget for imports. The policy goal then becomes clear: to reduce the GHG emissions of imports by 80% or more, rather than reducing imports to zero. In this way, the GWRA established a mandate for New Jersey policy makers to help drive decarbonization of the broader region. Regional decarbonization that leverages New Jersey's own decarbonization, then becomes a central goal for the EMP.

While the GWRA creates a legal mandate to reduce emissions from imports, New Jersey cannot achieve this goal through direct state authority. But effective climate change solutions do not lend themselves to clear lines of authority for cities, states, regions and countries. Pretending that New Jersey can build a wall around the state to isolate and control its emissions would be akin to rearranging the deck chairs on the Titanic. New Jersey's climate strategy should not be limited to behaviors and activities that the State can control directly, but should include, as the GWRA itself makes clear, coordination and collaboration with other states and regional entities, as well as national and international efforts.

c. Set accurate emissions targets under the 100% clean energy mandate

The EMP should define 100% clean energy to mean zero emissions from electric generation located in-state by 2050 and maximum electrification of the transportation and building sectors to meet or exceed the GWRA emissions reductions by 2050.[8] This mandate will require the reduction and eventual elimination of all natural gas electric generation located in New Jersey. The primary challenge will be to develop policies that achieve this goal without leakage, i.e., causing increased GHG emissions in other states that are part of the same electrically interconnected grid of which New Jersey is part. Those increased emissions could result from using fossil fuels in other parts of the regional grid to produce electricity simply for consumption in New Jersey, and from using those fuels for balancing purposes, which include both replacing balancing services currently provided by in-state gas plants, and providing additional balancing services required by New Jersey's growing amounts of variable renewable energy.

[8] The requirement of Governor Murphy's Executive Order 28 for the 2019 Energy Master Plan "to provide a comprehensive blueprint for the total conversion of *the State's* energy production profile to 100% clean energy sources on or before January 1, 2050." Emphasis added.

d. Accurate accounting for emissions, with full environmental integrity

The state should project and measure, or where necessary, estimate emissions using the most accurate methods available. The initial GWRA analysis assumed that emissions could be calculated based on annual net imports of electricity and that if annual net imports are zero, then emissions would be zero. This simplifying assumption is inaccurate and can greatly underestimate actual emissions, a problem that is likely to become greater with high levels of renewable resources. A new, much more accurate method is required, both for ensuring compliance with the GWRA and for developing and evaluating future clean energy policies.

Accuracy requires that the actual emissions associated with all inflows of electricity, whether of short or long duration, and without netting against outflows in other time periods, be estimated with as much granularity as possible. Since PJM's dispatch system can identify actual dispatch and shift factors on constrained transmission elements, it may be possible to estimate this time-stamped emission intensity with a high level of precision. In the planning process, the same approach should be used to identify all modeled emissions in the interconnected system at the time of any modeled inflows, and to estimate the modeled emission intensity for each modeled time-period within which there are inflows of power into New Jersey.

Such accuracy is essential for policy development as well as for compliance with the GWRA. For example, one can imagine a proposed anti-leakage policy, based on the assumption that new zero-emission MWH generated in the rest of PJM would somehow "offset" the leakage caused by New Jersey's elimination of gas-fired generation. The imputed MWH-for-MWH offsetting of "leaked" GHG emissions could only happen in the real world, however, if the new renewable MWH in PJM, when they are actually produced, displace exactly the same type and amount of fossil generation that would be used in PJM to provide the same services that were formerly provided by New Jersey's gas plants. This one-for-one offsetting is unlikely, especially with today's resource mix in PJM. Instead, it is entirely possible that new wind, for example, in the rest of PJM would primarily displace emissions from much more efficient gas combined cycle plants (with emissions of around 800 lbs of CO_2 per MWH), or even zero carbon nuclear resources in PJM, while the generation actually used in PJM to provide the services formerly provided by New Jersey's gas plants would be much less efficient, thermal fossil plants - with emissions of perhaps a ton or even considerably more CO_2 per MWH, when out-of-merit dispatch associated with these plant's operation is accounted for. Thus, with no basis in accurate forecasting or measurement of real emissions, such a policy would falsely attribute the full offsetting of leaked emissions to investments that could, in reality, end up more than doubling the amount of GHG emissions actually emitted by out-of-state generators of electricity consumed in New Jersey. New Jersey must be vigilant that it not destroy the environmental integrity of its GWRA compliance mechanisms, as well as the credibility of its own clean energy leadership efforts, through such inaccurate projections of GHG emissions and imputed but erroneous estimation of emission reductions.

By contrast, accurate projection and modeling of the electric system's operation and GHG emissions could identify combinations of clean energy resources which, if developed through collaborative efforts by multiple states, would provide zero-carbon replacements for the services provided by New Jersey's gas plants, and that would reduce the demand for additional fossil energy balancing services anywhere in PJM as New Jersey phases out gas plants. Accurate measuring of the net change in system emissions associated with these resources could then be used to evaluate compliance with the GWRA's mandated reductions on inflows of electricity to New Jersey from other states, and provide additional feedback and incentives to create "negative leakage" — that is, complementary GHG emission reductions in other states that are caused by, facilitated by, or leveraged by New Jersey's own actions.

This same high degree of accuracy in projecting, modeling and measuring emission reductions associated with New Jersey sponsored projects and technologies will be even more important as New Jersey deploys large amounts of offshore wind and solar. Large amounts of these resources will create significant balancing needs, not only in New Jersey but in neighboring states that will be importing (and thereby helping pay for) New Jersey's growing renewable energy resources. These new balancing needs could far exceed the amount of flexible gas capacity currently deployed in New Jersey and the surrounding region, as has proven to be the case with the "neck" of the "duck curve" in California and other states with high levels of renewable resources.

Preventing such leakage, and instead supporting "negative" leakage that reduces GHG emissions in both New Jersey and surrounding states, will therefore be important as part of New Jersey's roll-out of offshore wind and growing amounts of in-state solar. Policies to address this will likely include tailoring amounts of storage, flexible load, and flexible electrification to absorb high levels of local renewable production and to shift that energy to times of high ramping needs, such as at sundown or when offshore breezes die down, without requiring additional ramping services from gas or other fossil resources located in surrounding states. But, for that tailoring to be accurate and the investments to be cost-effective, the state must have highly accurate ways to model the regional electric system under various clean energy configurations, coupled with highly accurate ways to project and measure resulting GHG emissions.

III. Exploration of policy challenges to achieve deep decarbonization goals

Before offering policy solutions, the EMP (and IEP) should focus first on identifying key barriers to the achievement of desired outcomes. This step is critical to ensure that policy solutions will work in the real world. And, if they don't, it is important to revisit the identification of barriers and revise policies to address them successfully. Advanced planning tools can also aid in identifying barriers and challenges that are less obvious today, but will become critical in the future.[9]

a. Limitations of high levels of renewable generation and concentrated local development

New studies based on the same modeling techniques described earlier enable policymakers to explore what would happen to energy systems by 2050 under various clean energy

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[9] Appendix A provides a simple depiction of the limitations of current policy approaches compared to optimized portfolios of clean energy resources.

policies. Some studies explore scenarios that build high levels of renewable generation, compared with building lower levels of renewable generation with increased deployment of emerging clean firm (i.e., dispatchable) resources.[10] These studies highlight the limitations of simply focusing on renewables, or focusing on developing renewables within smaller geographic areas and state borders. Key findings include:

1. without addressing the need for clean grid flexibility, natural gas generation will continue to play an important role, even with substantial renewable generation;
2. at high levels of penetration, incremental amounts of renewable generation become increasingly ineffective at further reducing emissions;
3. haphazard configurations of clean energy resources produce higher cost energy systems, which are likely to cost more than BAU;
4. development of high levels of renewables within state borders, or in smaller geographic grids produce higher costs than the development of high levels and more diverse mixes of renewable generation across a larger geographic footprint.

b. Barriers to development of clean energy resources in wholesale energy markets

Before developing state policies that are designed to induce significant development of new renewables, as well as flexible clean resources in the PJM region it is important to evaluate why markets are not driving greater adoption. The penetration of solar and wind is about 4% of generation within PJM, despite high technical potential and availability of projects at levelized costs that are competitive, and even lower than, the cost to develop new natural gas generation.[11] There are several reasons that low cost renewables have not achieved greater penetration.

