Welcome & Overview

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Why We’re Here & Purpose of Meetings
  ◦ Purpose of Consortium series
  ◦ Steering Committee role

Mission Statement
  ◦ To engage stakeholders on policy and market topics that identify the opportunities to deploy energy storage for a modern, resilient, cleaner, low-carbon grid for all Pennsylvanians.
Steering Committee

- Jennifer DeValerio, Senior Manager – Regulatory & Political Affairs, NextEra Energy Resources LLC
- Thad Culley, Senior Manager – Policy, Sunrun
- Tom Bonner, Manager – State Government Affairs, PECO
- Donna Clark, VP Regulatory & General Counsel, Energy Association of Pennsylvania
- Dave Edinger, Fixed Utility Financial Analyst, Pennsylvania PUC
- Joel Harrington, Director of Public Policy & Institutional Affairs – Eastern U.S. Region, Enel North America, Inc.
- Devin McDougall, Senior Attorney, Earthjustice
- Todd Olinsky-Paul, Senior Project Director, Clean Energy Group/Clean Energy States Alliance
- Michael Rooney, Vice President, Rye Development
- Jason Wert, National Market Leder – Renewables, RETTEW
Agenda – Meeting #2, Dec. 7

I. Welcome & Overview, Housekeeping, Review of Meeting #1
II. The Energy Storage Value Proposition
III. The Current Landscape of Storage in Pennsylvania: Policy, Deployment & Economics
   I. Case studies presented from Enel North America, UGI, PPL, & PA PUC
   II. Short moderated panel
IV. Stakeholder Discussion and Q&A
V. Wrap-Up & Next Steps
Overview & Housekeeping

• **PA DEP Energy Storage webpage:** [https://www.dep.pa.gov/Business/Energy/OfficeofPollutionPrevention/Pages/Energy-Storage.aspx](https://www.dep.pa.gov/Business/Energy/OfficeofPollutionPrevention/Pages/Energy-Storage.aspx)
  - Registration: All attendees must register to receive future communications from PA_energystorage@strategen.com
  - *Download Strategen’s paper “Pennsylvania Energy Storage Assessment: Status, Barriers & Opportunities
  - *Recording of Meeting #1; Meeting #2 (today) and subsequent meetings will NOT be recorded

• **Structure & Logistics**
  - Four PA Energy Storage Consortium Meetings:
    • Sept. 28, Dec. 7, and March 1, and Q2 in ’22 (date TBD): all meetings 1-3pm EST
    • Continuation of Steering Committee as content advisors – scheduled in between Consortium meetings

• **Key Desired Outcomes & Goals**
  - Intention of creating a stakeholder engagement forum – your participation is key!
  - Please use ‘chat’ and ‘raise hand’ functions on Teams

• **Review of Meeting #1 on Sept. 28**
Core Values

- Collaboration
- Technology and business model neutral
- Maximizing environmental and economic benefits
- Energy system resiliency and modernization
- Decarbonization
- Environmental justice
Introductory Poll Results

1. Who’s in the room? Please select your industry:

- Consulting services: 5
- Storage developer: 6
- Solar developer: 1
- Solar + storage developer: 9
- Government – PA state & local: 12
- Government – federal: 0
- Utility – Electric IOU: 11
- Utility – POU or CCA: 0
- Non-profit, enviro, education: 10
- Trade association: 4
- Media: 0
- ISO/TSO/RTO: 0
- Manufacturer / component su...: 5
### Pennsylvania Energy Storage Recommendations - choose your top 3 priorities:

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Votes</th>
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<tbody>
<tr>
<td>1. Establish a storage procurement goal or target</td>
<td>15</td>
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<td>2. Designate public funding to accelerate storage deployment</td>
<td>11</td>
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<td>3. Seek wholesale market improvements by participating in PJM stakeholder...</td>
<td>5</td>
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<td>4. Consider changes to resource adequacy rules and oversight</td>
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<td>5. Develop a strategic plan to accelerate microgrid deployment at critical...</td>
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<td>6. Develop a tariff for distribution-connected solar-plus-storage facilities</td>
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<td>7. Establish direct incentive programs for storage projects</td>
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<td>8. Adopt a multiple-use application framework</td>
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<td>9. Update the interconnection process for distributed energy resources</td>
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<td>10. Enhance distribution planning and procurement processes</td>
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<td>11. Enact retail rate reforms</td>
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<td>12. Expand retail customer programs</td>
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<td>13. Streamline permitting on state and local levels</td>
<td>4</td>
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<tr>
<td>14. Support research and development of new energy storage technologies</td>
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Discussion Poll Results

2. What is the best approach for a potential Pennsylvania energy storage goal?
   - Megawatt (MW) 7
   - Megawatt hour (MWh) 4
   - Percentage of total generation 3
   - Unsure 4
   - Other 1

3. Where do you most want to see market growth for energy storage?
   - Distributed/customer-sited 4
   - Utility-scale 4
   - Distributed/customer-sited and utility-scale 9
   - Unsure 2
   - Other 0

