Maximizing Value from New Jersey's Storage Incentive Program

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Contents

Summary

Front-of-the-meter (FTM)[1] storage presents a high value opportunity for New Jersey ratepayers because it can be deployed rapidly and leverage existing infrastructure to unlock its full value

- Solar Landscape retained The Brattle Group (Brattle) to evaluate the treatment of FTM storage under New Jersey's proposed Storage Incentive Program (SIP)
- Our assessment finds that FTM distributed storage can provide the same or greater benefits as BTM distributed storage, but would only be compensated with **20% to 33%** the revenue
  - FTM storage can be deployed ***quickly***, as developers can use existing interconnection rights to connect to the distribution system without requiring a large customer to operate it behind their meter
  - In the near-term, distribution-connected FTM storage can *p*rovide ***the same benefits*** as BTM storage, responding to price signals to lower energy costs and decrease system peaks - participation in the distribution level performance incentive program will ensure that system benefits are maximized for ratepayers
  - In the long-run, FTM storage has the potential to provide ***additional value*** since it could be dispatched by the utility to maximize ratepayer benefits, whereas BTM systems have to account for onsite loads and balance customer requirements
- By overlooking opportunities for FTM storage, the 2024 Straw misses out on an important technology for helping New Jersey achieve its policy goals

1. *Front-of-the-meter storage describes batteries that are connected directly to the distribution system and not co-located with load. In some cases, FTM storage may be co-located with existing community solar, leveraging existing infrastructure and interconnection rights.*

Recommendations

To create a level playing field and ensure distribution connected storage can be deployed efficiently and realize its full potential we recommend:

1: SIP provides equivalent compensation FTM resources relative to BTM resources through a FTM performance payment

- The performance payment is needed to compensate FTM batteries for services that they can provide to the wholesale grid but are unable to realize at this time: **capacity revenues / value for avoided transmission / demand charge reductions and performance incentives**

2: SIP retains an option for utilities to dispatch FTM resources so that they can be utilized in a way that maximizes distribution value

- Utilities may still need to deploy Distributed Energy Resource Management Systems (DERMS) in order to provide the granular dispatch signals to maximize distribution connected storage, but once these systems are in place the program should facilitate utility dispatch to realize this additional value

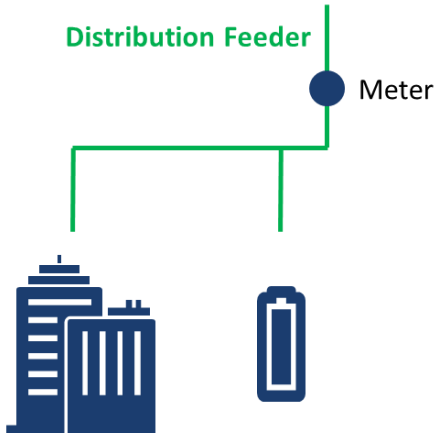
3: BPU work with EDCs to develop a Tariff that would ensure distribution connected batteries are eligible for incentives available to BTM batteries and not subject to demand charges

NJ Storage Incentive Program (SIP) Incentive Design

The proposal categorizes distributed FTM storage as "Grid-Supply" resources, limiting their ability to access several key revenue opportunities

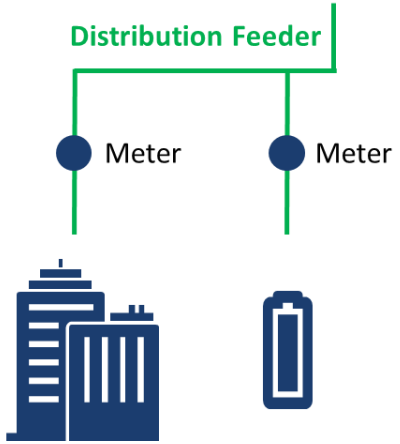
- The proposed incentive framework would allow customers with *BTM* batteries to stack multiple revenue steams, incentivizing private investment in distributed battery storage
  - In addition to receiving direct programmatic incentives and being able to use their batteries for energy arbitrage, BTM customers can also use their battery to reduce their generation capacity obligation and lower their monthly demand charge
- By contrast, FTM customers only receive the fixed portion of the incentive, and have limited ability to receive payments for providing capacity value to PJM

Behind-the-Meter Storage



- ✓ Demand Charge Reduction
- ✓ Performance Based Incentive
- ✓ Reduced Capacity Charge
- ✓ Reduced Transmission Charge
- ✓ Energy Arbitrage
- ✓ Fixed Incentive

Front-of-the-Meter Storage



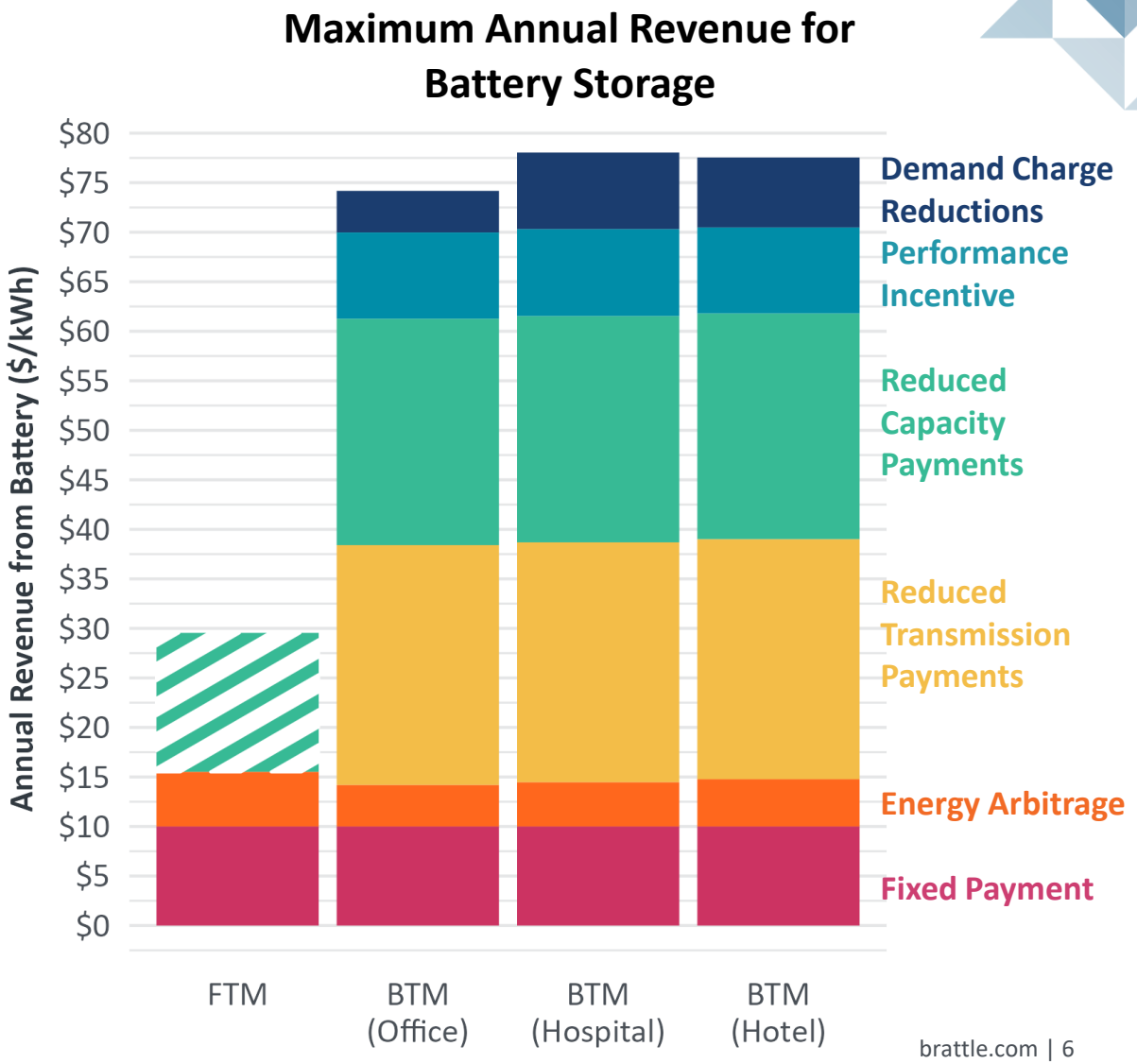
- ✗ Demand Charge Reduction
- ✗ Performance Based Incentive
- ? Reduced Capacity Charge
- ✗ Reduced Transmission Charge
- ✓ Energy Arbitrage
- ✓ Fixed Incentive

Compensation Disparity

Despite providing equivalent grid value, FTM will be severely disadvantaged relative to BTM storage based on the current SIP proposal

- We estimate that FTM storage faces an annual revenue shortfall of $45-$62 per-kWh (57-80%) relative to BTM storage, depending on the FTM battery's ability to earn revenue through PJM's capacity market.
- This will likely make it prohibitively expensive for private developers to build FTM storage that could be used to provide valuable energy services to New Jersey ratepayers.
- Furthermore, by not providing FTM storage with an incentive to inject power during distribution system peaks, New Jersey EDCs will not extract the maximum value from these assets.

Note: BTM storage can realize value by reducing a customer's capacity payments under PJM's 5CP pricing. FTM Storage is only able to realize capacity value by participating in PJM's market as part of an aggregation, creating an additional hurdle. In addition, PJM's interconnection queue issues mean distributed storage resources face many years of delays in order to connect to the grid.