Renewable project developers need certainty of sufficient revenues to cover their debt costs and offer a real opportunity for a return on equity in order to attract financing. There are two important components of this certainty. The first is that market prices, over time, must be high enough to cover development costs, including financing. The second is that the revenue streams based on those prices must have limited volatility. Otherwise, high prices in some years and low prices in others could lead to an inability to make regular debt payments, making debt financing impossible or excessively costly. PJM markets currently do not do a good job of providing either of these two critical revenue needs. Due to low gas prices and an oversupply of capacity, prices in both PJM's energy and capacity markets are low and volatile, so that even where average prices, over time, may be high enough to pay for new renewables, there is typically too much volatility in those prices to support efficient debt and equity financing.

Traditionally, renewable energy resources have cost significantly more than fossil technologies. Accordingly, most renewable energy policies have offered additional revenue

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[10] See Sepulveda, et al., 2018

[11] Recent price information from projects within the PJM footprint show:
Solar offer prices (at the 25th percentile) range from $32 to $36 in eastern and central PJM
Wind offer prices (at the 25th percentile) range from $32 to $33 in eastern and central PJM
https://leveltenenergy.com/blog/ppa-price-index/q2-2019/ The 2nd Quarter 2019 report is based on approximately 1,000 price offers from more than 360 renewable energy projects across the U.S. The report provides power purchase agreement offer price averages submitted through the LevelTen Marketplace.

or lower costs for renewable projects, e.g. by creating and additional revenue stream from the sale of renewable energy credits (RECs) and by offering tax credits. But as renewable energy has become increasingly cost competitive, market prices have the potential to be high enough, over time and on average, to provide the needed revenue for lower cost renewable resources, without additional policy-based revenues.

For PJM's market prices to reach and remain reach and, over time, remain at levels that could provide high enough revenues to support substantial amounts of new renewable investment, significant amounts of excess fossil fuel capacity would need to retire, to prevent a persistent oversupply with depressed prices. Our recommendation for coordinated integrated energy planning among PJM states with strong clean energy and decarbonization goals is one way to help create appropriate incentives for such retirement. But, even with market prices that are high enough, on average, to support development, new renewables in PJM would also need to overcome the volatility in energy and capacity market prices to be able to get the necessary financing. Perhaps the most effective way to do this, from a project development perspective, is to lock in revenues through a long-term offtake contract, typically referred to as a power purchase agreement (PPA). With PPA contracts, a significant number of wind and solar projects within PJM could be developed in the near term. PPAs can also include fixed price payments for RECs, which removes the volatility and other risks in REC prices which, like power price volatility, can act as a barrier to entry. RECs have proven to be an inefficient policy tool, as the risk-adjusted value of RECs to project developers is much lower than their direct, and very real, cost to ratepayers.

To be successful, efforts by states to add renewables to PJM must directly address both the price volatility and price level risk factors, and must also, either directly or indirectly, address the oversupply of fossil fuel plants and the need to replace them with optimized clean energy portfolios, rather than simply adding renewables alone. Further, simply replacing existing fossil plants with renewables will very likely induce the development of new gas resources to provide the critical balancing services required for reliability.

To preempt this new gas deployment, coordinated state policies should identify and deploy appropriate types and amounts of clean flexibility resources to provide the balancing services needed by their combined new renewable energy supply portfolios. The resulting aggregated clean energy portfolio will not only meet each participating state's decarbonization goals in a least-cost, best-fit manner, it will also preempt the deployment of additional gas resources in other states, simply through the forces of supply and demand in the PJM energy market. To further enhance these market dynamics, coordinated state policies should also address ways to reduce the operation of, and then retire, existing fossil generation resources, to make room for the addition of the clean energy portfolios without unduly suppressing the market prices they will increasingly be able to rely on, due to their low costs.

Figure B depicts the relationships between these policy goals and a number of candidate policies, and how they can be designed to interact, both with each other and with market price and other dynamics, to accelerate regional deep decarbonization.

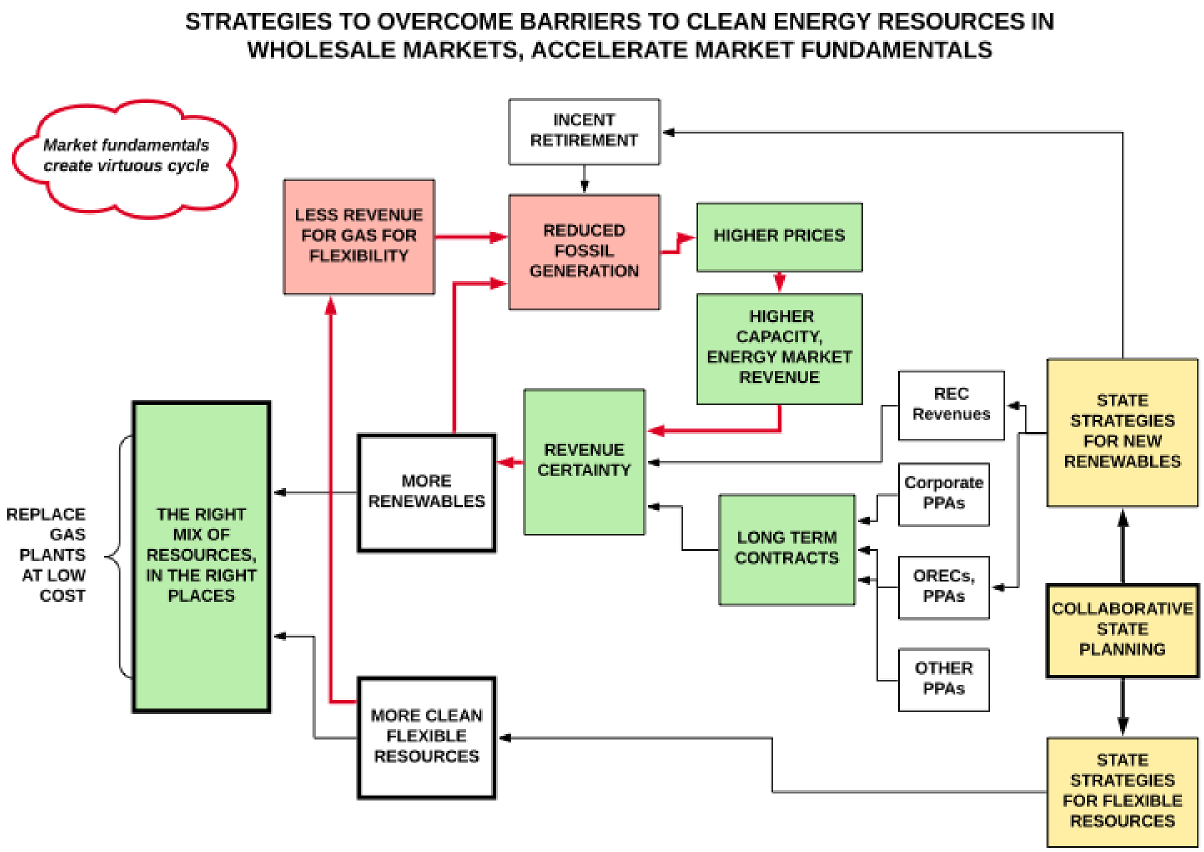

Figure B. Strategies to overcome barriers to clean energy resources in wholesale markets and accelerate market fundamentals

c. Policy challenges likely to emerge from new decarbonization plans

In this section, we explore likely challenges as New Jersey begins to develop policies based on the emerging blueprint. First, we assume that the as yet uncompleted IEP process will lead to a blueprint that resembles the results of other, similar planning studies, and will include the following key design elements:

1. regional decarbonization goal of 80% or higher
2. low cost, based on optimized portfolios of clean energy resources - clean generation and clean flexible resources
3. low cost, based on the development of new clean solar and wind in PJM footprint (including, but not limited to, New Jersey), in the right amounts, types and locations

4. high levels of electrification of buildings by 2050 with interim goals by 2030
5. high levels of electric vehicles by 2050 with interim goals by 2030

Such a blueprint will help identify the need for new policy tools and approaches to achieve the following objectives:

1. Set near term generation targets for in-state solar, consistent with IEP targets for an optimal mix of solar, wind and continued nuclear operation — see description below
2. Engage states in regional collaboration to accelerate deep decarbonization — see description below
3. Incent low-cost development of optimal amounts and types of new renewable generation within PJM footprint — see description below
4. Incent development of flexible clean resources, within NJ, that are highly complementary to in-state and regional renewable energy portfolios and that help prevent both leakage to existing regional gas plants and new gas plant development
5. Ensure reduced emissions from electric generation in NJ, while avoiding leakage
6. Achieve high levels of building electrification by 2050, with flexible load capabilities to the extent needed to balance renewables
7. Achieve high levels of vehicle electrification by 2050, with flexible charging capabilities to the extent needed to balance renewables
8. Ensure compliance with deep decarbonization targets for 2050 as required under the amended Global Warming Response Act and EO

Chart 1 suggests a framework laying out our high-level suggestions for the type of policy proposals the EMP should offer for each of these objectives, along with the general types of steps that would work best for actually developing those policies, after the EMP is published. We recommend the EMP expand upon this framework for setting out distinct policy workstreams and appropriate policy processes in each of them.

