Committee Meeting

of

SENATE ENVIRONMENT AND ENERGY COMMITTEE

"The Committee will meet to hear testimony from invited guests on what actions the State should take to achieve net-zero greenhouse gas emissions by 2050, and the cost of those actions to ratepayers"

LOCATION: Committee Room 10
State House Annex
Trenton, New Jersey

DATE: March 14, 2022
10:00 a.m.

MEMBERS OF COMMITTEE PRESENT:

Senator Bob Smith, Chair
Senator Linda R. Greenstein, Vice-Chair
Governor Richard J. Codey
Senator Edward R. Durr, Jr.
Senator Jean Stanfield

ALSO PRESENT:

Christina Denney
Eric Hansen
Office of Legislative Services
Committee Aides

Joseph Gurrentz
Matthew H. Peterson
Senate Majority
Committee Aides

Rebecca Panitch
Senate Republican
Committee Aide

Meeting Recorded and Transcribed by
The Office of Legislative Services, Public Information Office,
Hearing Unit, State House Annex, PO 068, Trenton, New Jersey

Bob Smith
Chairman

Linda R. Greenstein
Vice-Chairwoman

Richard J. Codey
Edward R. Durr, Jr.
Jean Stanfield

NEW JERSEY STATE LEGISLATURE

SENATE ENVIRONMENT AND ENERGY COMMITTEE

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COMMITTEE NOTICE

TO: MEMBERS OF THE SENATE ENVIRONMENT AND ENERGY COMMITTEE

FROM: SENATOR BOB SMITH, CHAIRMAN

SUBJECT: **COMMITTEE MEETING - MARCH 14, 2022**

The public may address comments and questions to Eric Hansen or Christina Denney, Committee Aides, or make bill status and scheduling inquiries to Pamela Cocroft, Secretary, at (609)847-3855, fax (609)292-0561, or e-mail: OLSAideSEN@njleg.org. Written and electronic comments, questions and testimony submitted to the committee by the public, as well as recordings and transcripts, if any, of oral testimony, are government records and will be available to the public upon request.

The Senate Environment and Energy Committee will meet on Monday, March 14, 2022 at 10:00 AM in Committee Room 10, 3rd Floor, State House Annex, Trenton, New Jersey.

The committee will meet to hear testimony from invited guests on what actions the State should take to achieve net-zero greenhouse gas emissions by 2050, and the cost of those actions to ratepayers.

The State House Annex has reopened to the general public. The Committee will meet in-person and there will not be an option to participate by telephone or video.

Visitors are required to wear a mask to access the State House Annex, in hallways, and in certain other facilities. Masks may be required in Senate Committee Rooms. Please visit https://www.njleg.state.nj.us/Publications/PDF/JMC%20Rules.pdf for more information.

The following bill(s) will be considered:

S333 Singleton/Scutari	Prohibits persons convicted of criminal animal cruelty offenses from owning domestic companion animals and from working or volunteering at animal-related enterprises; establishes presumption against pretrial intervention for certain persons; designated as "Moose's Law."

(OVER)

S429 Smith, B	Provides corporation business tax and gross income tax credits for purchase and installation of electric vehicle charging stations and for commercial zero emission vehicle fleet conversions.
S438 Smith, B	Changes entity responsible for management of NJ School of Conservation to nonprofit organization, and directs DOE to request funding for center annually.
S981 Diegnan/Gopal	Revises law prohibiting cruel tethering and confinement of dogs; establishes procedures for seizure, care, and forfeiture of animals involved in animal cruelty violations.
S1369 Vitale A642 (1R) Coughlin/Dancer	Concerns use of steel slag as aggregate.
S1679 Pou	Requires DEP to prioritize funding for environmental infrastructure projects for applicants with established program to employ, at project or related facilities, local residents or residents of nearby urban aid qualifying municipalities.
SR67 Smith, B/Stanfield	Urges Atlantic States Marine Fisheries Commission to continue prohibiting harvest of female horseshoe crabs.

FOR DISCUSSION ONLY:

S431 Smith, B/Greenstein (pending referral)	Directs BPU to update interconnection standards for Class I renewable energy sources and develop fixed fee structure for interconnection costs.
S2185 Smith, B/Greenstein	Requires BPU to develop program to incentivize installation of new energy storage systems.