Expected Benefits

Effective deployment of distributed connected storage would provide many benefits to the New Jersey grid and broader economy

Achieve State Policy Goals	• New Jersey has a statutory mandate to achieve 2,000 MW of installed energy storage capacity by 2030. Appropriately incenting FTM storage deployment could fast track storage development by over 5 years compared to storage at the wholesale level given interconnection delays.
Reduced Emissions	• Providing the right incentives to distribution connected storage has the potential to decrease emissions by over 3 million metric tons of CO2 equivalent annually.
Reliability	• The rapid deployment of distribution connected storage means it is one of the few resources to meet rapidly growing demand.
Support Clean Energy Economy Goals	• Provide additional resiliency and reliability to attract new investment in growing sectors of the economy such as data centres.

Contents

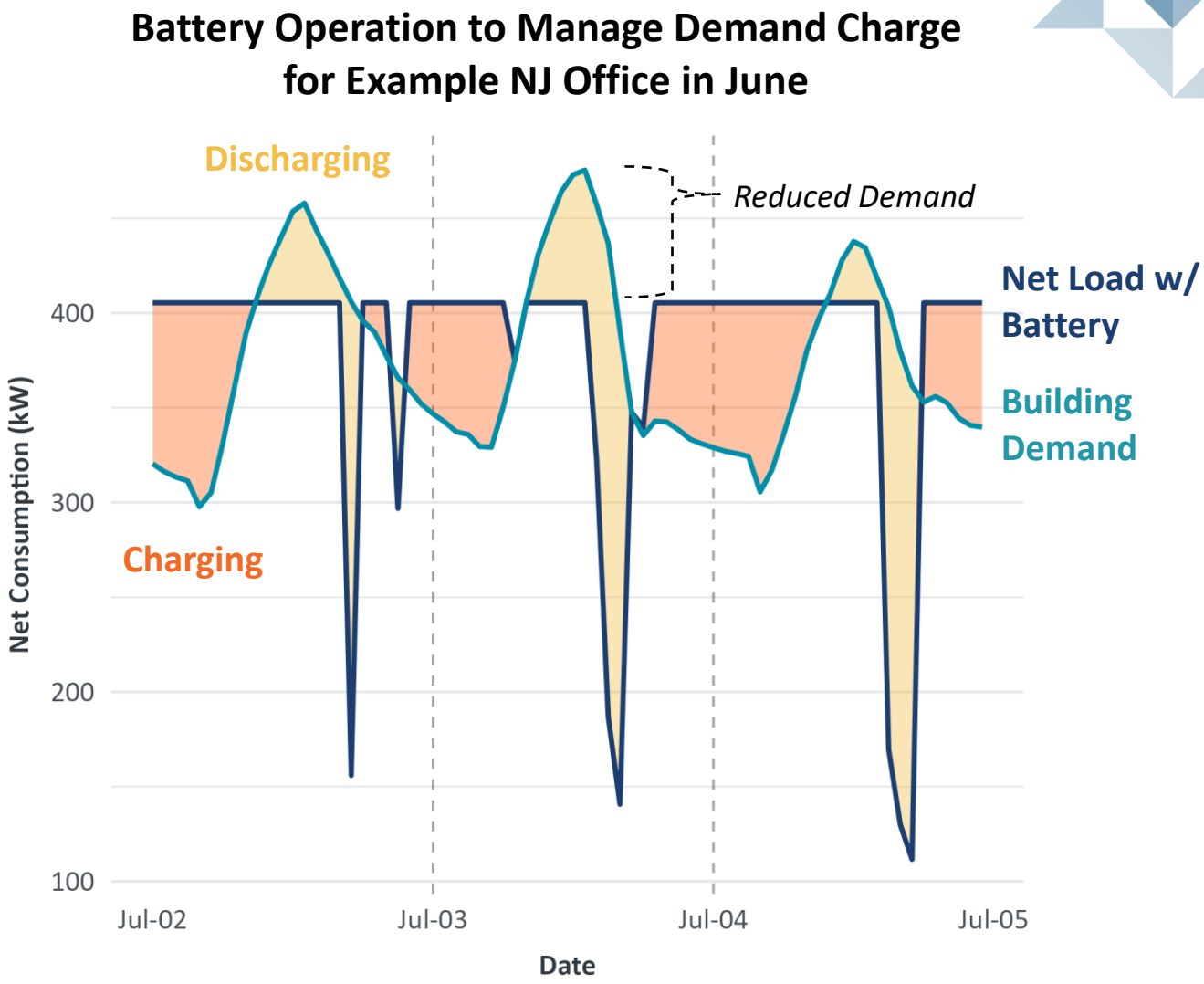
Approach

Brattle assessed the economic opportunities available to behind-the-meter (BTM) vs. front-of-the-meter (FTM) distributed storage under New Jersey's proposed Storage Incentive Program (SIP)

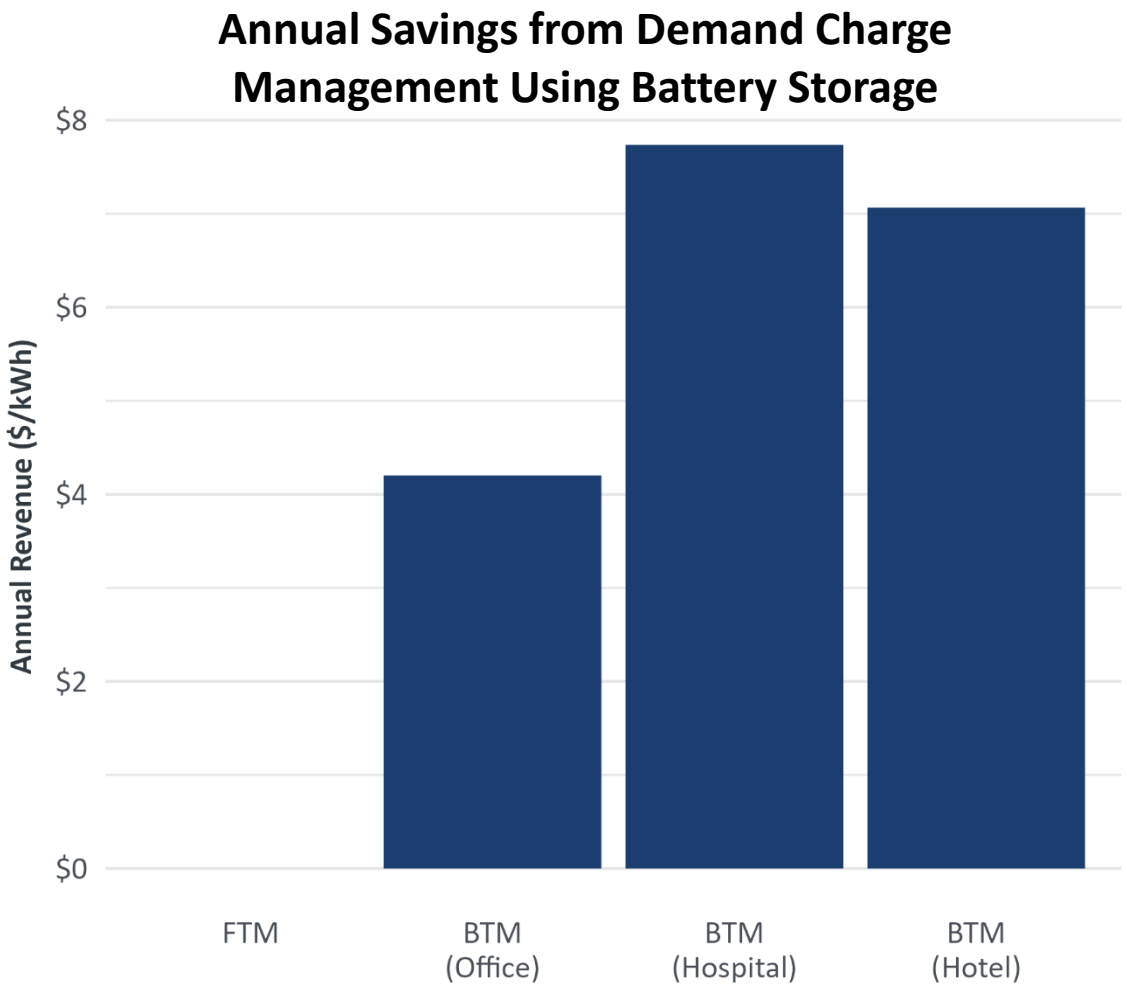
- Brattle identified potential revenue streams available to customers adopting BTM storage, then employed an in-house optimization model called REACT (Retail Energy Adjustment and Cost Tool) to estimate the maximum annual revenue available to these customers
- Brattle compared these opportunities to those for customers building FTM storage and identified several gaps in potential revenue for these customers
- We also reviewed the interconnection issues in PJM and the New Jersey grid in particular to understand a) the prospect of FTM distribution connected batteries achieving connection to the grid; and b) the potential implications for the New Jersey storage policy goal of 2,000MW by 2030

Demand Charge Reductions (1)

- Demand charges are determined each month based on a customer's highest consumption during a short interval (typically over 15 minutes or 1 hour)
- A customer that reduces their monthly peak demand is effectively compensated by the utility for the value they create by reducing load on the distribution system
- Behind-the-meter batteries can be dispatched to flatten net loads, allowing these customers to lower their demand charges



Demand Charge Reductions (2)