CHART 1. **Policy areas with suggested post-EMP steps**

Policy Area	EMP proposals	Post EMP steps, issues to address
Reduce emissions from generation in NJ	Describe possible approaches and tradeoffs; strategies to avoid leakage	**Administration technical conference** (DEP, BPU) Expert input from PJM and others.
Ensure compliance with GWRA and EO decarbonization goals and accurate measurement and accounting for GHG impacts of clean energy initiatives	Joint DEP - BPU rulemaking on GHG measurement, interim benchmark(s) and compliance mechanism	**Administration technical conference** needed to inform further rulemaking. Completion of Global Warming Response Act report by July 2020. Rulemakings to establish interim target(s) and regulations within 18 months of completion of report.
Regional collaboration	Identify regional goals; Framework for collaboration; Explore multi-state policies to prevent leakage, accelerate fossil retirement and preempt new gas plants	Begin exploration with other states
Incent low cost, optimal mix of new renewables within PJM	Explore PPAs and related financing support approaches (e.g., credit-enhancement for load interests who wish to enter into PPAs)	**Administration technical conference**, Potential PPA counterparties; EDC and TPS roles; credit enhancement / Green Banks; relationship to current and future incentive and compliance mechanisms (demand obligation, market-based incentives, others)

Incent appropriate types and amounts of flexible clean resources within NJ	Describe 2020 - 2025 targets: Type, amount, location, informed by IEP analysis	Requires a dedicated workstream by BPU and stakeholders to develop a minimum set of practices and standards to support efficient levels of Distributed Energy Resources (DERs), including flexible load and lithium ion battery technologies. Also consider pumped hydro, mechanical gravity, thermal, and large scale flow battery storage technologies.
Building electrification - substituting electricity for gas	Create pilots for gas-free subdivisions, MFHs, and corporate campuses; Plan for incentives to adopt efficient cold climate electric technologies, such as cold climate air source heat pumps; plan for the elimination of incentives that lock in natural gas technologies; Revisit gas distribution expansion policies and requirements.	BPU staff proposals with stakeholder response and concept development
Building electrification - key technologies	Describe initial strategies for market transformation with core technologies (e.g., ccASHP, water heaters)	**Administration technical conference** (BPU, DCA, Treasury, DEP) expert input on strategies, lessons
EV deployment and charging infrastructure development and management	Convene EV and automotive innovation companies and experts to evaluate state of knowledge, best practices and key risks.	Stakeholder process-based rulemakings and legislative proposals
All electrification	Assess potential and prepare for electrification to provide additional flexibility to meet need indicated	

	by IEP.	
In-state solar targets (successor program)	Describe 2020 - 2025 targets: Type, amount, location, informed by IEP analysis; Describe 2030 targets as a placeholder; provides guidance to the industry, but should be revisited as part of growing optimized regional portfolio, considering added features such as smart inverters and solar plus storage in New Jersey.	BPU sets target budget based on assumed costs, within new successor solar rules; Competitive processes in 2020, 2021 will reveal actual cost and amounts; BPU can adjust amounts with each procurement cycle to remain within budget and on track to achieve MW targets by 2025
All distributed energy resources	Identify most cost-effective incremental pathway to develop distributed energy management, infrastructure planning, aggregation, and interface with wholesale market.	Technical evaluation of approaches in other states and countries, with a focus on the role and scale of DERs in reducing costs and increasing benefits in the optimal scenarios identified by the IEP process.

d. The EMP blueprint and evolving solar policy

The solar transition required by the Clean Energy Act offers a specific example of how the IEP and EMP process could support efficient continued growth of solar as part of New Jersey's decarbonization and clean energy goals. As the BPU is aware, the Clean Energy Act requires the development of a new set of solar incentives for in-state solar projects, after the closing of the SREC program to new projects once 5.1% of retail sales have been provided by in-state solar resources. But the statute does not create a new solar mandate or carve-out for this successor incentive program. Absent such a specific mandate, the BPU's best policy may be to use the IEP to help identify how much in-state solar would be included, over the next ten years, in several of the IEP's more likely decarbonization scenarios.

This amount, which would be based on cost assumptions included in the IEP modeling, could then form initial targets for in-state solar development in each of the next ten years. If the IEP modeling does not explicitly solve for an RPS compliance pathway that stays with the RPS budget and overall RPS compliance, as required by the Clean Energy Act, a second round of modeling will be needed to adjust the IEP solar quantities and cost assumptions to ensure that the BPU's solar targets will, indeed, stay within the RPS cost caps while also supporting full compliance with the RPS goals.

The projected annual costs of these solar development initiated in these 10 years, which in aggregate would be certain of staying within the RPS budget, could then be converted to a budget for the entire successor solar incentive program for the next ten years' worth of new projects. Then, to the extent solar costs fall below the projected cost levels, additional solar could be developed in each year, until the annual new development budgets are met. If solar costs rise, fewer megawatts would be developed, and additional lower cost renewables in other locations would be procured to ensure full RPS compliance, with both the RPS and the RPS budget still being met.

Subsequent IEP and EMP cycles would be updated with the insights into costs and the total quantity of solar deployed, to better identify the optimal paths for future clean energy resource deployment to stay on an affordable, reliable and viable path to decarbonization. These subsequent cycles would also identify additional storage and flexible load opportunities that could create additional value in terms of balancing renewables, enhancing customer value through increased resilience and lower energy costs, and cost-effectively improving the distribution system — many of which could offer new, synergistic business opportunities for New Jersey's solar companies.[12]

e. A framework for effective regional coordination in implementing state clean energy goals

A growing number of states are adopting aggressive goals for renewable and clean energy deployment, in efforts to address the growing risks of climate change. Current state

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[12] See the section "DER Opportunities, Challenges and Planning", below.

policies face two important limitations. First, as explained previously, state policies such as RPS will be insufficient to obtain sought after emissions reductions, once renewables increase beyond low levels of penetration.

Lower costs will depend on getting the right mix of clean energy resources over time, likely to pose a significant challenge for current state clean energy policies and energy planning, as well as for current interstate transmission planning and wholesale energy markets under federal jurisdiction.

This challenge is particularly substantial for most states, including New Jersey, that are served by a regional power system considerably larger than the state itself. Further, for many states, the optimal portfolio of clean energy resources is likely to include renewables and firm resources located outside of the state, as well as within it. As a result, increased regional coordination in planning and developing the region's overall clean energy portfolio will likely be an essential step in each state achieving its own clean energy goals in a highly reliable and low-cost way.

To illustrate, the widespread popularity of solar could lead each state in a region to select solar as the primary way it will achieve a 50% share of renewable energy. If just one state in an interconnected regional wholesale market did this, the regional electric system as a whole would likely absorb and balance its peak solar production with no problems. But if a large number of states all choose to achieve 50% renewables primarily from solar, the regional grid could be overwhelmed by excess production during many sunny days, resulting in the frequent curtailment of excess solar production. This would both raise the effective cost of solar energy and fail to achieve the intended levels of renewable energy production and displacement of fossil-based CO_2 emissions. Increasing battery storage could help to a degree, but at an excessively high cost. Given the dynamic interaction of clean energy resources in a power system, even more wasteful and ineffective outcomes could result from states collectively deploying too much or too little of any particular resource type, or from deploying mixes of resources that interfere with each other, such as large amounts of wind and nuclear in the same constrained area.

