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December 12, 2022

New Jersey Public Board of Utilities
Acting Secretary of the Board
44 South Clinton Ave., 1st Floor
PO Box 350
Trenton, NJ 08625-0350

RE: Clean Energy Group Response to New Jersey Energy Storage Incentive Program (SIP) Straw Proposal, Docket QO22080540

Clean Energy Group (CEG) and Clean Energy States Alliance (CESA), two national nonprofit organizations working to advance an equitable and inclusive clean energy transition, appreciate the opportunity to provide this response to the New Jersey Public Board of Utilities (NJ BPU) regarding a request for comments on the New Jersey Energy Storage Incentive Program (NJ SIP) Straw Proposal, Docket No. QO22080540. These comments reflect the position of CEG/CESA, and do not necessarily reflect the positions of our partner organizations or funders.

Clean Energy Group/CESA extend their compliments to NJ BPU on developing a very good proposed program with a lot of positive aspects including the customer storage program, combined fixed and performance-based incentives, and provisions for enabling access and benefits to overburdened communities. In response to the NJ BPU's request for stakeholder comments, CEG offers the following comments on specific aspects of the proposed program.

SIP procurement allocation between BTM and FOM programs

NJ BPU has proposed a significantly larger procurement of grid supply storage than distributed storage. We note that in year one of the program, NJ BPU proposes grid supply capacity procurement three times the size of distributed capacity procurement; however, the proposed procurement for grid supply also accelerates faster than distributed storage procurement, so that by year seven of the program, the proposed grid supply procurement is ten times the distributed procurement. CEG/CESA believes this is out of balance and recommends a much higher rate of distributed storage procurement, for several reasons:

1. *Distributed energy storage should receive a greater share of the incentive budget because it provides greater benefits.* While grid supply storage typically provides bulk power benefits, distributed storage is capable of providing both bulk power benefits (for example, the Massachusetts ConnectedSolutions program and similar model programs that tie behind-the-meter (BTM) storage dispatch to grid needs) *and* local, community benefits such as resilience, cost savings, and increased renewables use. While it is

technically possible for grid supply storage to provide local benefits, this is not typically the case, and doing so requires innovative and complex arrangements (such as multi-user microgrids) that tend to add significant cost and depend heavily on utility collaboration. We note that the proposed SIP does not include any requirements or incentives that would lead storage developers to configure grid supply storage in this manner.

2. *Distributed energy storage should receive a greater share of the incentive budget because it is essential to providing access to underserved communities and meeting NJ BPU's commitment to equity.* Equity energy storage projects tend to be BTM batteries hosted by community-serving facilities, such as firehouses, schools, churches, health centers, multifamily affordable housing, community centers/shelters and municipal buildings, located in historically underserved communities. These types of projects can directly benefit their communities by reducing energy cost burdens and providing clean resilient power during grid outages. As an important subset of distributed energy storage procurement, equity energy storage should have a carve-out and enhanced incentives (see comments below on incentives for projects in overburdened communities). These projects should not have to compete for limited incentive dollars with projects that are more easily financed, such as early-adopter corporations and upscale residential customers. A larger distributed storage procurement program will help ensure that a significant number of equity storage projects are able to access the SIP.

3. *Distributed energy storage should receive a greater share of the incentive budget because it is a flexible resource, is well-supported by established solar+storage development companies and is capable of rapid growth.* As we have seen in other states, distributed battery storage is capable of rapid growth. Once the appropriate markets, regulations, and incentives are in place, established companies will enter the New Jersey market, bringing with them third-party marketing, financing, installation and services provision. This can lead to very rapid growth in the distributed energy storage sector, as shown in Table 1, below, from the California Energy Commission's 2018 report on progress under the California energy storage procurement mandate:

Table 1: IOU AB 2514 Energy Storage Procurement

Pacific Gas and Electric					
	Target	On-Line Storage	Approved, Some Are in Progress	Pending Approval	TOTAL PROCURED
Transmission	310	0	0	692.5	692.5
Distribution	185	6.5	10	20	36.5
Customer	85	26.1	0	20	46.1
Southern California Edison					
	Target	On-Line Storage	Approved, Some Are in Progress	Pending Approval	TOTAL PROCURED
Transmission	310	20	100	0	120
Distribution	185	56	65.5	10	131.5
Customer	85	110	195	0	305

Note that although Southern California Edison's customer-sited storage target was much smaller than its targets for distribution and transmission-sited storage, the total customer storage capacity procured is greater than the transmission- and distribution-sited storage combined. This shows that customer-sited batteries can grow quickly under the right state policy and market conditions, just as distributed solar PV has done.