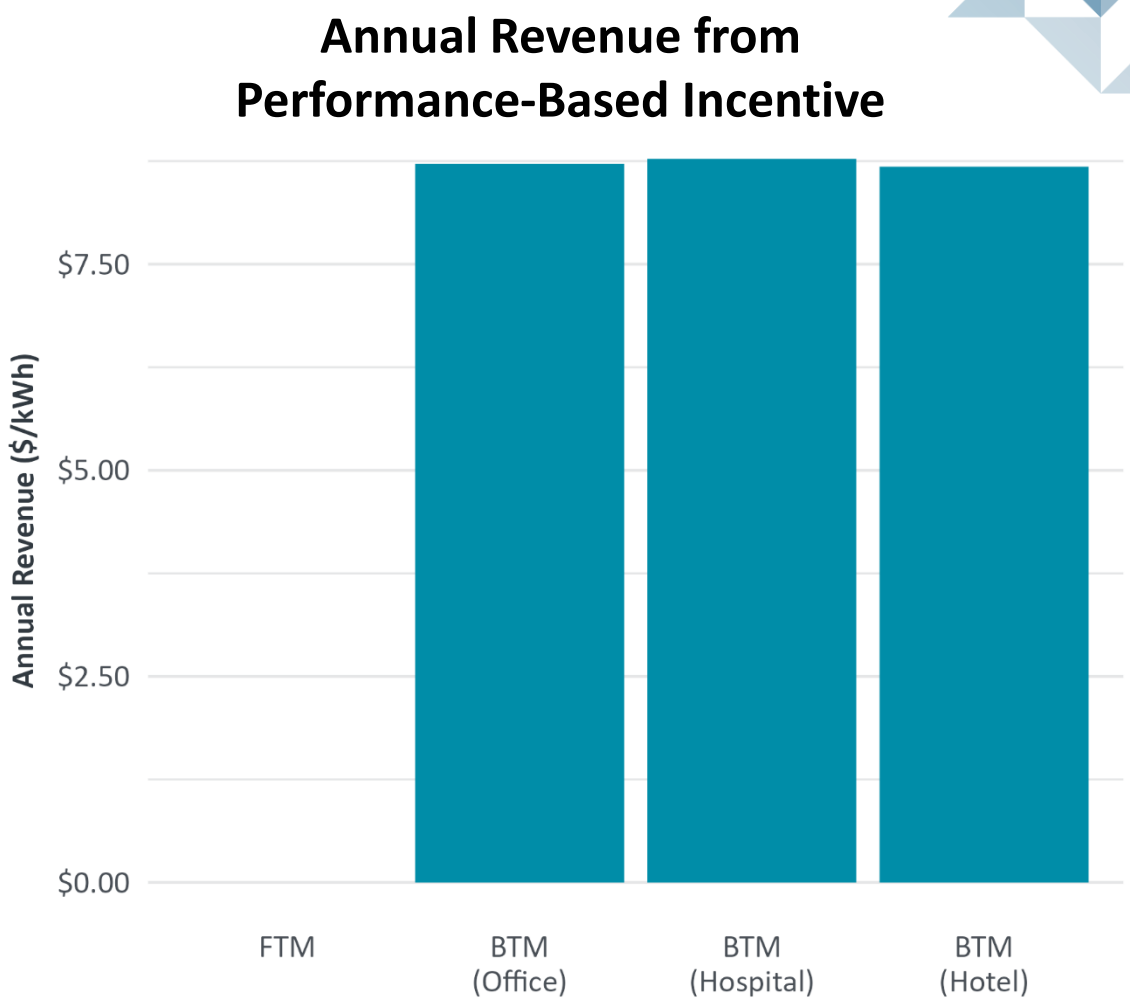


- We analyze three type of New Jersey commercial customers (offices, hospitals, and hotels), and find that the value derived from demand charge management varies from approximately $4 to $8 per-kWh, annually
- The extent to which batteries help a customer manage their demand charge depends on that individual customer's hourly load profile
- FTM resources do not have access to this revenue stream

Note: Dollar per-kWh figures describe annual revenue per-unit of storage capacity, not per unit of energy discharged to grid.

Performance-Based Incentive (PBI)

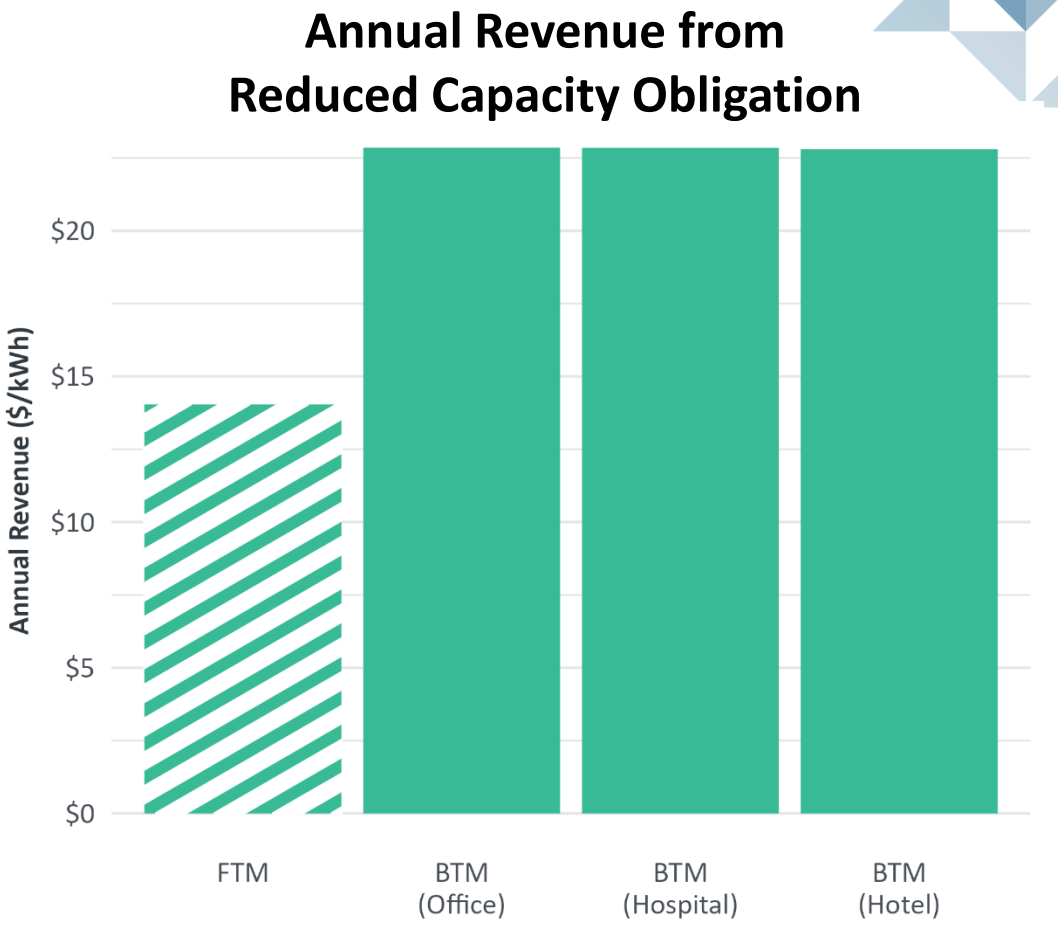
- BTM customers would also be able to collect revenue from the proposed performance-based incentive (PBI)
- While the final implementation of the incentive will be left to the electric distribution companies (EDCs), the Straw suggests a program in which customers are compensated for voluntarily discharging their batteries during 4-hour afternoon call windows on 10 peak days selected by the EDC
- We model the PBI as described in the Straw, and find that all customer types are able to earn approximately 85% of the maximum possible revenue[1]



1. *These earnings are mediated by constraints on the minimum and maximum state-of-charge on the batteries, which are determined based on manufacturer specifications*
2. *The fixed incentive is assumed to be $10 per-kWh for both BTM and FTM batteries. FTM batteries, competing in a competitive bidding process, may ultimately receive larger or smaller fixed incentives.*