These results could be avoided if some states focused more on wind development, some more on solar development, and were all able to collectively get the right amounts of these investments and of complementary investments in transmission, storage, controllable load, and firm clean resources needed to minimize both cost and carbon emissions. How might this be done, especially by restructured states in a region served by a large, single wholesale electricity market?

Many observers look to historical integrated resource planning (IRP) for guidance on how to achieve clean energy goals. But historical IRP wasn't designed to address three key decarbonization issues:

1. Decarbonizing the power system requires, as discussed above, synthetically creating a suitable level of control and flexibility by building a well-configured, least cost portfolio of renewables and complementary resources. Historically, IRP focused on minimizing the cost of an existing utility system by adding incremental amounts of energy efficiency and renewables, while continuing to rely on existing fossil resources for the control and flexibility needed to operate the system reliably.

2. Decarbonizing the electric system in restructured states requires creating policies and incentives that depend on voluntary private investment, much of it beyond the skill and scope of utilities. Historically, vertically integrated utilities developed integrated resources plans that were subject to approval by state PUCs. Utilities would then develop new resources, add them to their “ratebase” and then recover the prudent cost in rates charged to captive customers.
3. Decarbonizing the electric system, especially with high levels of renewable energy, requires investments — including new transmission — spanning multiple utility service territories and state lines. IRP focused on in-state and in-service territory rate-based investments by in-state utilities.

These three needs indicate the basic framework needed for coordinated state clean energy planning:

1. Using similar, advanced clean energy planning tools and comparable processes in each participating state’s individual planning process is the critical first step in effective regional coordination. This requires participating states to use similar, state-of-the-art regional power system simulation and planning tools that can identify efficient regional configuration “pathways” of clean energy deployment, over multiple decades of decarbonization. Each planning cycle will identify specific amounts and types of clean energy resources that are optimal for current deployment, based on current market- or bid-based cost and performance characteristics. Future technology deployments in the pathways are placeholders, which will be updated and adjusted in subsequent planning cycles, on the basis of technology costs and capabilities at that time, as determined through periodic bids or market assessments.
2. Commensurate tools, a transparent process and a coordinated planning schedule will support better results for each state and the region. More formal interstate agreement on policies, development programs, or technology goals, could potentially support even greater benefits. States will be able to develop better plans simply by participating as observers in each-other’s planning processes. Iterative planning sessions with feedback from state regulators and stakeholders can help state level plans further converge on feasible, low-cost and effective configurations. Each state can then design its clean energy policies to incentivize and support private and utility investment, as warranted, in the mix of resources and in the locations that do the most good at the least cost.
3. Coordinated decarbonization planning among even a few states within an RTO’s footprint, if done with state-of-art system simulation and planning tools, can profoundly influence an RTO’s transmission plans and resource mix, helping ensure the regional connections and market-driven synergies needed to decarbonize the entire region quickly, reliably and at least cost. Federal law and regulations already require regional transmission operators (RTOs) to develop regional transmission plans (RTPs) that, among other things, develop transmission needed to meet state policy goals.

f. Incent low-cost development of renewable generation within PJM footprint

Energy experts and PJM officials note that most new renewable projects have been developed based on contracts for energy and RECs, in the form of a power purchase agreement (PPA) with a duration of about 15 years. Large corporate purchasers that have sustainability goals - such as Amazon - have been the primary drivers of projects within the PJM footprint over the past few years. A new market is developing fueled by mid-sized corporations, that are now able to procure renewable energy through aggregation and diversify project risk by contracting for portions of multiple projects.

States should explore whether a different approach to procuring RECs, using long-term contracts, or PPAs, is possible. Such an approach, if viable, would offer assurance that PPAs achieve the policy goal of new renewable development, and could provide a benefit to ratepayers of substantially lower, or zero costs to obtain RECs. The OREC structure provides an example for New Jersey policymakers to consider. At current energy prices, such a policy tool would enable state entities to obtain RECs for an incentive cost of zero.

IV. Distributed energy resource (DER) opportunities, challenges and planning

The draft EMP provides an impressive catalog of potential DER initiatives and objectives. We recommend that the final EMP develop a more strategic, integrated approach to DER technologies, based on their costs, their capabilities, and the needs they can cost-effectively meet. These needs tend to fall in three distinct types — the needs of customers for better energy services, the needs of the low-voltage distribution system for greater capacity and control at lower costs, and the need of the bulk power system for help in balancing growing amounts of variable renewable energy while decreasing the use of natural gas and other fossil fuels. The EMP, guided by the analysis of the IEP, offers an opportunity for New Jersey to develop strategies and policies that will maximize the value of DERs across all three of these needs, stacking multiple layers of value for specific DER technologies wherever possible.

Such value-maximization is unlikely to be achieved by an "all of the above" and "the more the merrier" approach to DER deployment. Instead, the most cost-effective, value-enhancing DER deployment strategy will require two parallel and coordinated planning workstreams. The first workstream will build on the IEP analysis to identify key DER technologies, capabilities and quantities that can create the most customer value, distribution system value, and bulk power system value at the lowest cost to ratepayers. For example, this workstream can identify the types and amounts of storage and flexibility that will enhance customer resilience, reduce distribution system capacity costs, and meet but not exceed bulk power balancing needs.

The second planning workstream is needed to identify and implement any changes in low-voltage distribution system planning, design, operation, maintenance, data collection and management, and DER control systems that are needed to support the deployment and effective use of the DERs identified by the first workstream as part of an optimal DER portfolio in the state. Two particularly important challenges for the second workstream will be 1) to identify the most suitable approach or approaches for DERs to interact with the wholesale market to help balance growing levels of renewable resources; and 2) to identify the right mix of roles for regulated utilities and competitive entities in owning, aggregating, operating and managing these DERs. Both of these challenges will require a focus on enhancing the three-way value proposition of DERs for their customer/owners, the local utility distribution system and the bulk power system.

Clearly, these two workstreams need to be aligned and ultimately integrated, since the nature and scope of DER planning, management, and market interface will, to a large degree, determine how many DERs can be really be deployed and what combinations of value they can actually deliver to customers, the distribution system, and the bulk power system. Finally, the integrated planning workstreams should be used, in future policy development, IEPs and EMPs, as blueprints for the development of specific policies to achieve a value-rich, cost-effective DER ecosystem in New Jersey.

V. Dismantling the gas bridge in New Jersey

New Jersey built a natural gas "bridge" a decade ago and now needs to take steps to remove it and replace it with renewables, flexible load and electrification. The EMP should be absolutely clear that natural gas consumption will be reduced in New Jersey, with a projected timeline, backed by facts, analysis and near term actions.

Projections of natural gas usage for electric generation in New Jersey will be informed by analysis that is the basis for the Integrated Energy Plan. The IEP will identify pathways that meet or exceed the Global Warming Response Act targets in a way that minimizes costs and ensures reliability of the electric grid. Each pathway will specify a combination of clean energy resources and technologies - such as solar, wind, flexible load and storage - that meet emissions goals by 2050.

The findings of the Integrated Energy Plan (IEP) will provide a detailed view of the mix of resources for each year from 2020 to 2050, that achieves New Jersey's climate goals. This mix will show the specific year by year decline of natural gas generation that maintains a reliable electric grid as the penetration of renewables and clean flexible resources increases. In addition, the EMP should identify near-term strategies and actions to bring about the combination of clean energy resources and technologies that will turn the detailed plans in the EMP into real emissions reductions from in-state gas plants, without creating leakage in other states.

The largest use of natural gas in New Jersey is for building thermal systems. Conversion from fossil fuels to electric heating and cooling systems is just beginning in New Jersey and market transformation work will be required over many years to achieve high levels of market penetration. The EMP should clearly state emissions reduction goals for building thermal systems and identify a set of initial strategies and policies designed to accelerate the market adoption of new electric thermal solutions.

By providing detailed analysis, planning and policies for both electric generation and building thermal systems, the EMP will provide a clear signal to all stakeholders as well as potential investors in natural gas projects that consumption in New Jersey is declining, and this decline will soon accelerate.

a. Use accurate data to evaluate costs and benefits from proposed gas pipeline projects

Analysis of gas flows is required to determine whether a proposed gas pipeline would provide specific benefits or do so cost-effectively. Various claims made by pipeline proponents should be analyzed using actual historic data about gas flows and contracts, particularly during peak winter periods. Skipping Stone is an energy markets consulting and technology services firm founded by former energy CEOs,[13] and one of a handful of consultants in the country that has datasets of all scheduled receipts and deliveries, on most major pipelines (especially in the east), every day (and in many cases for every scheduling cycle) going back for years. Greg Lander, President of Skipping Stone, is a leading national gas expert, who has advised FERC Commissioners and staff for years on gas market regulations).