Issued 3/7/22

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(This is an excerpt from the Senate Environment and Energy Committee meeting of March 14, 2022.)

SENATOR BOB SMITH (Chair): So the order of the next item of business-- And I mention it only because Senator Lesniak is here, and I know he's here for some of the animal bills.

We do have a promise, however, to a Princeton -- a very fine Princeton professor. Every one of our committee meetings starts with a discussion of global climate change and what are the solutions. And, because I didn't have my trusty notes immediately available, I forgot. So let me ask Jesse Jenkins to come forward, and let me tell you a little bit about him, and right after that, we'll get into it.

Jesse Jenkins is an Assistant Professor at Princeton University in the Department of Mechanical and Aerospace Engineering, and the Andlinger Center for Energy and the Environment. He is a macro-scale energy systems engineer, with a focus on a rapidly changing electricity sector, including the transition to Zero-Carbon resources, the proliferation of distributed energy resources, and the role of electricity in economy-wide decarbonization.

Professor Jenkins leads the Princeton ZERO -- Z-E-R-O, capital letters -- Lab, the Zero-Carbon Energy Systems Research and Optimization Laboratory, which conducts research to improve decision making to accelerate rapid, affordable, and effective transitions to net-zero carbon energy systems.

Professor Jenkins also served as Co-Principal Investigator of the Princeton *Net-Zero America* study, which offers guidance on how to build a

net-zero greenhouse gas emission economy in the United States. Professor Jenkins has been published in peer-review journals and advised Federal and state regulators on energy policy.

I think you'll find Professor Jenkins' input today to be really fascinating and maybe a totally different approach to global climate change.

So, Professor, take it away.

J E S S E D. J E N K I N S, Ph.D.: All right, thank you, Chairman Smith, and honorable members of the Committee.

I appreciate the opportunity to testify today and to share the findings of a new study that was published today from my Princeton ZERO Lab on pathways for New Jersey to reach 100 percent carbon-free electricity supply.

As the Chairman mentioned, my name is Jesse Jenkins; I'm an Energy Systems Engineering Professor at Princeton University, but I must note that my views expressed today are my own and do not represent the views of the University.

So as you know, New Jersey is among a vanguard of states that is pursuing a pathway to a 100 percent carbon-free electricity system. In 2018, Governor Phil Murphy's Executive Order 28 set the goal of 100 percent clean energy by 2050, and tasked the State's Board of Public Utilities, in consultation with other State agencies, to develop the New Jersey Energy Master Plan to provide a comprehensive blueprint for the State's conversion to a carbon-free electricity supply. Additionally, the State's Global Warming Response Act of 2007 directs State agencies to develop plans and policies to reduce emissions of greenhouse gasses across the entire economy by 80 percent by 2050.

The Energy Master Plan was released in January 2020, which defines the goal of 100 percent clean energy as 100 percent carbon-neutral electricity supply by 2050; as well as maximum electrification of transportation -- electric vehicles; and buildings -- like electric heat pumps for water heating and space heating -- in order to meet or exceed the requirements of the Global Warming Response Act. The Master Plan includes comprehensive modeling of pathways to transform the State's energy system, and outlines a set of key strategies to reach New Jersey's clean energy goals. The Master Plan rests centrally on electrification of vehicles and buildings, accelerated deployment of renewable and distributed energy sources, retention of our existing nuclear power plants, and improved energy efficiency.

Well, today, after a two-year effort initiated by Dr. Chuan Zhang and Neha Patankar, and ably completed, under my supervision, by Dr. Qingyu Xu, The Princeton ZERO Lab is releasing a new study entitled *New Jersey's Pathways to a 100% Carbon-Free Electricity Supply*. The goal of this study is to provide an independent, detailed assessment of key policy and technology options and choices, and their implications for New Jersey as we chart the path to 100 percent clean electricity. In particular, this study examines least-cost options for New Jersey's current laws -- to reach New Jersey's current laws and stated policy goals under a range of possible future conditions, and to explore the role of in-state solar photovoltaics (PV), offshore wind, nuclear power, gas-fired power plants, and imported electricity from the rest of the region in the State's electricity future.