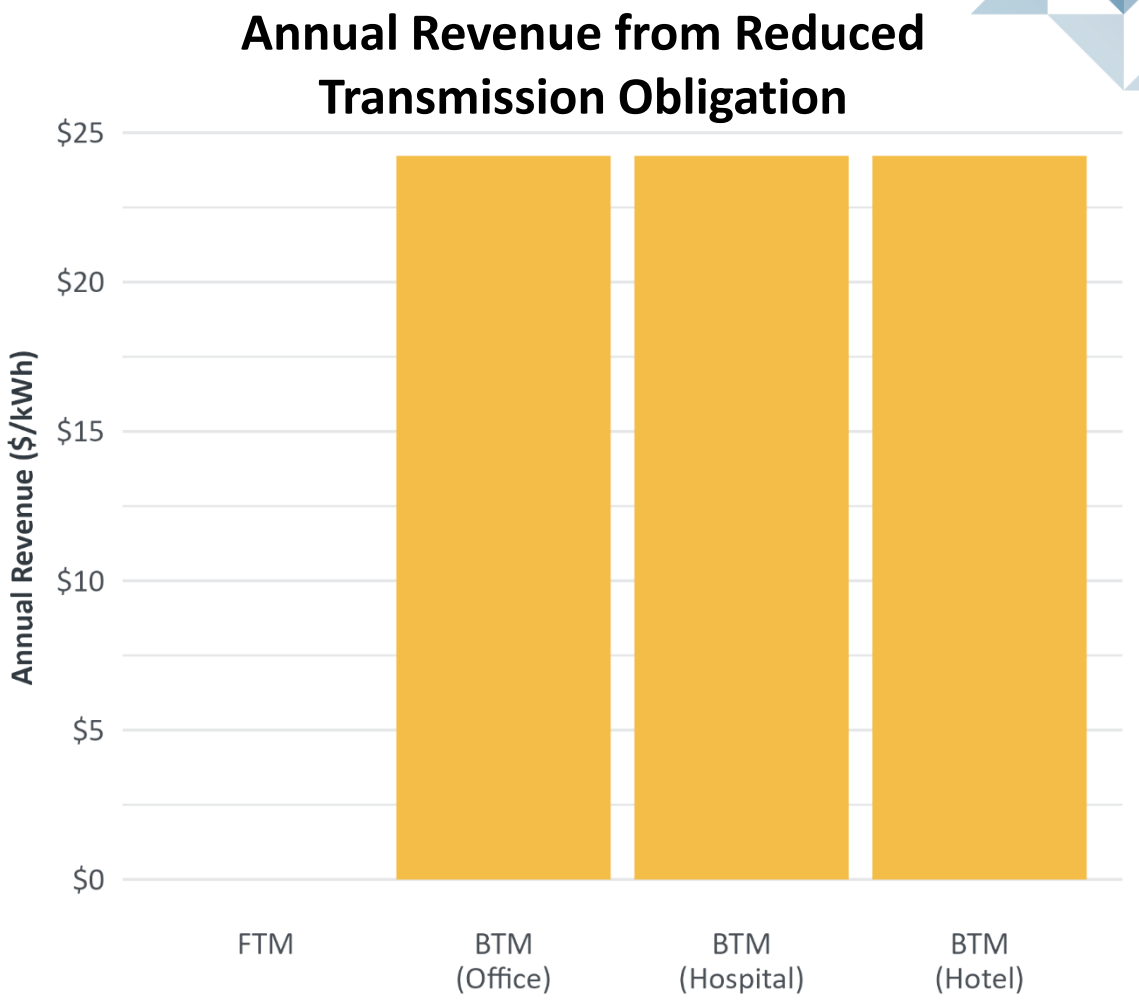
Generation Capacity

- BTM batteries can be used to reduce a customer's Generation Obligation under PSEG's Basic Generation Service contract
  - The customer's Generation Service obligation is determined based on their consumption during PJM's peak 5 hours
- While FTM batteries can theoretically earn payments be enrolling in an aggregation and participating in PJM's capacity market, this produces less revenue than for BTM customers:
  - Payments for battery storage resources enrolled in the PJM Capacity market are de-rated by the ELCC for battery storage (currently 57%), whereas BTM resources can reduce Generation Capacity Obligations based on directly on their performance
  - A BTM customer reducing their Generation Obligation by 1 kW is also able to reduce their share of associated reserves, further enhancing compensation
- In addition, PJM Interconnection issues mean that FTM storage resources are unlikely to connected any time soon (See Section 4, Timing Analysis)



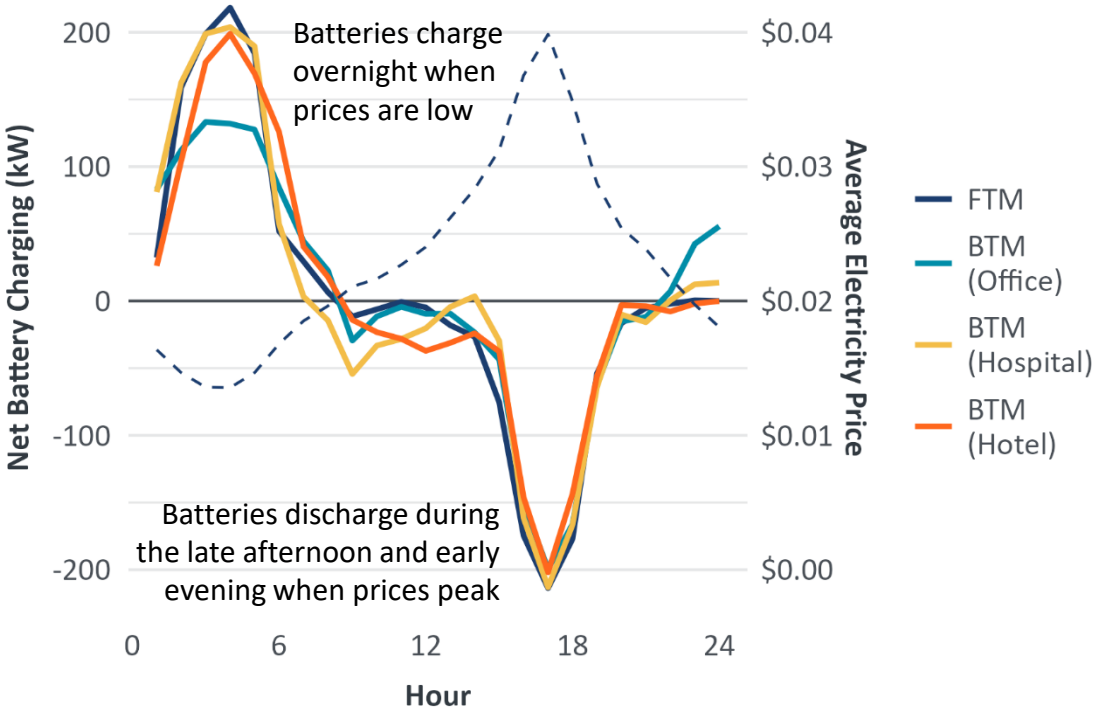
Transmission Capacity

- BTM batteries can be used to reduce a customer's Transmission Obligation under PSE&G's Basic Generation Service contract
  - The customer's Transmission Service obligation is determined based on their consumption during PSEG's peak 5 hours
- These customers are effectively compensated for reducing PSE&G's transmission obligations
- This benefit is not available to FTM storage applications



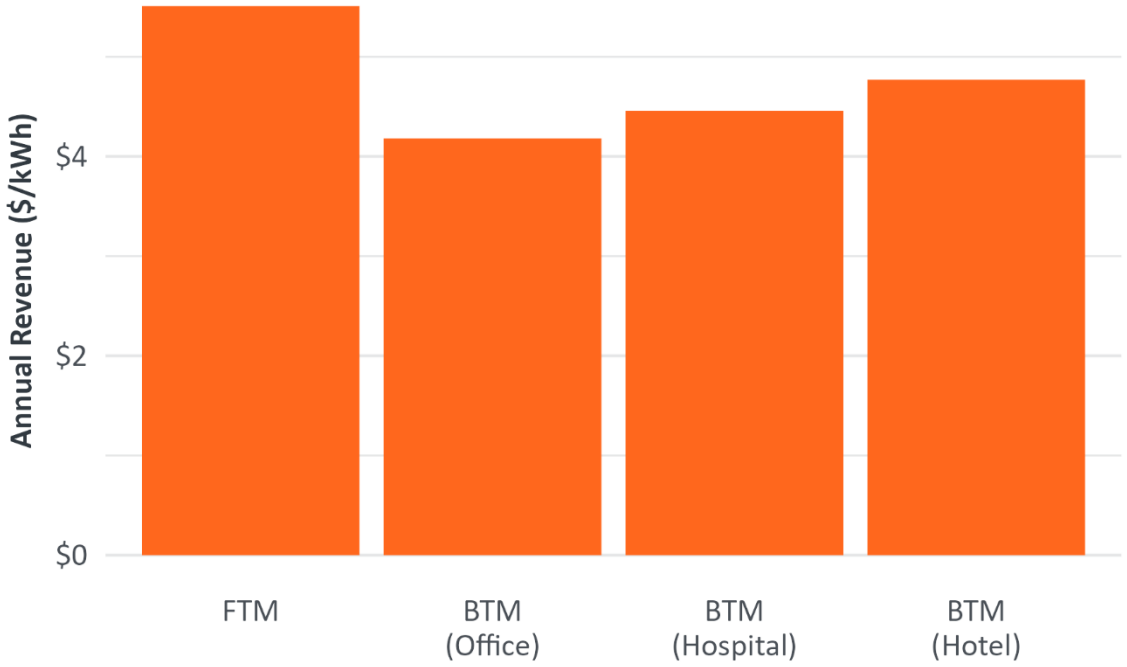
Energy Arbitrage Opportunity

Average Summer Charging Profiles



Both BTM and FTM customers are able to realize value through charging at low energy prices and discharging when prices are high[1]