Analysis of historic data of gas flows during peak winter periods can shed light on whether a specific addition of pipeline capacity would reduce costs to gas customers and whether it would reduce price spikes during peak periods. Analysis can also evaluate investments in additional pipeline capacity to meet reliability needs. Historic data can show whether specific new pipeline capacity would be required to meet firm customer contracts if an outage were to occur on a major interstate pipeline during the winter.

b. Appropriate analysis shows no need for specific proposed gas pipelines

Expert analysis conclusively shows that the PennEast pipeline is not needed to meet either current or future energy demand in New Jersey and the region the proposed pipeline would service. Moreover, building the pipeline would increase costs to New Jersey energy consumers and become increasingly wasteful and irrelevant as the state transitions to deep decarbonization based on clean, renewable energy sources.

New Jersey already has more than enough gas pipeline capacity to meet current and projected needs. With about 8 billion cubic feet per day of pipeline capacity now serving the state, there are only a few days each year when pipeline capacity may be fully utilized. Numerous studies of various proposed pipeline projects conclusively show, in each case, that PennEast satisfies no unmet needs in New Jersey.

One study shows that a rapid buildout between 2011 and 2018 added 3.1 bcf/d of pipeline delivery capacity to New Jersey — a 52% increase.[14] Further analysis shows that by 2018, more pipeline capacity was added and excess capacity is now conservatively estimated at

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13 Skipping Stone Inc. President Greg Lander is responsible for strategic consulting in the mergers and acquisition arena with numerous clients within the energy industry. As an expert in the energy industry he has advised and given testimony at numerous FERC, state-level, arbitration, and legal proceedings. Lander has served for 22 years as a Member of Board of Directors for the North American Energy Standards Board, and its predecessor, the Gas Industry Standards Board. As Chairman of the Business Practices Subcommittee he drafted approximately 450 initial industry standards that are now codified FERC regulations.

14 Lander, Greg. (2016, September 12). PennEast Analysis of Alternatives, p. 11. Skipping Stone. https://rethinkenergynj.org/wp-content/uploads/2016/09/PennEast-Analysis-of-Alternatives_Skipping-Stone_Sept-12-2016.pdf.

more than 2 billion cubic feet per day (bcf/d).[15] This estimate of excess capacity means that there is currently about 35% more pipeline capacity than needed to meet peak demand. Figure C depicts this analysis.

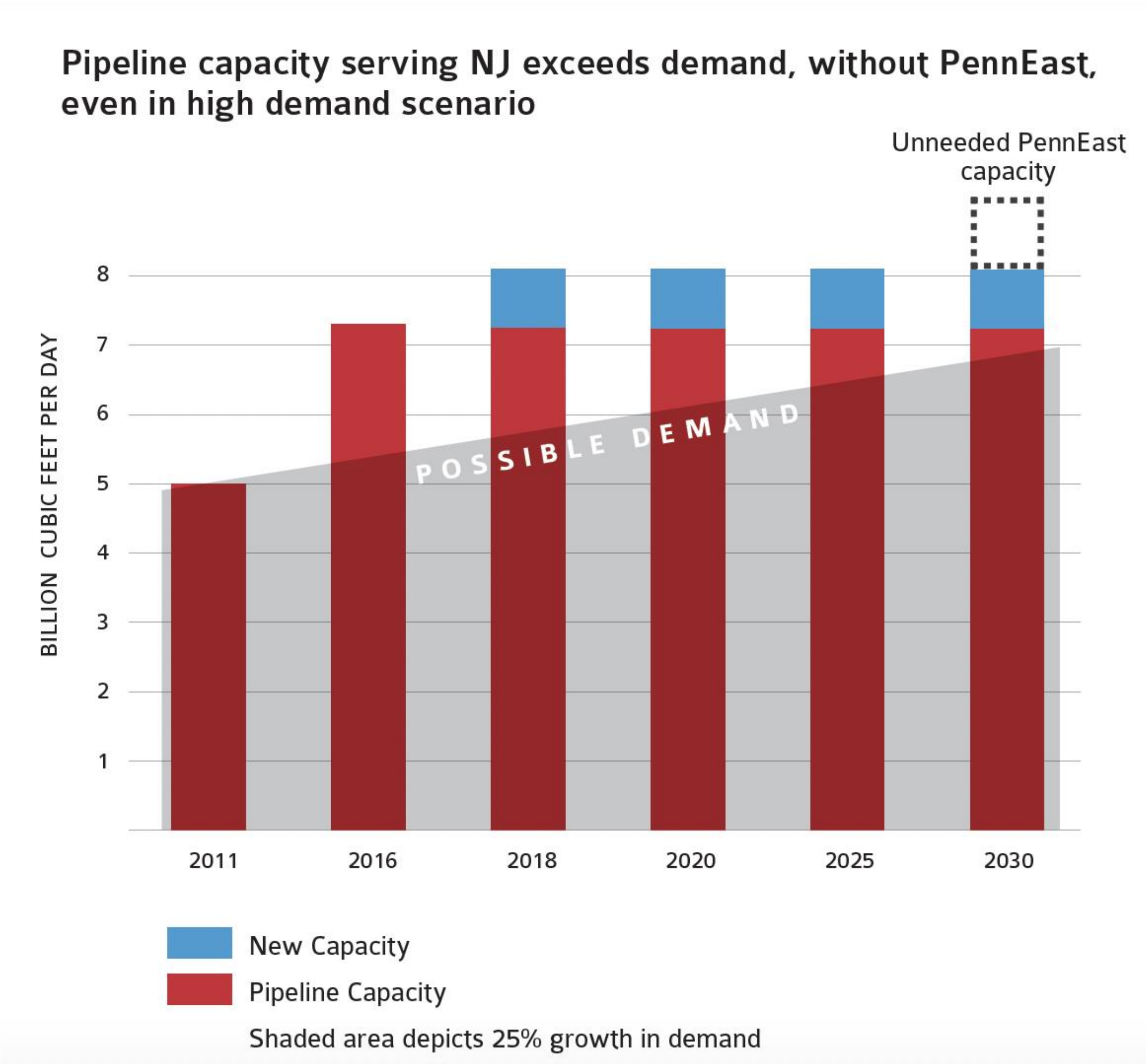


Figure C. Actual pipeline capacity in 2018 compared to possible increasing demand

The current glut of capacity will persist to 2030 and beyond. Analysis by Skipping Stone shows that pipeline capacity serving New Jersey will exceed demand by at least 1.3 billion cubic feet per day (bcf/d) by 2030, even in the unlikely scenario in which peak demand continues to grow by 25% through 2030. PennEast would increase this unneeded, excess

15 Blumenthal, B. (2018, September). A solution in search of a problem: Analysis shows no need for PennEast pipeline. New Jersey Conservation Foundation. Retrieved from https://rethinkenergynj.org/wp-content/uploads/2018/09/NJCF_Sept2018_PennEastReport_SolutionInSearchOfProblem_FINAL.pdf

capacity to 2.3 bcf/d in 2030. In the near term, PennEast would increase excess capacity from about 2 bcf/d to 3 bcf/d. Of course, any progress on reducing emissions and achieving climate goals would significantly reduce peak demand and further increase this substantial excess pipeline capacity.

In February 2018, Skipping Stone reconfirmed its finding of excess capacity using new data from the extreme cold period (referred to as the "Bomb Cyclone") from December 2017 through January 2018, stating:

> This analysis shows that PennEast is not needed to meet peak winter demand, not even for a single day, even during extreme weather events. Given the addition of Atlantic Sunrise capacity by June 2018, which increases capacity in the region by another 14%, and the existence of substantial, in-region, interstate-pipeline connected, peaking supplies, it is difficult to imagine any scenario for at least a decade where additional pipeline capacity will be required.[16]

c. No risk of outage shown for catastrophic event during peak winter period

An important question for policymakers and regulators is whether New Jersey residents will be able to obtain gas to heat buildings even if a major outage occurs on an interstate pipeline supplying New Jersey. In April 2016, a rupture occurred on Texas Eastern pipeline, but did not lead to any shortfall for contracted customers in New Jersey. This event led to an important question: what would have happened if the explosion had occurred in the winter?