Our goal is to provide an independent assessment of costs and trade-offs associated with our different choices that face stakeholders and

decision-makers in the region, and to provide actionable insights to guide decisions.

For this study, we used a state-of-the-art electricity system optimization model, originally developed by myself at MIT, and now jointly supported by the MIT Energy Initiative and the Princeton ZERO Lab. This model plans investments and operational decisions to meet our projected future energy demands, while meeting all relevant engineering, reliability, and policy constraints, all at the lowest affordable cost. We create a detailed model of the New Jersey electricity system, as well as the broader PJM interconnection that we are a part of, and neighboring grid regions that we trade with, in order to explore a range of policy, technology, and fuel price scenarios to assess options for New Jersey to reach 100 percent clean electricity by 2050.

So now I'll summarize some of the key findings and takeaways of the study for the Committee. First, I think most importantly, a transition to 100 percent carbon-free electricity is feasible while maintaining necessary reliability and with reductions in bulk electricity supply costs. Across a range of possible futures that we model in the study, we find that a least-cost strategy to reach 100 percent carbon-free electricity by 2050 results in a 5 to 25 percent decrease in bulk electricity supply costs, relative to a 2019 cost benchmark. Bulk electricity supply costs include the cost of full-scale electricity generation, capacity, transmission costs, and policy support for bulk generation, energy storage, and distributed solar resources. Excluded in our totals are distribution network costs, retailing and hedging costs, and other policy charges that might be included in retail bills as well.

Second, though we find the lowest cost strategy, to reach 100 percent carbon-free electricity entails a significant increase in New Jersey's dependence on imported electricity. Imports of wind, solar, and other carbon-free resources from out of state are generally more affordable than available in-state resources, and so make up about two-thirds of New Jersey's electricity supply by 2050 in our least-cost strategy.

We also find that electricity demand could grow significantly, with total sales increasing by 70 percent, and peak demand increasing by 85 percent, as electrification of vehicles and buildings proceeds, consistent with New Jersey's economy-wide climate goals. These new demands for electricity will also shift the pattern of electricity consumption in important ways, from summer afternoon peaks driven by air conditioning demand, to winter overnight peak demands driven by electric vehicle charging and heat pump heating demands. That has important implications for the value of different resources in our mix; for example, the role of solar power, which produces most of its energy, of course, during the daytime and can't contribute to those winter overnight peak periods.

Fourth, we find that the lowest-cost pathway to a carbon-free electricity supply departs in important ways from New Jersey's current approach to policy, which prioritizes in-state and distributed energy resources, like rooftop and utility-scale solar, offshore wind, and our existing nuclear power plants.

We find that import dependence can be reduced by requiring more in-state renewable resources than in the least-cost strategy, and by preserving the state's existing nuclear reactors -- but this comes at a higher cost for New Jersey electricity consumers. The most affordable strategy that

we identified to prioritize in-state resources, which would meet about 80 percent of electricity demand in that scenario, increases our bulk electricity supply cost by about 7 to 10 percent relative to the least-cost strategy. Yet this strategy will result in costs that are still comparable to or lower than today's, ranging from about 20 percent below to 4 percent greater than 2019 costs, depending on the different uncertain futures that we look at.

Sixth, we also look at scenarios where all states in the region pursue parallel pathways to deep decarbonization goals, following New Jersey's lead, and proceeding to develop clean electricity sources and to electrify vehicles and buildings. We find that in this case, if other states follow our lead, it will increase costs for New Jersey by 16 to 20 percent in 2050. The reason for that is that greater demand for clean energy across the region drives up the cost of imports for New Jersey, as more people are demanding the same resources across the region. That means that bulk electricity supply costs in 2050 are higher, but still range from between 13 percent below and 11 percent above 2019 costs, assuming all states in the region pursue similar goals. So still roughly comparable to 2019 costs, but more reliant on in-state resources and with higher costs for imports.