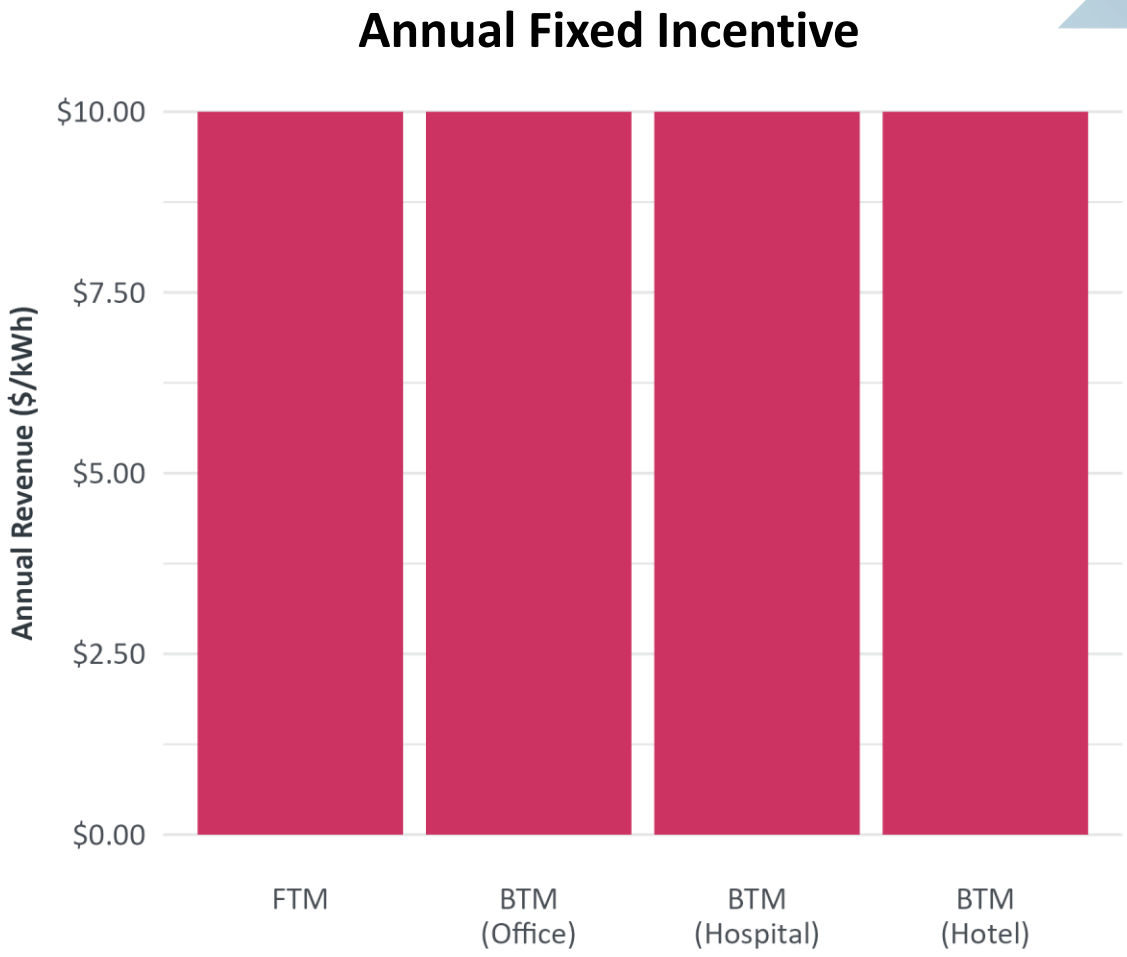
Annual Revenue from Energy Arbitrage



FTM batteries are able to create (and realize) greater value from energy arbitrage because they are not also managing other price signals, including demand charges

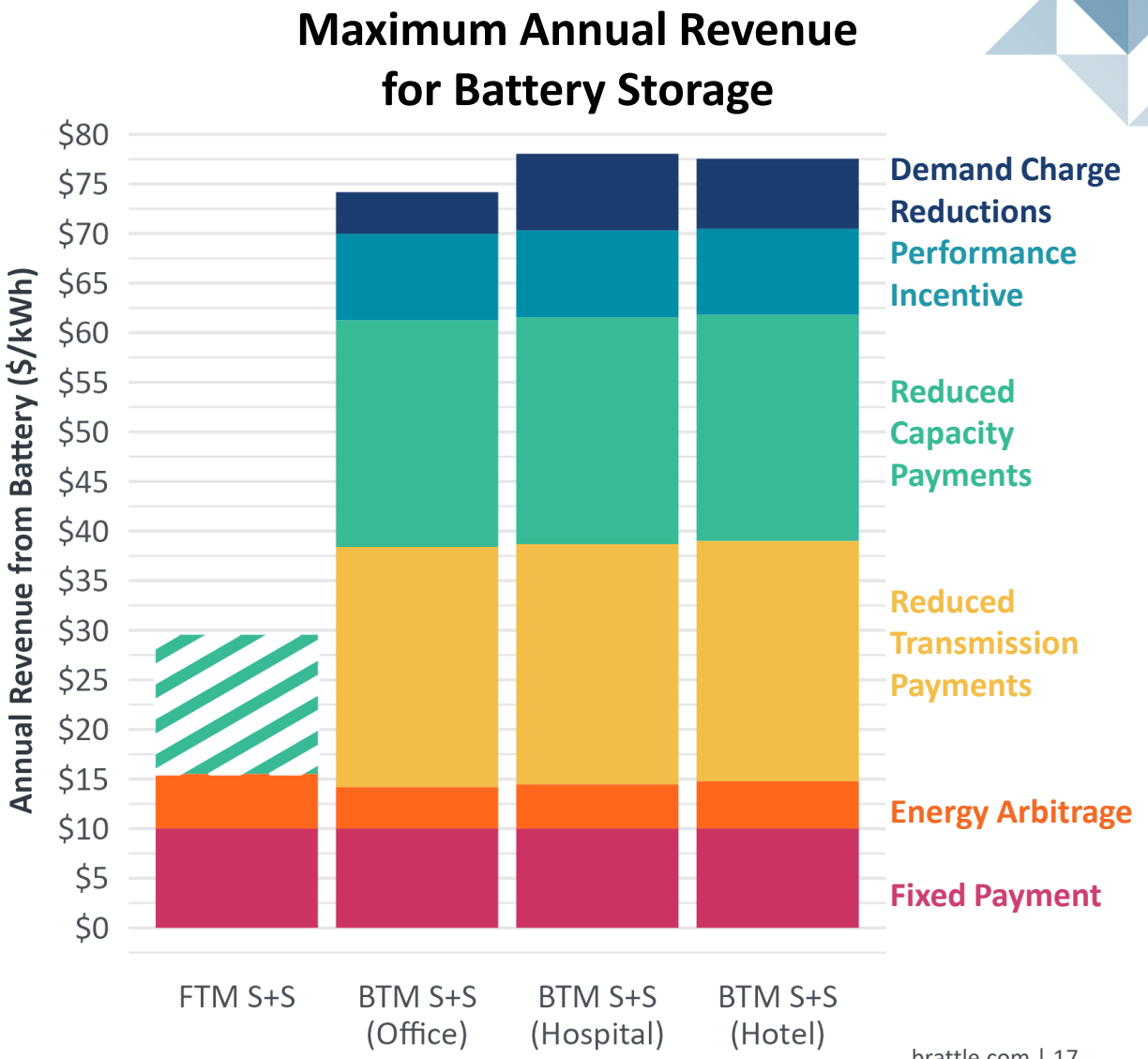
Fixed Incentive

- Both BTM and FTM customers should be able to receive the fixed incentive under the NJ SIP program
- As proposed, medium-scale distributed FTM customers would have to compete with larger grid-supply storage developers, who are able to benefit from greater economies of scale. This makes their ability to capture this revenue uncertain.



Summary

- In aggregate, we estimate that FTM storage faces an annual revenue shortfall of $45-$62 per-kWh (57-80%) relative to BTM storage[1]
- This will likely make it prohibitively expensive for private developers to build FTM storage that could be used to provide valuable energy services to New Jersey ratepayers
- Furthermore, by not providing FTM storage with an incentive to inject power during distribution system peaks, New Jersey EDCs will not extract the maximum value from these assets.

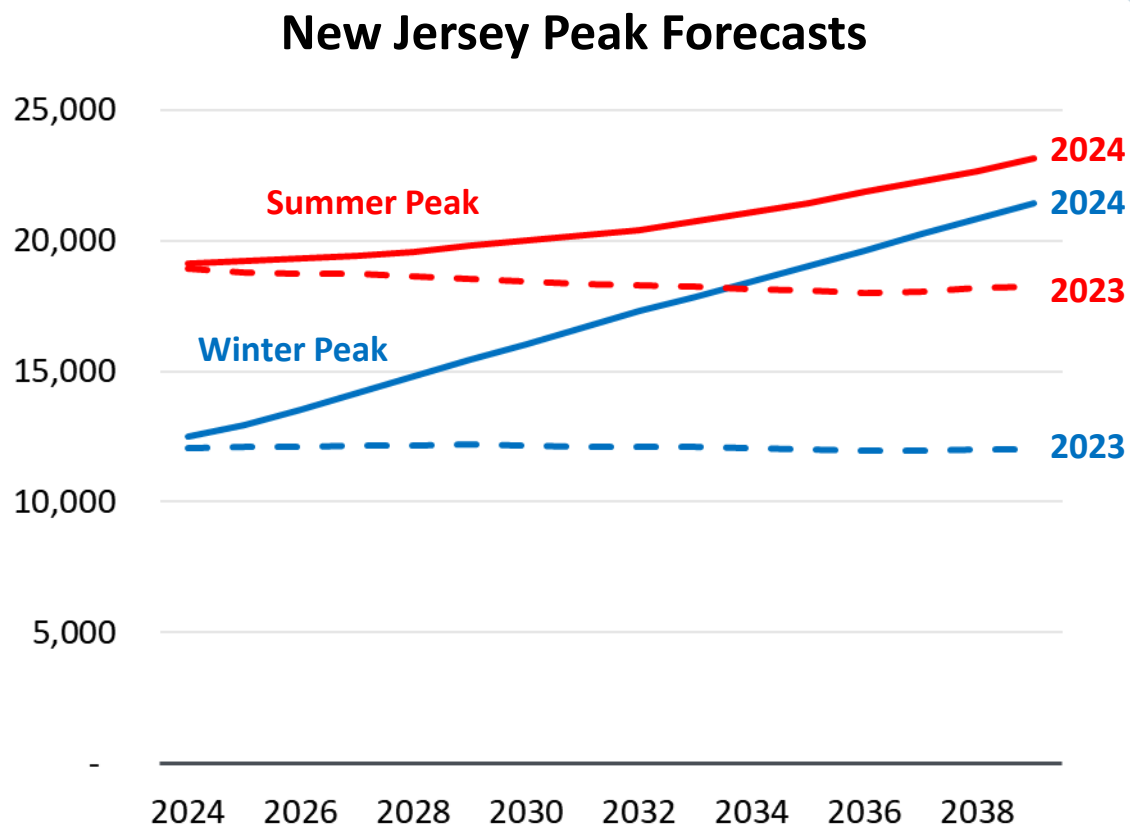


1. *This range is determined by including/excluding capacity value, which depends on the FTM battery's ability to earn revenue through PJM's capacity market*