Incentives for Projects in Overburdened Communities

NJ BPU has requested stakeholder input on how to best design the incentive program for equity projects in historically overburdened communities. CEG/CESA recommends implementation of both a reserved capacity block AND an additional up-front incentive. *Both are important*.

- *Carve out.* For energy storage located in and serving historically overburdened communities, a carve-out is necessary to ensure that these communities will have the opportunity to participate. Without a carve-out, there is a risk that distributed storage incentives will be fully subscribed by more advantaged customers before overburdened communities are able to access the program. With regard to the size of a carve-out for overburdened communities, the NJ BPU should consider a Justice40 standard as recommended by the federal government and adopted by Connecticut in their Energy Storage Solutions program. For more information on the federal Justice40 initiative, see https://www.whitehouse.gov/environmentaljustice/justice40.

  However, **a carve-out alone will not be sufficient to overcome the additional cost and risk barriers associated with these projects** (for an example, look at the California SGIP program, which initially had a carve-out but no adders for low-income communities. There was no uptake until CA instituted equity adders, at which time the LMI budget was fully subscribed almost immediately). Therefore, **we recommend that the NJ BPU adopt both a separate capacity block and an additional up-front incentive for overburdened communities.**

- *Up-front incentive.* An up-front incentive is important to help offset higher costs and also higher risks of financing. For historically overburdened communities, the initial cost barrier of funding or financing an energy storage project can be difficult or impossible to overcome. While annual small rebates do add up over time, this type of incentive does require a greater initial investment. Therefore, CEG/CESA recommends that the fixed incentive be provided to equity projects up-front in full, and/or that a separate up-front incentive is provided, to reduce the initial cost barrier for these communities. (Note that the NPV of any incentive is greater when offered up-front than when paid out in a series of annual installments).

  NJ BPU may also wish to consider waiving the program participation fee for projects in historically overburdened communities (which may not all serve public entities and thereby qualify for the public entity exemption).

As a side note, we agree with other stakeholders who have commented that it is not enough for equity projects to be located in overburdened communities – they must provide real benefits to those communities. We therefore recommend that developers of equity energy storage projects be required to demonstrate how their project will benefit the host community, in order to qualify for equity project incentives.

Distributed system incentive cap

There should be an upper limit for distributed storage incentives, to prevent developers gaming the system with grid-scale storage behind meters that could suck up all the distributed storage incentives. For an example of this, see the recent report from Massachusetts ConnectedSolutions program administrators, who have received applications for BTM batteries in excess of 100X the capacity of the associated facility site peak load (see program update presentation at https://www.youtube.com/watch?v=9PtuT3bRmaA). Note that the Massachusetts program administrators are proposing to cap the ConnectedSolutions performance payments for such projects, but NOT to cap the size of the projects. This allows developers to install large BTM batteries for participation in other market programs, while ensuring sufficient incentive budget remains to support smaller community-benefit projects. (For more information on how the MA program administrators propose to address this issue, see the presentation at the above link.)

Availability requirements

While availability requirements make sense for grid supply energy storage, CEG/CESA does not recommend that distributed energy storage contracted to EDCs for performance payments should be required to additionally meet EFORd requirements. The New Jersey EDCs will develop their own availability requirements, and since performance payments are by definition contingent on actual performance, we view additional EFORd compliance requirements for small distributed storage projects as unnecessary and needlessly complex. Furthermore, it is likely that much of the distributed storage enrolled in the SIP will be administered by third-party developer/aggregators, who will have a financial incentive to ensure these systems are available for dispatch.

Interconnection barriers

Interconnection barriers are very real, as we have seen in other states where similar programs have been implemented. The NJ BPU may want to consider distribution system planning, or some other method of proactively and transparently addressing distribution system hosting capacity limits. Also, it is important to address potential barriers posed by the "cost-causation" model of paying for needed distribution system upgrades (first in pays). For an example of how interconnection cost barriers can frustrate program goals, see the recent history in Massachusetts, where 900 MW of proposed projects under the SMART solar incentive program were delayed for months and potentially years due to cluster studies and the failure of utilities to adequately plan for the inrush of solar and storage proposals under state incentive programs they themselves had helped to design and implement. Massachusetts had moved from cost-causation to cluster studies (which did not work) and is now in the process of developing a proactive grid modernization model. NJ BPU should benefit from the lessons learned in Massachusetts. (Note that CEG has a report due out in January or February that will address this issue.)