Skipping Stone evaluated this question for a specific cold day in 2018 (a date suggested by a New Jersey gas utility) in order to determine whether this gas utility would be able to obtain a portion of its contracted supply in the event of a rupture on Texas Eastern. To the surprise of many, analysis showed that the utility would have obtained **100% of contracted supply**, due in part to substantial excess capacity in the pipeline system as of 2018 during peak winter events.

It is important to understand how pipelines operate under a catastrophic event, or "Force Majeure." First, curtailment of firm contracted capacity is governed by pipeline tariffs. The pipeline is required to provide supply from other sources, as dictated by their tariff. If any shortfall remains, the rules require that secondary supply on other pipelines must first be offered to fill any curtailment gap for firm contracts, before satisfying the requirements of customers with interruptible supply contracts.

The IEP will provide more specific information about the consumption of natural gas for electric generation and building systems. The final EMP should use this analysis to provide a clear and specific timeline for the decline of natural gas in New Jersey.

d. Presume that further gas pipeline expansions are not needed

[16] Lander, Greg. Analysis of Regional Pipeline System's Ability to Deliver Sufficient Quantities of Natural Gas During Prolonged and Extreme Cold Weather (Winter 2017-2018). February 11, 2018, p. 3. Skipping Stone. https://elibrary.ferc.gov/idmws/common/OpenNat.asp?fileID=14820449.

While the EMP does not contemplate conducting detailed analysis of each proposed pipeline project as discussed above, it should rely on expert analysis where it is available. The EMP should state clearly that some gas pipeline projects have been subject to rigorous analysis and have been shown **not to provide** claimed benefits, such as reduced costs, or to fill a defined gap in reliability, even if demand were to increase.

Further, knowing that existing pipeline capacity is sufficient and that future consumption will decrease rather than increase, the EMP can state with confidence that regulators should ***presume*** that further expansion of pipeline capacity is not needed, unless shown otherwise by specific analysis of gas flows and contracts.

PennEast is one such pipeline for which there has been substantial analysis of winter capacity needs, reliability, cost and alternatives. The State of New Jersey has taken a strong legal stand that there is no need for PennEast. The Southern Reliability Link proposed by New Jersey Natural Gas is another project for which expert analysis has shown that the project cannot be justified on the basis of need, cost or reliability.

The final EMP should reinforce New Jersey's clear and strong authority to deny permits for natural gas and other fossil fuel infrastructure projects that don't meet the state's stringent environmental standards under existing laws and regulations. In addition, the final EMP should call for the BPU and DEP to develop a process to evaluate proposed fossil fuel projects for consistency with the IEP/EMP, and to incorporate this consistency determination into their regulatory and rate recovery review of such projects.

VI. Additional EMP topics

a. Interim targets

2019 legislation enacted amending the Global Warming Response Act requires NJ DEP, in consultation with the NJ BPU and other agencies, to establish interim targets that are necessary to ensure that New Jersey is on track to reach the 2050 targets under the act.

Establishing interim emissions targets for 2025 and 2030 for major sectors (transportation, buildings, electric generation) will be helpful to guide policy development and should be chosen based on IEP pathways and other analysis. Targets should also take into account the latest climate science and IPCC targets that stress the urgency of reducing emissions to stave off the worst effects of climate change. Climate science increasing indicates that either total global GHG emissions must be eliminated relatively soon, or technologies to permanently remove GHGs from the atmosphere must be developed and widely deployed by mid-century. The EMP should propose that mix of aggressive interim targets and such negative carbon technologies that the Murphy Administration believes is most achievable and sustainable within the coming three decades — keeping in mind that New Jersey's success at lowering costs while dramatically reducing GHG emissions is likely to have the biggest impact on regional, national and even international emission reductions. Targets should also be revisited with each IEP planning cycle, to reflect the latest climate science and low-cost pathways in light of evolving technologies and costs.

b. Solar siting in New Jersey

There is great potential for appropriately-sited community solar projects to advance clean energy and ensure greater access to solar energy for residents and communities that have generally lacked access to solar energy. At the same time, New Jersey has placed a premium on preserving our remaining open spaces that sequester carbon and provide clean water, healthy produce, scenic beauty, wildlife habitat and outdoor recreation for the benefit of present and future generations. Therefore, the EMP and the BPU should ensure that future solar development of all forms is subject to clear and strong siting guidelines and policies that guide solar development to preferred locations as identified in NJ DEP's 2017 updated solar siting guidelines, and avoid unnecessary conflicts with the state's longstanding and ongoing land preservation and natural resource protection efforts.

The siting of solar development on preserved Green Acres properties should be limited to projects that utilize existing parking lots for solar canopies, or existing buildings for rooftop solar. These exceptions should be clearly stipulated and exclude solar development that conflicts with protecting the natural, recreational or scenic values of these lands.

The EMP should prohibit solar development on forests, given the numerous benefits including carbon sequestration that forests provide, and the abundance of more appropriate locations available in our state. The importance of preserving more natural carbon sinks such as forests and other greenfields to combat global warming will only increase in the future.

VII. Answers to EMP questions

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

> New Jersey is currently targeting the installation of 3,500 MW of offshore wind generation by 2030, but there is likely room for much more growth. Can New Jersey achieve more? Why or why not, and if so, how much is feasible? What concerns and barriers must we address in developing this resource?

New Jersey should first evaluate the technical potential for offshore wind, and estimate a timeline for the development of new lease areas. Given a conservative projection of total potential, the state then should select near term targets based on analysis in the IEP process. This analysis will provide insights about how much additional development is part of the optimized mix.

Policymakers should exercise caution about increasing the targets for offshore wind before 2030, unless it is informed by regional electric system analysis. For example, it is likely that substantial flexible resources will be needed to integrate up to 3,500 MW of offshore wind by around 2030. Additional transmission may also be needed to export electricity when offshore wind and nuclear plants are both operating at times of low load, with substantial trade-offs likely between the amount of local flexibility — which may be provided in large part by electric vehicle charging and flexible electrification of buildings — and the amount of transmission needed. Finally, even with substantial amounts of flexibility and new transmission, the economic impact of offshore wind on PJM energy and capacity revenues received by New Jersey's nuclear plants — if they are still in operation at that time — may be such that the nuclear plants will be uneconomic, even under the current ZEC provisions.

> How should New Jersey address the solar and NJ Class I cost cap established in the Clean Energy Act?

The cost caps include the cost of legacy solar SRECs, transition solar, successor solar and remaining Class I RECs needed to achieve the RPS goals set for each year. The most significant factor in whether the cost caps will be met is the level of compensation paid through SREC prices to legacy solar projects after the SREC program is closed to new applications. If SREC prices, in the closed market, are allowed to reach and remain at historic high levels, it is unlikely that the cost caps will be met while continuing to achieve the RPS goals. By contrast, if the BPU takes effective steps to ensure that the price of SRECs in the closed market do not reach excessively high levels — and equally important, do not fall to levels that would be punitive to many legacy solar projects, then all indications are that continued solar development, along with a mix of enough Class I RECs and ORECs to meet the RPS goals, can be achieved within the RPS budgets. As discussed above, the IEP / EMP process can help the BPU fine-tune the solar program to ensure the RPS budgets are not only met, but optimized in terms of their public interest benefits. While we believe such an outcome is entirely feasible, should it turn out that the level of SREC compensation needed to stay within the RPS cost caps while meeting the RPS goals is simply too low to be acceptable to legacy solar project owners, the best solution may be to develop a new, longer dated but no more costly SREC compensation mechanism, which would likely require legislative authorization. The BPU, in light of the insights it is gaining into the state's solar industry through the solar transition proceedings, could play a key role in determining whether such a compensation mechanism is needed and, if so, how it might best be structured.

The BPU can also take further steps to reduce the impact of Class I RECs on ratepayer costs. Currently, total expenditures for RECs (with prices around $10/MWh) is by far the smallest portion of the cost cap budget. Nevertheless, the BPU should explore a number of different ideas that could reduce the cost of acquiring Class I RECs. A simple idea that can be implemented quickly by BPU staff is to allow solar developed outside of NJ, that produces a PJM REC to qualify as a Class I REC in New Jersey. The current BPU interpretation only allows RECs generated by solar within New Jersey to count as Class I RECs.