Contents

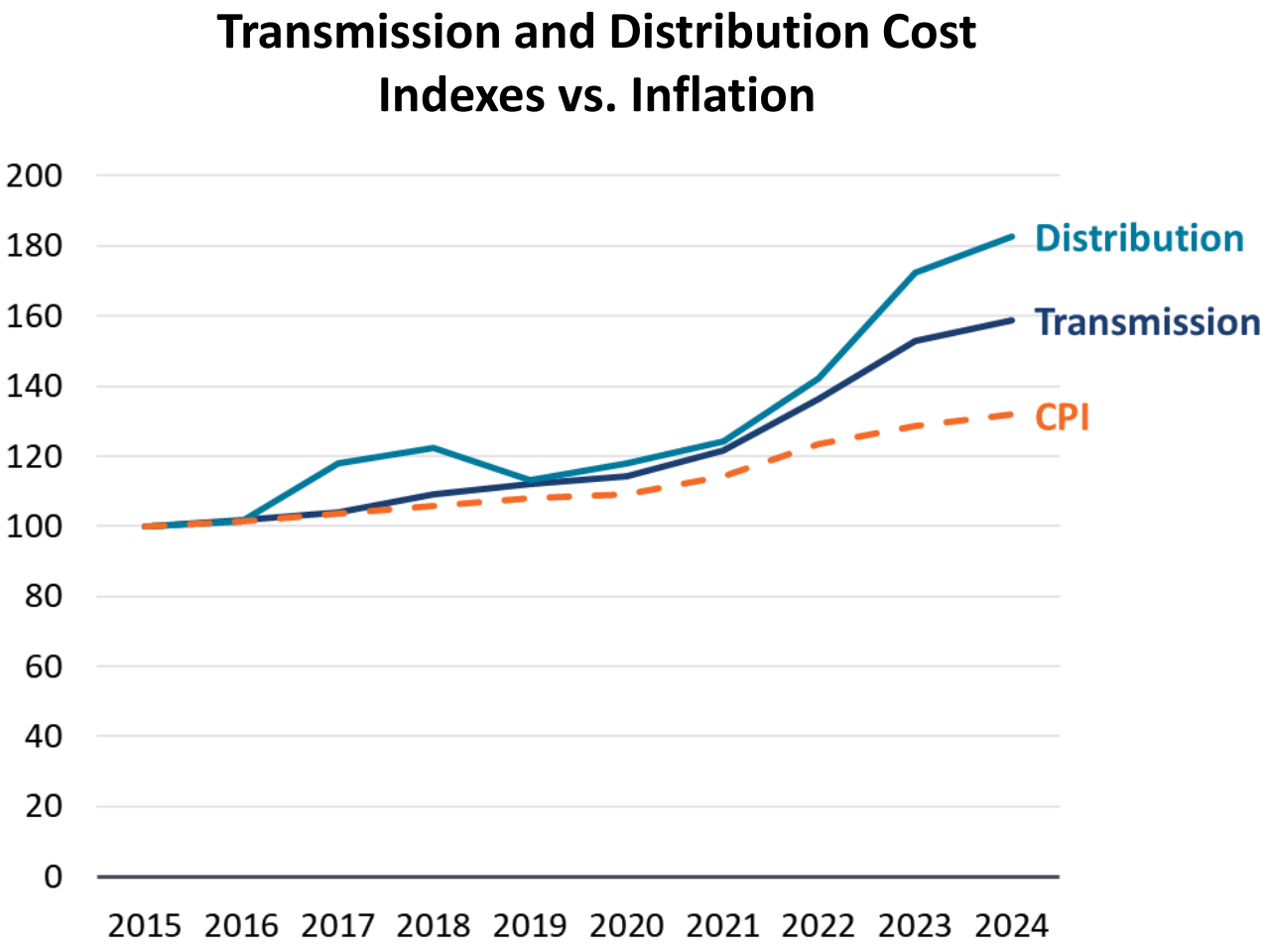
New Jersey is Facing Steep Load Growth

- PJM recently revised its 15-year load forecast to account for increasing load growth from electrification and data centers
- The RTO is now expecting New Jersey peaks in 2039 to grow by:
  - **Summer Peak to grow by 4 GW**
  - **Winter Peak to grow by nearly 9 GW**
- As load in New Jersey continues to grow, the distribution system will need to be reinforced to accommodate increased peaks



Source: PJM Load Forecast.

Increasing Transmission and Distribution Costs



Source: Handy Whitman Index January, 2024. CPI data from FRED.

- As the need for upgraded transmission and distribution equipment rises, capital costs associated with this infrastructure have shot up over the last decade, significantly outpacing inflation
- This is explained by a combination of supply chain constraints and increased global demand for similar components
- Current trends are expected to continue given policy commitments to electrification and decarbonization

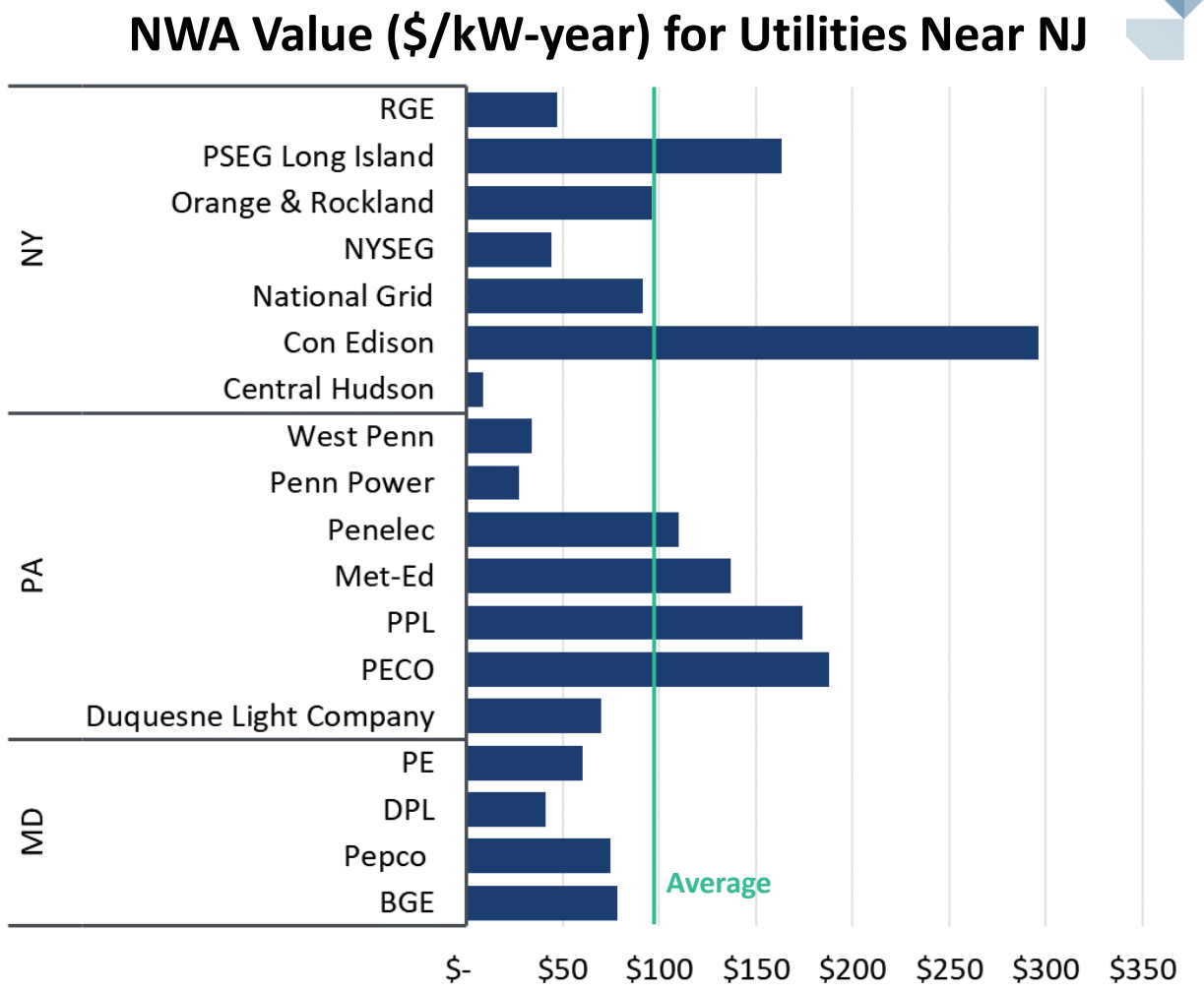
Non-Wires Alternatives

- Non-Wires Alternatives (NWAs) can allow utilities to **defer or even avoid costly distribution system upgrades** using distributed resources located at the grid edge
- A FTM battery that is directly controlled and dispatched by an electric distribution company could be operated as part of a NWA, creating value for NJ ratepayers
  - Upstream transmission-connected batteries are not able to create this value, while BTM batteries provide limited visibility/load control opportunities to utilities, thereby mitigating their value
- There are several notable examples[1] of utilities using battery storage as part of NWAs, including in Arizona, New York, Maine, and California