Peaker replacement

Regarding peakers, we believe the SIP's emissions reduction incentive will NOT provide a price signal sufficient to encourage the transition from peaking generation to energy storage. Additional steps will be necessary if the NJ BPU wishes to incorporate peaker replacement into the SIP. For more information on the technical and economic ability of energy storage to replace fossil fuel peaker plants, and case studies on peaker replacement efforts across the country, see CEG's Phase Out Peakers project at https://www.cleanegroup.org/ceg-projects/phase-out-peakers.

With regard to use cases, NJ BPU should consider incorporating incentives for criteria pollutant emissions reduction (such as fine particulates, sulfur oxides and nitrogen oxides (SOx and NOx) in overburdened communities. These pollutants have local health impacts as well as more widespread environmental impacts, and their inclusion as a use case with incentives could help strengthen the price signal for peaker plant replacement as well as a focus on overburdened communities.

BTM vs FOM energy storage applications and services

Regarding the programmatic split between behind-the-meter vs front-of-meter (FOM) storage services in the straw proposal, we would like to point out the following:

1. A third-party aggregator could enroll multiple BTM storage systems into the grid supply program, controlling and tracking the charge/discharge cycles of those distributed systems to achieve greenhouse gas (GHG) reductions, assuming a GHG signal and incentive were provided. For example, the California SGIP program now predicates 50

percent of the distributed energy storage incentive on GHG emissions reduction, with the result that BTM batteries now contribute to emissions reduction in California. And in Massachusetts, the Clean Peak Energy Standard rewards BTM battery systems that absorb renewable energy and discharge it during peak demand hours.

2. By the same token, FOM grid supply storage can also provide community benefits such as resilience (reference the new Green Mountain Power resilience zones program in Vermont) and virtual demand charge management (reference SMUD Storage Shares program in Sacramento, CA). However, these are pilot programs without an established track record.

While provision of local community benefits by grid-supply storage is still in the pilot program stages, provision of grid services from BTM batteries is well established in numerous states. With this in mind, CEG urges NJ BPU to allow for (and incentivize) grid services provision from BTM energy storage systems. This would mean allowing distributed batteries to enroll in the grid supply program to achieve GHG emissions reductions.

Hydrogen

The NJ SIP is proposed to be **technology neutral**. THIS IMPLIES THAT HYDROGEN COULD BE ELIGIBLE TO ENTER THE SIP AS AN ENERGY STORAGE TECHNOLOGY. There are significant problems with hydrogen (even “green” hydrogen) that the BPU should be aware of, as well as associated questions for the BPU. For example:

1. **Hydrogen leaks**. Hydrogen is notoriously difficult to contain, and fugitive hydrogen acts as an indirect greenhouse gas through its effect on hydroxyl (OH) radicals. By reducing the levels of OH in the atmosphere, hydrogen increases the lifetime of some direct greenhouse gases, such as methane, making it many times more potent than carbon as a greenhouse gas. If hydrogen storage were allowed into the SIP, would fugitive H2 emissions be included in GHG reduction calculations for purposes of the grid supply performance payment?
2. **Adverse health impacts**. In addition to leakage, hydrogen combustion is also harmful, because it emits nitrogen oxides, which contribute to the formation of ozone and fine particulates. These in turn have significant human health impacts in local communities. If hydrogen storage and combustion were allowed into the SIP, would NOx emissions from hydrogen combustion be included in the BPU’s calculations regarding performance payments?

Because the topic of hydrogen is one that does not seem to be separately addressed in the straw proposal, and because there is a lot of misinformation about hydrogen being promulgated by the fossil fuel industry, we feel this topic warrants a more detailed statement. Although the NJ BPU may not have intended to create a hydrogen incentive, unless hydrogen is *specifically excluded* from program eligibility, we anticipate that hydrogen project proposals

WILL be submitted to the SIP. Therefore, we recommend that hydrogen storage be excluded from the program. The reasons for this recommendation are explained in detail below.