If we take a look at some of the key technology options that New Jersey faces, our study finds the following: The least-cost pathway to 100 percent carbon-free electricity supply for New Jersey entails a substantial expansion of utility-scale solar resources; new gas-fired generating capacity, mostly efficient combined cycle power plants; and conversion of all of these gas plants to run on zero-carbon fuels by 2050. That could include some combination of hydrogen, biomethane or biogas, or synthetic methane produced from carbon-free or carbon neutral sources; as well as a significant

increase in imports, as I mentioned, of zero-carbon electricity from throughout the region. And then we also include off-shore wind, distributed solar, and storage capacity that's required by current statutes and regulations.

We looked closely at the role of New Jersey's existing nuclear plants, and concluded that preserving New Jersey's nuclear generators can reduce dependence on imports, and avoid an increase in fossil gas generation -- and associated CO2 emissions and air pollution -- that might otherwise occur in the 2030s when those nuclear plants retire and are replaced, in part, by natural gas generation. Supporting continued operation of New Jersey reactors after 2030 is consistently among the lowest cost options for in-state carbon-free generation. But we stress it would require ongoing policy support after 2030, when the current Zero-Emissions Certificates Program ends.

Additionally, if all states in the region pursue deep decarbonization and/or the state prioritizes in-state generation, maintaining nuclear operation is part of a least-cost strategy to meet the State's goals. We find that utility-scale solar is considerably lower cost than the distributed resources that have typically been supported by State policy. Expanding large utility-scale solar projects is part of the least-cost portfolio in all of our scenarios. In the end, though, deployment may be constrained in the long run by available land for citing of large-scale solar farms. So proactive steps to identify locations, and setting reforms and processes that could untap or unlock more utility-scale solar setting potential, would help lower the cost of our transition.

Expanding distributed or smaller-scale solar resources on rooftops or parking lots, or other facilities connected at the distribution level, will require more substantial policy support, but may become a lower-cost

option than off-shore wind by the 2040s, as cost declines for solar PV are expected to continue. We find that requiring about 23 gigawatts of distributed solar by 2050, which is similar to the values in the New Jersey Energy Master Plan, would increase our 2050 bulk electricity supply cost by about 6 to 11 percent, relative to the least-cost import-dependent strategy. But growing distributed solar could lower costs if the State is committed to 80 percent of our electricity from in-state resources.

I wanted to note that this study is limited in scope to modeling the wholesale electricity system at the transmission level, so distributed solar systems can result in additional costs and/or savings at the distribution level, depending on the pattern and scale of deployment, and these impacts are not assessed but are important to consider when we look at distributed solar.

Offshore wind is one of the more expensive options that New Jersey has for decarbonization, and we find in our modeling it is rarely deployed beyond current mandated levels across the scenarios that we modeled. There are some exceptions in futures where all states are pursuing deep decarbonization, and therefore we need to rely more on in-state resources, since out-of-state resources prove more expensive.

Flexible electricity demand -- we just heard about the importance of network charging -- can reduce New Jersey's peak consumption of electricity and help compensate for increased demand from electrification of vehicles and buildings. Unlocking this kind of flexible demand can substitute for what would otherwise be poorly utilized battery storage capacity or gas-fired generator capacity -- that is rarely used -- and could eventually lead to cost savings for New Jersey consumers on the order of half a billion dollars annually by 2050.

New Jersey gas-fired generating capacity actually expands in almost all of our modeling until 2040, while electricity generation, consumption of fossil gas, and related emissions from these units all decline. Gas-fired capacity, or the ability to produce power when needed, is needed to meet growing demand from electrification as we turn more to electric vehicles and heat pumps. But we use these resources less and less over time, as more clean energy deployment squeezes them out of their role in the energy mix. By 2050, these resources would all have to be converted to run on some zero-carbon fuel; or, if we pursue a carbon neutrality approach, any residual emissions would have to be offset by carbon removal technologies by 2050, when 100 percent carbon neutral electricity is required. By that point, these gas generators are used very infrequently, only to provide firm power during periods when both wind and solar output are very low.

Finally, New Jersey will need to expand our transmission capacity to increase deliverability between coastal and inland areas in the near term, in order to integrate the offshore wind that we're planning to deploy on the coast; as well as to significantly strengthen ties to neighboring regions, states in PJM, and New York in the longer term, in order to enable greater imports.