1. *PLMA. "Non-Wires Alternatives: Case Studies from Leading U.S. Projects," November 2018. https://www.peakload.org/assets/38thConf/Non-Wires-Alternatives-Projects.pdf.*

NWA Value

- Brattle's survey of Marginal Cost of Service studies finds that the average value of deferring or avoiding T&D upgrades for utilities in nearby states is **$97 [1] per-kW-year**
- These values range significantly between utilities and even within utilities
  - For example, in Consolidated Edison's service territory, Brattle estimates that the value of deferring T&D upgrades ranges from $89 - $364 per kW-year (2024 $)[1]
- Creating a market for FTM battery developers creates two key opportunities:
  - Some batteries may prove useful as NWAs in the future, at which point EDCs can contract for direct load control with the battery owner
  - Growing the pool of private FTM battery developers operating in the state today will ensure a competitive marketplace for future NWAs

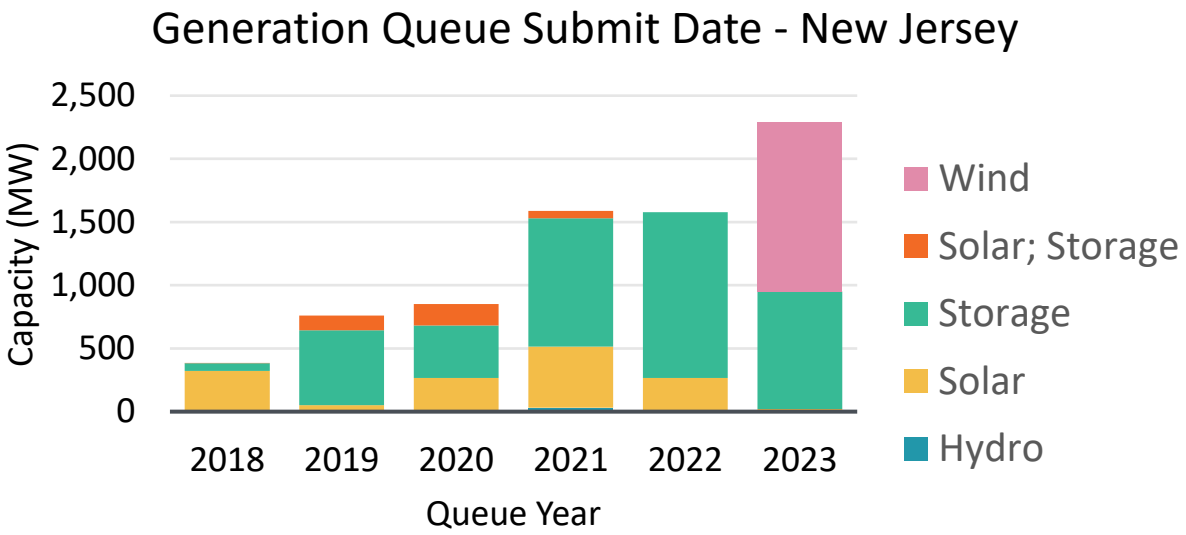


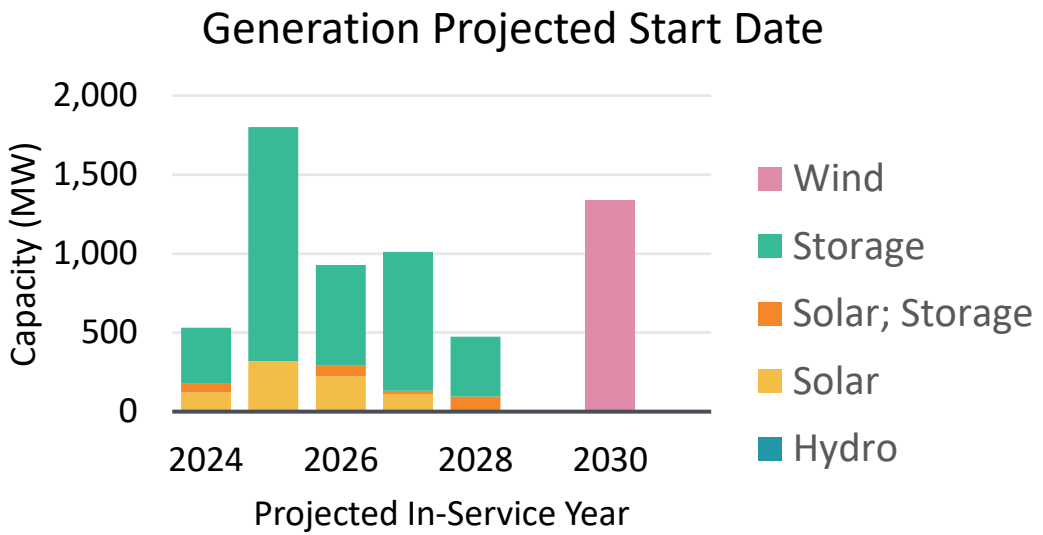
1. *Adjusted to 2024 using the Handy-Whitman index.*

Contents

PJM Interconnection Queue Analysis

The current status of the PJM Interconnection Queue shows extensive build of resources with increasing additions of storage and offshore wind



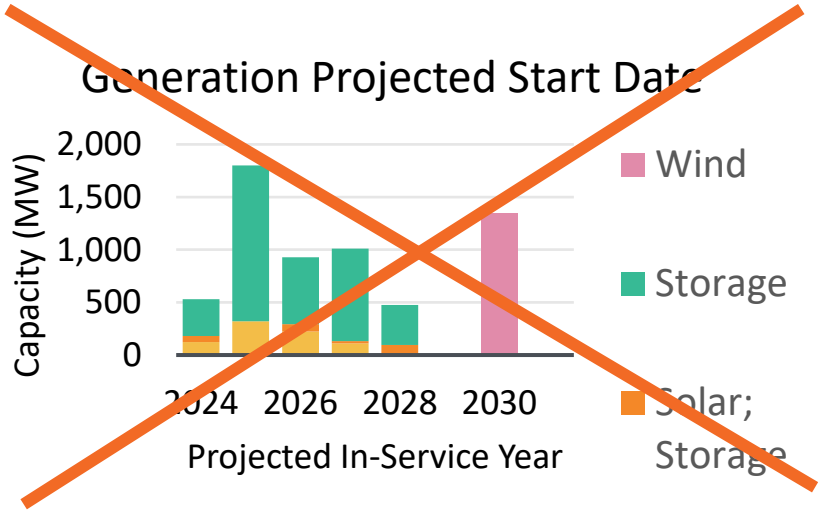


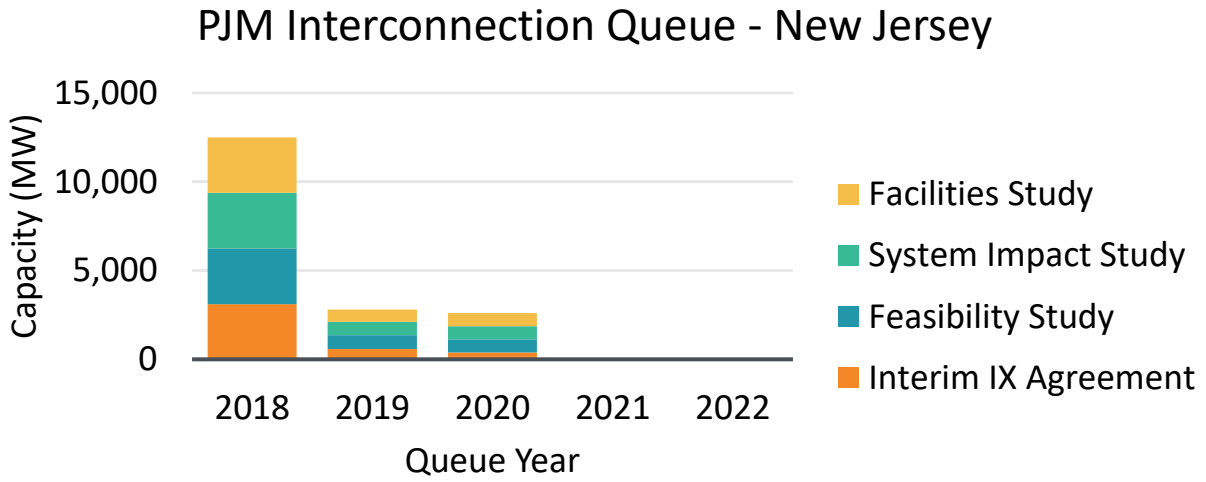
- **37,218 MW** of generation resources are currently in the PJM New Jersey interconnection queue
- **6,815MW** of solar and storage is in the queue
- Some resources have been in the queue for decades, storage has been in the queue since 2018

- Solar and storage projects are projected to come on-line between 2025 and 2030 (wind)

PJM Interconnection Queue - Issues

PJM has effectively placed a pause on new interconnections ensuring that new generation projects are unlikely to connect as planned.