For the past two years, CEG has worked extensively with environmental justice and community-based partners on topics intersecting with hydrogen production, demonstration, and storage. Through its national Hydrogen Information and Public Education initiative, CEG is working to counter hydrogen misinformation by developing a repository of research and information on the viability of and issues related to the production and use of hydrogen. This work informs our comments regarding the implications of the NJ SIP's technology neutral approach to applying front-of-the-meter and behind-the-meter incentives. Clean Energy Group strongly recommends that the NJ SIP does not take a technology neutral approach to applying incentives, and specifically excludes hydrogen as an eligible energy storage technology under the NJ SIP.

Several power generators in New Jersey have already expressed interest in pursuing green hydrogen as a form of energy storage.[1] Green hydrogen is hydrogen produced from renewable energy via a process called electrolysis, in which an electric current is run through water to separate the molecules. Because hydrogen can be stored at high pressure for long periods of time, it can be used as a form of firm energy storage, to be either combusted in a power plant or run through a fuel cell to produce electricity when called upon. While green hydrogen can make sense in very specific applications, Clean Energy Group strongly recommends it not be considered an eligible energy storage technology for the following reasons:

Safety

Hydrogen is extremely difficult and expensive to store and transport safely. Due to its small size, hydrogen is highly prone to leakage rates, with some estimates suggesting it could leak at rates up to 10 percent higher than natural gas.[2] This high leakage rate, combined with hydrogen's energy density and high flammability, make it particularly dangerous for residential applications. One report prepared for the United Kingdom's Energy Ministry found that using hydrogen in the home would lead to four times as many domestic explosions as natural gas.[3]

Embrittlement is another factor contributing to hydrogen's high leakage rate. If steel is exposed to hydrogen at high temperatures, hydrogen will diffuse into the alloy and combine with carbon to form tiny pockets of methane. This methane does not diffuse out of the metal and cracks the steel. This process, called "hydrogen embrittlement," means that hydrogen cannot simply be

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[1] Bergeron, Tom, "Is N.J. in Prime Position to Benefit from Clean Hydrogen, Too?" *ROI-NJ.com*, November 15, 2022. https://www.roi-nj.com/2022/11/15/industry/energy-utilities/is-n-j-in-prime-position-to-benefit-from-clean-hydrogen-too/.
[2] Ocko, Ilissa, and Steven Hamburg, "Climate Consequences of Hydrogen Emissions," *Atmospheric Chemistry and Physics,* 22 (July 20, 2022): 9349–68. https://doi.org/10.5194/acp-22-9349-2022.
[3] Brown, Sophie, Gabor Posta, and Paul McLaughlin, "Safety Assessment Conclusions Report Incorporating Quantitative Risk Assessment," Safety Assessment, London, United Kingdom: United Kingdom Department for Business, Energy, and Industrial Strategy, May 1, 2021. https://static1.squarespace.com/static/5b8eae345cfd799896a803f4/t/60e399b094b0d322fb0dadc4/1625528759977/conclusions+inc+QRA.pdf.

stored and transported with existing fossil fuel infrastructure.[4] Replacing existing fossil fuel pipelines to transport hydrogen safely could end up costing millions of dollars.[5]

Greenhouse Gas Emissions

Multiple studies have found that hydrogen has indirect warming impacts on the atmosphere. 20-30 percent of hydrogen that is leaked into the atmosphere oxidizes with hydroxyl radicals (OH), a naturally occurring molecule that usually acts as a methane sink. If more hydrogen is leaked into the atmosphere, there is less OH to interact with methane, thus extending the lifetime of methane in the atmosphere.[6] While both hydrogen and methane have shorter lifespans than carbon dioxide in the atmosphere, their warming potential is more potent in the short term. Blue hydrogen, which is hydrogen produced from natural gas via steam methane reformation paired with carbon capture and storage (CCS) technology, has an even higher warming potential than green hydrogen, due to its reliance on fossil fuels and the accompanying upstream methane emissions as a result.[7]

A recent analysis by the Environmental Defense Fund found that the warming potential of blue hydrogen could *increase* warming over the next 20 years by 25 percent, relative to continued fossil fuel use. Even green hydrogen, which does not rely on fossil fuels, would only reduce warming over the next 20 years by two thirds relative to continued fossil fuel use.[8] Tools sensitive enough to monitor hydrogen leak rates do not currently exist, so it is impossible to estimate the full global warming potential of hydrogen leakage beyond current estimates.