The BPU can also explore requiring EDCs or other entities to contract for renewable energy which could further reduce the cost of RECs, while leading to significant new renewable development, as described in the comments.

> Does the allowance in the current RPS on the use of unbundled Renewable Energy Certificates (RECs) interfere with state efforts to incentivize in-state renewable energy power generation?

No, in fact, it facilitates those efforts. This is because spending even a relatively small fraction of the RPS budget on unbundled RECs can provide a substantial share of the total RPS requirement. The result is the much larger fraction remaining can then be spent on buying a large amount of in-state resources. By contrast, spending all the money on in-state resources would only add a relatively small amount of additional in-state resources, while failing to meet the RPS goals. The only way to meet the RPS goals, within the statute's RPS cost caps, is to spend a relatively small share of the total budget, under the cost caps, on low cost unbundled RECs, saving most of the budget for procuring a relatively small amount of the more expensive, clean SRECs and ORECs, generated inside the state.

> Which policy mechanisms do you recommend the state implement to lower the cost of capital for in-state renewable energy power generation?

Longer term, fixed price instruments, with the incentive level set by competitive processes or market indicators, are the best way to reduce the cost of capital. The state should explore ways to qualify PPAs for new renewables entered into by new categories of counterparties, such as municipalities and corporations, to qualify for RPS compliance.

> What policy, legislative, or regulatory mechanisms can New Jersey develop to ensure that it can most cost-effectively pursue a 100% carbon neutral power sector?

The IEP / EMP process to identify the least cost mix, considering type, quantity, and location, of clean energy supply and balancing resources is the first step. Long-term, fixed price incentive or purchase contracts, as suggested above, are the second. For resources where PPAs or other market-based instruments are unlikely to work, then incentive mechanisms should simulate these results, as is called for in the Clean Energy Act for the solar incentive program.

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

> What are the strengths and weaknesses of the utility-run energy efficiency programs, third- party supplier-run energy efficiency programs, and state-run programs that NJBPU should consider?

Contracting impediments within a state-run program make it an ineffective approach for program delivery.

Strategy 5: Modernize the Grid and Utility Infrastructure

> How should NJBPU consider planning and paying for upgrades to the electricity distribution system, including Distributed Energy Resource (DER) connections; EV charging; and utilities' recuperation of cost?

> What best practices should New Jersey consider and which pitfalls should the state avoid regarding data ownership and privacy as it pertains to Advanced Metering Infrastructure?

The first step is to avoid a "shopping spree" approach to DERs and the related, but broader issue of grid modification (gridmod). There is no shortage of advocacy for the policies intended to support or hasten the comprehensive redesign of distribution systems; full deployment of Automatic Metering Infrastructure (AMI) and its addition to regulated utility ratebase, with no definition of AMI or any cost-benefit analysis; new utility System Control and Data Acquisition (SCADA) networks, including new secure, dedicated, utility-owned and ratebased data transmission systems that ignore the already available capabilities of the internet and the cloud; new layers of utility-owned Automatic Distribution System Management Systems, (ADMS), Distributed Energy Management Systems (DERMS);; creating Distribution System Operators (DSOs) or Independent Distribution System Operators (IDSOs); setting up real-time pricing systems for locational prices on the distribution system for DERs; transforming the existing utilities' cost of service regulation to incentive regulation; allowing or requiring regulated utilities to extend their monopoly to electric vehicle charging infrastructure; relaxing utility affiliate controls so that utilities can use their shared joint and common costs to subsidize affiliates to compete with private sector providers of other DERs; etc., etc.

The BPU and the final EMP should avoid this shopping spree mentality, because all of these wildly popular ideas have the potential to increase costs to ratepayers dramatically and far in excess of any benefits they might offer. All of them run the risk of dramatic increases in regulated utility ratebases and so to produce rates that could easily exceed the ability and willingness of utility ratepayers to pay — especially if growing numbers of consumers can buy cheaper solar-plus-storage from a friendly, competitive solar company and dramatically reduce both the amount of energy and the amount of capacity they buy from their regulated utility. This is a recipe for massive ratepayer revolts, and financial catastrophes for the regulated utilities and their investors, who might well end up wishing they had simply "stuck to their knitting" of maintaining wires and transformers, rather than try to do everything, and put it all in their ratebase.

Instead of going on a shopping spree, the Board should:

1. Use the IEP and related processes to develop a "first cut" indication of what types and amounts of DERs will actually be needed, over the course of the next decade, for the state's first stages of developing an optimized clean energy portfolio. That is, the combination of regional and local renewables and a wide range of flexible, clean resources — including emerging clean firm generation technologies — that will minimize the cost of decarbonizing the state and, as much as is possible, the region.

2. Take this "first cut" optimized mix and amount of DERs, and through a focused distributed energy planning process, identify the specific changes to New Jersey's four distribution systems — including any changes to metering equipment, data acquisition and

management, DER aggregation and optimization, safety and reliability management, voltage and reactive power management — would be needed to be installed over the next 10 years to safely accommodate the optimal DER resources.

2 (a). In parallel identify the market interface equipment and technology needed to allow the DERs to interact with the wholesale market in ways and to the extent needed to actually help balance variable renewable energy.

By this time, many of the acronyms and rate-base additions in the typical grid-mod shopping spree list should have been winnowed out or, alternatively, planned for in an appropriate scale and scope.

3. Update the next IEP cycle with the costs of all of the above modifications, along with the costs of the DERs themselves, and iterate the optimization analysis to arrive at a solution with the optimal path of DER deployment and supporting distribution system modifications.

4. Once the optimal package of DERs and grid modifications are actually known, develop and implement the policies that will govern their actual procurement, development, and utilization. Generally, we believe costs will be minimized and performance maximized if these policies rely on competitive development, operation, aggregation, optimization and marketing of DERs, with regulated utilities providing only those elements that clearly fit within their natural monopoly functions of owning infrastructure elements that cost substantially less if owned by a single firm rather than by multiple firms.

Appendix A — Limitations of current renewable policies

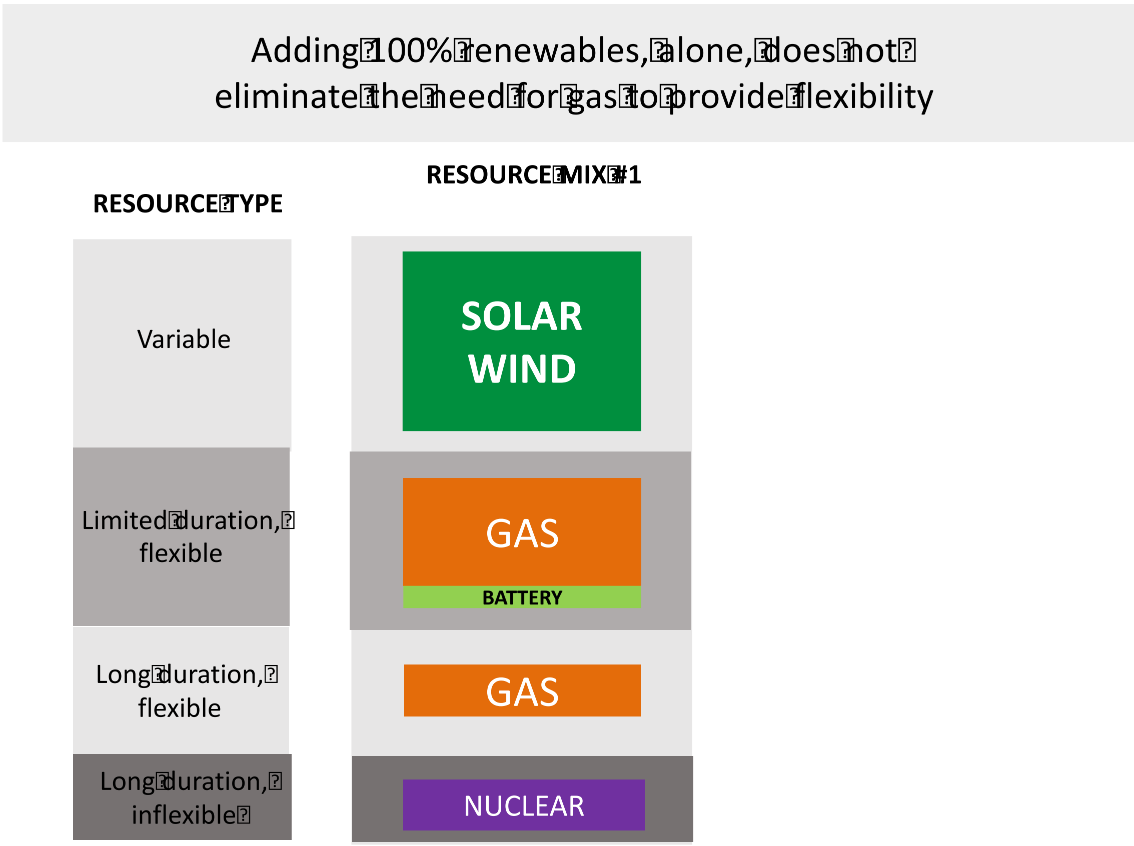
New Jersey was one of the early states to develop legislation addressing climate change. In the 90s, it was understood that it was essential to promote the development of renewable energy, particularly solar and wind, and that these industries needed financial incentives to develop these resources. Policies were developed that, rather than focusing on emissions reductions, focused on promoting specific technologies and industries. Fortunately, New Jersey played a role in the early development of the solar industry and currently has 2,500 MW of installed solar capacity. Currently, New Jersey is moving ahead to develop another new industry — offshore wind — and continues to support the development of solar and wind in New Jersey and in PJM.