- According to most analysts projects are unlikely to connect in the near term, ***"The country's largest grid operator, PJM Interconnection (PJM), has experienced the most severe delays and backlog in new generation—projects entering the queue today have little chance of coming online before 2030." ****
- Only 20% of projects have completed at least one of the studies required to complete the Interconnection Process and no projects after 2020 have initiated the studies needed to interconnect

*https://www.energypolicy.columbia.edu/publications/outlook-for-pending-generation-in-the-pjm-interconnection-queue/

PJM Interconnection Queue - Reforms

PJM is reforming its interconnection process, partly in response to FERC Order 2023, and transitioning to a "first ready, first served", rather than "first come, first served"

- The new approach will entail "clustering" projects that are seeking to connect and using a cycle approach rather than a one behind the other queue approach
- In theory the cluster study approach should speed up the interconnection process by assessing requests in batches rather than on an individual basis
- However, PJM has also initiated the **PJM Reliability Resource Initiative: Interim Accelerated Interconnection Process** that would allow 50 large, new and unqueued generation projects (about 20 GWs) to be inserted into Transition Cluster #2 ("TC#2").
  - This process would target resources that are **not currently** in the interconnection queue
  - PJM initially stated it plans to allow 100 projects to participate in the IAIP, subsequently reduced to 75 projects, and most recently just 50
- Adding 20 GW to TC#2 will add even more delay to the study process for existing projects and may impact these project economics if network upgrade costs are higher than originally anticipated.

Sources: 20241121-item-04a---1-member-consultation-regarding-reliability-resource-initiative---presentation.ashx

PJM Interconnection Queue - Reforms

PJM's proposed Interim Accelerated Interconnection Process will reward conventional generation with high UCAP and ELCC values and already constructed or under construction

- PJM proposes to allow any project to submit a request and be part of the 50 projects that are evaluated, but in reality, the eligibility criteria PJM intends to apply will skew the results to projects with a high UCAP and ELCC value consistent with natural gas and coal fired generating units that otherwise would have been mothballed or retired
- Should the PJM's proposed process be approved it will further delay storage and renewable deployment in PJM and New Jersey markets

RRI Formula Proposal:

UCAP (35 points)	**In-Service Date Viability** (35 points)	**ELCC** (20 points)	**Location** (10 points)
Rank highest to lowest UCAP	Critical path construction schedule validate by PJM (target is June 1, 2029 or sooner)	ELCC ranking	Adder for locating in a zone that cleared above the rest of the RTO in the 2025/26 BRA

ELCC Class	2028/2029 Preliminary ELCC Class Rating
Landfill Intermittent	56%
4-hr Storage	51%
6-hr Storage	61%
8-hr Storage	64%
10-hr Storage	72%
Nuclear	96%
Coal	85%
Gas Combined Cycle	83%
Gas Combustion Turbine	68%
Gas Combustion Turbine Dual Fuel	80%
Offshore Wind	47%
Diesel Utility	92%
Steam	75%
Onshore Wind	28%
Fixed-Tilt Solar	5%
Tracking Solar	7%
Hydro Intermittent	37%

ELCC ratings of storage versus coal and gas

SUMMARY

Achieve Policy and Reliability Goals

Creating the right incentives for Front-of-the-Meter, co-located storage can deliver on many of the stated program goals and help meet emerging reliability concerns

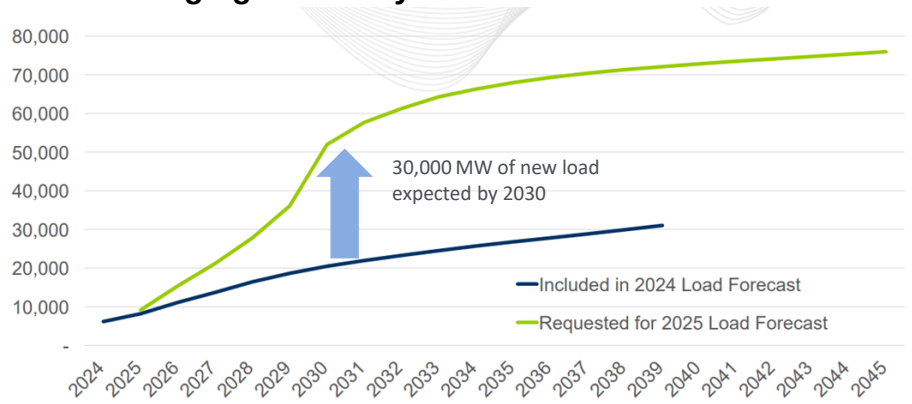
Program Goals

Meet Energy Storage Incentive Program goals

- Support deployment of 2,000 MW of additional energy storage systems by 2030, growing a sustainable energy storage industry;
- Encourage storage deployment that accelerates the clean energy transition;
- Decrease Greenhouse Gas ("GHG") emissions;
- Promote deployment of low-cost private capital into New Jersey storage projects;
- Support overburdened communities with energy resilience, environmental improvement, and economic benefits derived from energy storage;
- Establish a Program Administrator at the BPU who would oversee the efficient implementation of the program.

Grid Reliability

Address Emerging Reliability Concerns



FTM Dx connected storage can:

- **Accelerate storage deployment by over 5 years compared to storage at the wholesale level given interconnection delays**
- **Provide the same wholesale grid services and social benefits as BTM energy storage resources**
- **Potential to decrease emissions by over 3 million metric tons of CO2 equivalent***

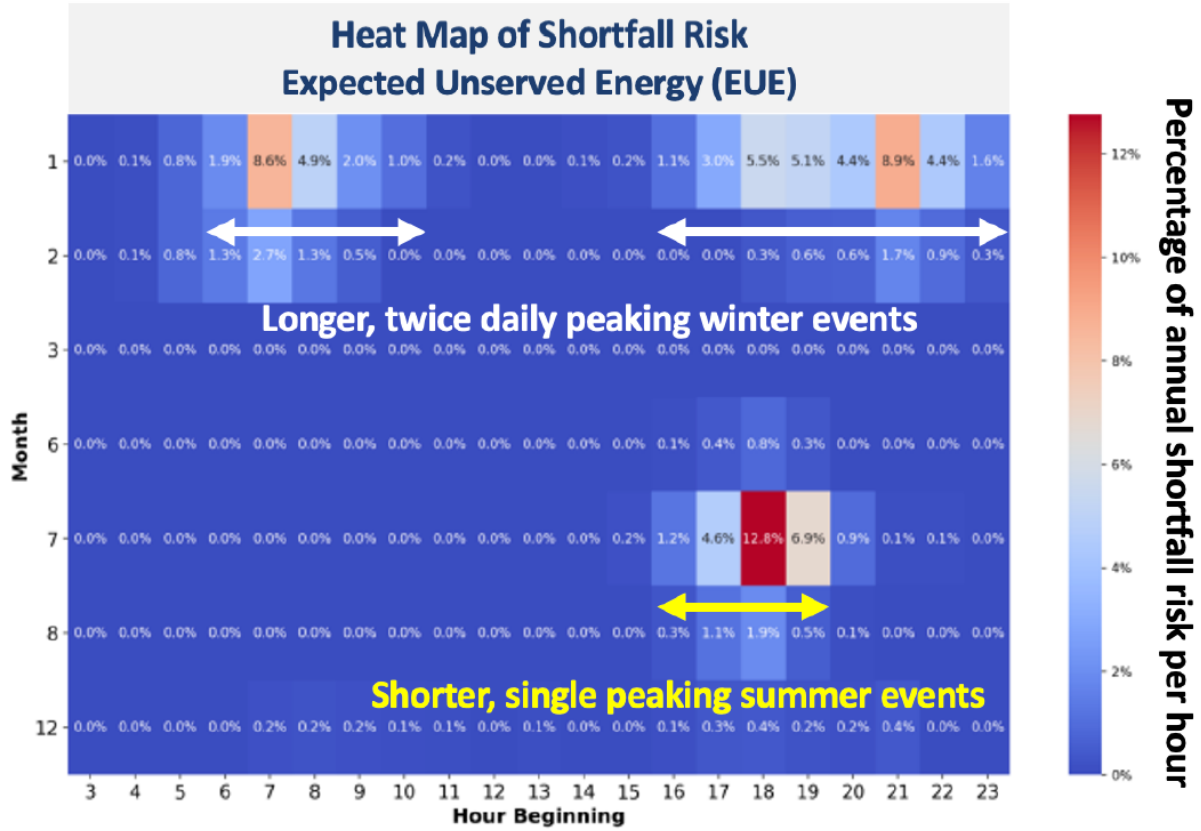
PJM recently updated its load forecast and is projecting materially higher demand in the near term

- **FTM Dx connected storage can be one of the few resources to meet the need for urgent deployment of capacity resources to meet growing demand**
- **Provide additional resiliency and reliability to attract new investment in growing sectors of the economy such as data centres.**

* Assume 2,000MW of installed distribution connected storage displacing 500lb/MWh C02 per cycle over 5 years

Capacity Value

- In order to earn capacity value, FTM batteries participating in PJM's capacity market must respond to three calls: a pair of coupled winter peaks consisting of two 4-hour blocks in the morning and evening on the same day, and a 5-hour summer peak in the late afternoon
  - Batteries must fully charge in advance of each peaks, then fully discharge over the course of the call window
  - This modeling is consistent with PJM's analysis of hourly capacity shortfall risk



This heat map was assembled by PJM as part of their 2023 capacity market reform proposal. It assesses resource adequacy risk on an hour-by-hour basis across a full calendar year. The month of January includes two longer duration periods where RA risk is high. This is in contrast to the month of July, where RA risk is limited to a single, shorter duration period.

Source: Capacity Market Reform: PJM Proposal," PJM, accessed August 12, 2024, https://www.pjm.com/-/media/committees-groups/cifp-