Inefficiency and Cost

Green hydrogen is extremely inefficient and expensive to produce. With current electrolyzers, green hydrogen's lifecycle efficiency is around 30 percent, meaning 70 percent of the renewable energy that goes into the process is lost.[9] Currently, conventional grey hydrogen

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[4] Murakami, Yukitaka, "21 - Hydrogen Embrittlement," *Metal Fatigue (Second Edition),* edited by Yukitaka Murakami, Second Edition., 567–607. Academic Press, 2019. https://doi.org/10.1016/B978-0-12-813876-2.00021-2.

[5] Saadat, Sasan, and Sara Gersen. "Reclaiming Hydrogen for a Renewable Future: Distinguishing Oil & Gas Industry Spin from Zero-Emission Solutions." Earthjustice, August 2021. https://earthjustice.org/sites/default/files/files/hydrogen_earthjustice_2021.pdf.

[6] Warwick, Nicola, Paul Griffiths, Alexander Archibald, and John Pyle, "Atmospheric Implications of Increased Hydrogen Use," United Kingdom Department for Business, Energy, and Industrial Strategy, April 25, 2022. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1067144/atmospheric-implications-of-increased-hydrogen-use.pdf.

[7] Howarth, Robert W., and Mark Z. Jacobson, "How Green Is Blue Hydrogen?" Energy Science & Engineering 9, no. 10 (October 2021): 1676–87. https://doi.org/10.1002/ese3.956.

[8] Ocko and Hamburg.

[9] "World Energy Transitions Outlook 1-5C Pathway 2022 Edition." Accessed November 21, 2022. https://prod-cd.irena.org/Publications/2022/Mar/World-Energy-Transitions-Outlook-2022.

costs between $1.25/kilogram to $2/kilogram in the U.S., while green hydrogen costs between $2.50/kilogram to $4.50/kilogram.[10] The biggest influence on the cost of green hydrogen is the cost of the renewable energy that powers its production – as larger scale renewable energy sources, such as offshore wind, come online in New Jersey, it is possible that green hydrogen costs could go down.

However, unlike conventional batteries, green hydrogen is not a source of electricity by itself, and the attendant costs of the necessary infrastructure to produce electricity from hydrogen must be considered as well. Once renewable energy is converted into green hydrogen, it must then be *re-converted* into electricity when called upon. This can be done either by running green hydrogen through a fuel cell, or by combusting it. Both methods of electricity generation from green hydrogen come with attendant costs.

With a hydrogen fuel cell, efficiency loss is occurring on multiple levels: the electrolysis process to generate green hydrogen fuel, transporting and storing the hydrogen, the AC/DC current inversion, and the hydrogen to electricity conversion. When accounting for these losses, the lifecycle efficiency of a hydrogen fuel cell is 33 percent. A typical battery's lifecycle efficiency, in comparison, is about 86 percent.[11]

If hydrogen is combusted, it produces dangerously high amounts of the air pollutant nitrogen oxide (NOx). Traditional combustion controls that are used in natural gas power plants to limit NOx emissions are not formulated to work with hydrogen.[12] Safe combustion of hydrogen in existing natural gas infrastructure is simply not possible without extensive retrofitting, an additional expense.[13]

In conclusion, hydrogen (even "green" hydrogen) is an untested, expensive, and inefficient energy storage technology, and including it in the NJ SIP could ultimately cost ratepayers more in the long term, as well as undermine New Jersey's decarbonization goals. For these reasons, Clean Energy Group strongly recommends the NJ BPU explicitly exclude all hydrogen storage technologies from eligibility.

For more information on hydrogen, see CEG's Hydrogen Information and Public Education project at https://www.cleanegroup.org/ceg-projects/hydrogen.

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[10] Saadat and Gersen.

[11] Tsakiris, Aristeidis. *Analysis of Hydrogen Fuel Cell and Battery Efficiency.* Copenhagen Center on Energy Efficiency, March 2019, 8.

[12] Cellek, Mehmet Salih, and Ali Pınarbaşı. "Investigations on Performance and Emission Characteristics of an Industrial Low Swirl Burner While Burning Natural Gas, Methane, Hydrogen-Enriched Natural Gas and Hydrogen as Fuels." International Journal of Hydrogen Energy 43, no. 2 (2018): 1194–1207. https://doi.org/10.1016/j.ijhydene.2017.05.107.

[13] Saadat and Gersen.

Thank you for this opportunity to comment on the NJ BPU SIP proposal. We look forward to continuing to support the development of energy storage policy and programs in New Jersey.

Respectfully submitted,

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