I'll leave it there and would like to leave some time for questions, if you have any.

And I appreciate the opportunity to share these findings.

SENATOR SMITH: Our biggest -- one of our biggest concerns is affordability. The actions that we need to take for global climate change we think will meet great resistance from the New Jersey public if there is a huge cost associated with it. And I noticed your first -- not your first choice,

but one of the first things you talked about, was getting more out-of-state renewable electricity as a model.

I don't know that New Jersey wants to be dependent on other states and their policies. If we rely more heavily on renewables in New Jersey, can we still say to our citizens, with a straight face, that there's a way to do that and keep the costs very manageable?

DR. JENKINS: Yes, so that's definitely the central choice that our study identifies -- how much do we want to depend on lower cost resources from throughout the region? Importing solar from North Carolina, for example; or wind from Indiana or Illinois or Pennsylvania, where the resource quality is better and there's more land availability.

And so we present, you know, sort of two poles of that, and we could land somewhere in between, of course. So the lowest-cost strategy is certainly to import resources from throughout the rest of the region -- again, that could result in a 5 to 25 percent decrease from current electricity supply costs, so certainly meeting our affordability needs.

But if we take current electricity costs as a benchmark and consider those as affordable, there are other strategies that would be higher cost than that but still affordable relative to today. The key would be to maintain our existing nuclear reactors and to develop utility-scale solar resources within the state. So larger multi-megawatt solar farms. Those are consistently the lowest-cost options for in-state carbon-free generation, offshore wind and distributed solar on rooftops being considerably more expensive; so we want to maximize the use of those resources before turning to more expensive resources, if affordability and in-state generation are our goals.

And of course, affordability is central but also there are other rationale for having in-state development. Economic development, environmental impacts could be a pro or a con, for setting in-state. And so our study doesn't comment on those other considerations, but tries to provide quantitative guidance on the affordability implications.

SENATOR SMITH: And would it be possible for you to send us the study that was released today--

DR. JENKINS: Yes.

SENATOR SMITH: -- so that we can share it with our members?

DR. JENKINS: Yes. I provided a summary I printed out for members today, and there's a link to the full report, which has additional detail for staff and others. And I'm happy to continue to discuss any of these findings.

You should also note that in the future-- We have now established this detailed model of the New Jersey electricity system, and we're happy to provide resources in the future to assess other scenarios that may be of interest to the Committee.

SENATOR SMITH: That will be very helpful for New Jersey.

Questions from other members?

Governor.

GOVERNOR CODEY: How the hell did you lose to Yale yesterday? (laughter)

DR. JENKINS: No comment on that.

GOVERNOR CODEY: Really? Did you go?

DR. JENKINS: No, I was traveling yesterday.

GOVERNOR CODEY: I didn't think so.

Let me ask you this. What would be the best investment for us to make right now, as a State, in terms of the environment?

DR. JENKINS: So the best from an affordability perspective, at least, would be to continue to develop larger utility-scale solar resources to try to unlock more flexible demand, so that we're not building transmission and distribution capacity or peaking power plants that are sitting around idle most of the time. Both of those are probably going to require both policy support and some regulatory reform in order to look at how we're going to cite utility-scale solar resources more effectively, and how to incentivize demand of -- electricity demand to be more flexible. Particularly new large consumption from electric vehicles or heating electrification, which has a lot of potential to shift around when it consumes and avoid those most heavily utilized periods.

So those are probably the two biggest ways, and then we are continuing -- we are now supporting our existing nuclear fleet through 2030; continuing that beyond 2030 would also help create a base of existing low-carbon generation that we can then build from in the state.

GOVERNOR CODEY: By the way, when I was Governor, I spoke at Princeton. And I got up and I said, "I was almost a student here, but I was 300 points short on the SAT." (laughter)

DR. JENKINS: I'm not sure I would have even been admitted by (indiscernible) either as a student, so no worries there.

GOVERNOR CODEY: And that was just on the math side. (laughter)

SENATOR SMITH: Any other questions from members for Professor Jenkins?

Senator Greenstein.