But simply expanding renewables is no longer a sufficient policy solution. In the not-too-distant future, when generation from offshore wind begins and in-state solar continues to grow, New Jersey will face a new challenge: how to provide flexibility needed to integrate higher levels of renewables, cost-effectively. Currently, fossil power plants provide a combination of generation and flexibility services that are required to assure that the lights stay on. Simply adding more renewable generation does not provide an answer to the electric grid's need for fast ramping, daily fluctuations in production, or dispatchable generation during seasonal periods of low renewable production.

Figure A depicts what happens when a region deploys very high levels of renewables, without adopting policies that address the need for clean flexible resources. While overbuilding renewables and requiring curtailment of excess production is a strategy some support, too much of both of these approaches to flexibility will be extremely expensive. As shown in resource mix #1, without region-wide strict prohibitions of fossil fuel use, **natural gas would continue to be used** for some daily flexibility and for much of seasonal flexibility and would limit further emissions reductions. Importantly, this gas, as well as excessively high levels of renewable curtailment, would cost more than a cleaner, optimized resource mix.

For the last 30 years, the overwhelming clean energy challenge was to deploy enough new, more expensive, clean energy technologies to get these technologies across the threshold of commercial viability. Now that solar, wind, batteries, and digitally controllable load are all highly commercialized and are increasingly cheaper than traditional resources, the challenge is integrating all these new technologies into the electric system in ways that reduce consumer costs, increase reliability and resilience, while replacing fossil fuel-based electricity and its associated emissions. We know these results are possible, but they cannot be achieved by continued reliance on old policies intended to simply deploy more renewables and energy efficiency.

Figure A. Depiction of resource types required for a reliable grid under one policy approach



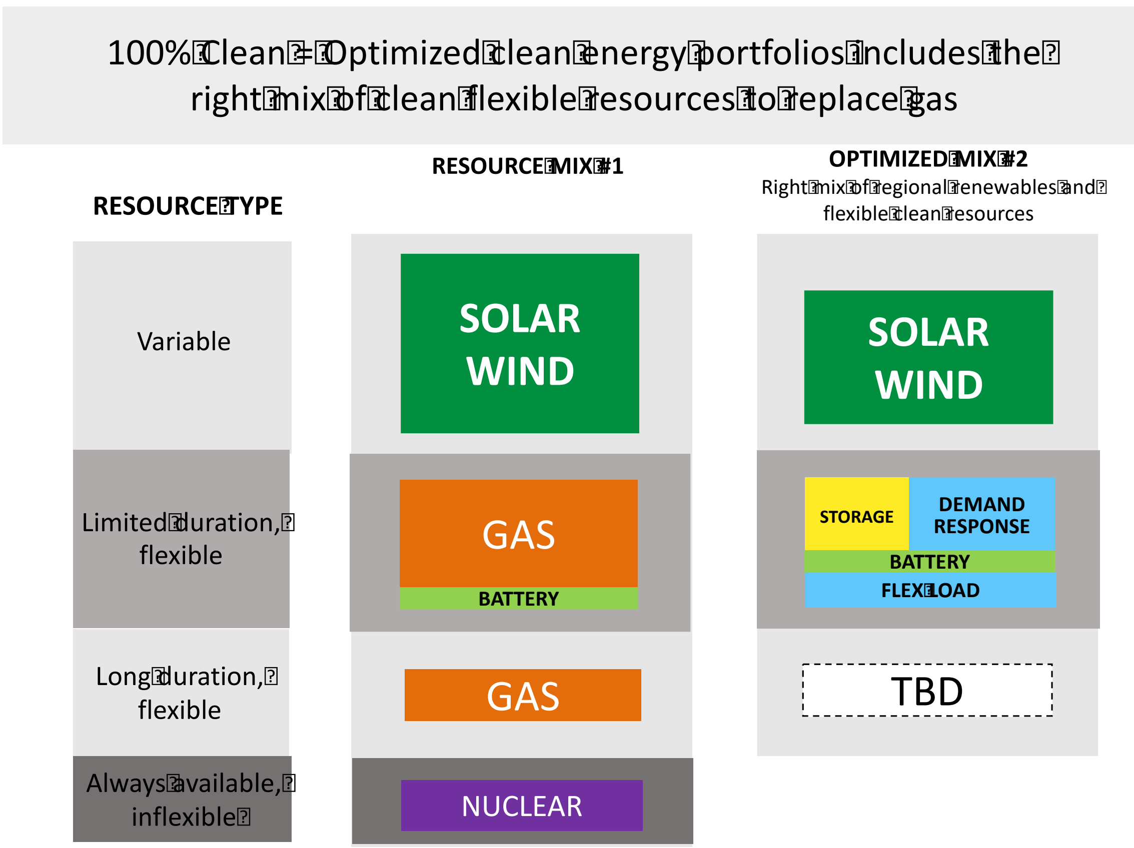
Recent studies show that an optimized mix of clean generation and clean flexible resources can achieve high levels of decarbonization while maintaining a reliable electric grid. These models simulate the electric grid operation every hour, each year until 2050, and demonstrate that an increasingly clean mix of resources will ensure reliable electric service while maintaining appropriate reserve capacity. Figure B compares a resource mix with high levels of renewables (mix #1) with a regionally optimized portfolio of clean energy resources that addresses the need for flexibility and replaces gas (mix #2).

Figure B also points to the need for new "firm" clean resources to provide longer duration flexible generation in order to completely eliminate natural gas and achieve 100% clean electricity. Our review of numerous high renewable integration modelling exercises and studies indicates that removing the last 20% or so of GHG emissions from the power sector is dramatically more expensive than removing the first 80%, primarily because of the very large amount of clean flexibility needed to achieve full decarbonization. Typically, these resources need to be able to operate for longer periods of time than current battery-based storage technologies, but with considerably more flexibility and extended periods of little or no operation than existing nuclear technologies. Further, we are aware of studies that suggest that cost savings will be much greater with "firm clean resources", such as

Canadian hydro or next generation nuclear, than simply with mixes of wind, solar, batteries and flexible load.[17]

Innovation will be required to address this need cost-effectively in future scenarios that achieve 100% clean (or carbon neutral) electric generation by 2050. Innovative firm clean technology would be addressed with a number of technologies, including the availability of a zero-carbon biogas fuel, next generation nuclear, or by PJM interconnections accessing additional Canadian hydro resources.

Figure B. Comparison of resource types required for a reliable grid under two policy approaches



[17] Ben Haley, Ryan Jones, Gabe Kwok, Jeremy Hargreaves & Jamil Farbes, 350 PPM Pathways for the United States, Evolved Energy Research, May 8, 2019. https://www.evolved.energy/single-post/2019/05/08/350-ppm-Pathways-for-the-United-States
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