SENATOR LINDA R. GREENSTEIN (Vice Chair): Thank you.

A very large percent of the greenhouse gas emissions in our state, I guess about 40 percent, comes from the transportation sector. How would you characterize New Jersey's current progress, as we're moving toward electric vehicles and other things, in transportation emissions reduction; and what policy changes do you identify that could help reduce these emissions?

DR. JENKINS: That's a great question, and there are, of course, important implications for electricity demand as we emphasized in the report as well. So we have to tackle both challenges of reducing emissions in electricity and expanding our electricity supply -- clean electricity supply to prepare for electrification.

I would say New Jersey is amongst the leaders in the country for vehicle electrification -- that's thanks in part to State policy support; rebates for electric vehicle adoption within the state that add to Federal incentives, and make it an affordable option for more consumers to purchase electric vehicles. Greater support for EV charging networks is critical, I think, to promote mass adoption at this point. We're at a point now where the industry is at a turning point. You see companies shutting down their investment in internal combustion engine development and committing entirely to electric product lines, so the industry is responding, the mass market models are increasingly available in all vehicle segments.

And so now the key is that for the next, you know, eight years or so, it's likely that there will still be an upfront cost premium for purchasing an electric vehicle. So you'll see that sort of sticker shock up front; but the

cost of ownership is already lower today, including that upfront cost, for electric vehicles, because fueling costs are far lower, even before gas prices shot up, and maintenance costs are lower.

So taking that initial sting out of the purchase price through the continuation of those sorts of incentive programs can really help facilitate adoption, as well as ensuring that range anxiety and charging needs are met with a robust charging network. That's particularly important in places where you don't have off-street parking, so finding ways to develop networks for folks in city, urban environments, as well, is key.

New Jersey's policies have focused on light-duty vehicles, primarily, and bus fleets, which is a good place to start. But medium and light-duty vehicle fleets -- you know the vans and delivery vehicles that bring all of our Amazon shipments and things like that -- that could also be cost-effectively electrified now, as well, and further focus on those vehicle segments is important. They are also significant sources of air pollution since a lot of that fleet is diesel, and so there are significant environmental justice and public health improvements that would come along with that as well.

SENATOR GREENSTEIN: Thank you.

SENATOR SMITH: Any other questions from members?

SENATOR DURR: Would you say that -- because I'm reading reports, and maybe you can correct it -- is the mining for the batteries of the cars more harmful than what we have now?

DR. JENKINS: So I wouldn't say it's *more* harmful; I mean, there are different types of harms and they are important to consider as part of the supply chain. So cobalt and other metals that are used in lithium-ion batteries, some of them come from parts of the -- countries with terrible

human rights concerns, right, like the Democratic Republic of Congo. And so the industry is moving away from those sorts of things, and we need to continue to accelerate our reduction and independence on those sorts of minerals for batteries.

But from a total resource consumption perspective, and from an emissions perspective, it's far better to use electric vehicles today than to continue to--

SENATOR DURR: Are they looking to improve the quality, too? The American people are an impatient bunch, and I hear 45 minutes to charge.

DR. JENKINS: Yes, but you don't do that very often, right? You do that at home. And the convenience of not having to go to the pump every couple of days to fill up is also, I think, underappreciated.

Consumer satisfaction amongst folks who have adopted EVs is quite high, and you see that in the vehicle offerings that Ford, and GM, and others are offering now. Reservations for the F-150 Lightning, the electric truck, are done -- they can't meet the demand for the rest of the year. So I think there's a significant uptick happening as well, as the vehicles have gotten to the point where it's not just a little hatchback you can buy; now you can buy midsized SUVs, you can buy full-sized pickup trucks, you can buy vans. And so the technology has significantly improved in the last few years and the industry is investing heavily in making sure our needs as consumers are met.

SENATOR DURR: Okay.

Thank you.

SENATOR SMITH: Thank you, Senator.

Any other questions? (no response)

Professor Jenkins, we're going to put you on speed dial.

DR. JENKINS: Okay; thank you very much.

SENATOR SMITH: We do appreciate your comments.

DR. JENKINS: Thanks for the opportunity.

(END OF EXCERPT)