4. Which energy storage technologies should Pennsylvania focus on?
   - Mechanical 3
   - Electrochemical 13
   - Thermal 0
   - Electrical 1
   - Chemical (Hydrogen) 2
Example Participating Organizations

- National Energy Technology Laboratory
- Clean Air Council
- Delaware Valley Regional Planning Commission
- Mid-Atlantic Renewable Energy Coalition
- Clean Energy Group
- East Point Energy
- Arkema
- PECO
- MCOR Marcellus Center for Outreach and Research
- IECPA
- PennState
- CLEARResult
- East Penn Manufacturing Co.
- Coalition for Community Solar Access
- Able Grid
- Customized Energy Solutions
- PEC
- Sustainable Energy Agency
- Sustainable Pittsburgh
- KEEA Keystone Energy Efficiency Alliance
- AMERESCO
- Evolution Energy Partners
- ppl
- Rettem
- Evolution Energy Partners
- Dynamic Energy
- Sunrun
- Energy Storage Association
- PINEGATE Renewables
- Dynamic Energy
- PAPUC Pennsylvania Public Utility Commission
- CALPINE
- Pennsylvania Department of Environmental Protection
- US VANADIUM
- INNERGEX
- Con Edison Battery Storage
- weis
- One Energy
- First Energy
- Convergent
Remaining Agenda – Meeting #2, Dec. 7

I. The Energy Storage Value Proposition
II. The Current Landscape of Storage in Pennsylvania: Policy, Deployment & Economics
   I. Case studies presented from Enel North America, UGI, PPL, & PA PUC
   II. Short moderated panel
III. Stakeholder Discussion and Q&A
Energy storage may play an important role in advancing many of Pennsylvania’s energy priorities.
Energy storage can enhance Pennsylvania’s climate and resilience initiatives across the entire electric grid – generation, transmission, and distribution.
Energy storage can provide value and benefit streams to many stakeholders.
The Energy Storage Value Proposition - Agenda

+ The value proposition of energy storage

+ How does the value proposition for storage vary for different parties/who is implementing?
  + Energy consumers
  + Utilities/EDCs
  + Developers/market participants

+ Evaluating the value proposition for grid connected storage via where it’s located and how it is deployed
  + Transmission system
  + Distribution system
  + Behind the Meter (BTM)
  + Hybrid Applications

+ Energy Storage in PA Today & Challenges to Deployment
Energy Storage in Pennsylvania Today

+ **22 operational or announced standalone, utility-scale energy storage projects**

   - Pumped hydro: *1,070 MW*
   - Lithium-ion batteries: *18 MW*
   - Lead-carbon batteries: *12.5 MW*
   - Thermal storage: *8 MW*
   - Lead-acid batteries: *3 MW*

+ **Increasing deployment for renewable energy that can benefit from energy storage as a grid-balancing resource**

   “Pennsylvania’s Solar Future” goal of 10% solar by 2030

Beyond legacy pumped hydro, new advanced energy storage projects are in the early stages of deployment in the state.
Energy Storage in Pennsylvania Today

+ Growing levels of utility-scale solar and solar + storage

+ Interest in storage as a distribution grid asset to support resilience and reliability

PUC Docket No. M-2020-3022877

+ Recent changes to applicable PJM wholesale market rules

FERC Order 841 requires energy storage market participation options

+ RGGI participation

Revenues from RGGI could support and standardize storage projects

The potential for energy storage is a growing topic of discussion in the state and region

Source: PJM (February 2021), “New Services Queue.”
# Barriers to Energy Storage in Pennsylvania

## State Policy
- Lack of storage or clean energy targets or requirements

## Retail Tariff Design and Customer Programs
- Lack of retail programs and rates tied to grid services
- Limited pathways for retail customers to provide grid services through DERs

## Distribution Utility Planning and Procurement
- Lack of framework and incomplete valuation of storage in procurement and planning

## Permitting and Interconnection
- Cumbersome local permitting and interconnection processes
- Limited local industry experience in advanced battery technologies

## Wholesale Markets
- Restrictive requirements for participation in PJM energy, capacity, and ancillary services markets
- Unclear market participation rules for hybrid systems, storage as transmission, and DER aggregations
- Limits on market access for multiple uses for storage

## Technology
- Potentially high battery costs and technical limitations
Enel North America, Inc.

I. Drivers & Value Proposition for Developers

II. PA Case Study: Pennsylvania’s Largest Battery Storage Project

Enel in the United States & Pennsylvania

Changing the face of energy
Enel: A growing green energy giant

Accelerating the Energy Transition: The focus on decarbonization and electrification

Enel is a multinational power company and a leading integrated player in the global power, gas and renewables markets. We are changing the face of energy as a shaper, leader and enabler of the energy transition.

Enel began as an energy utility over 50 years ago, but today we are not the company we once were. With a dedicated focus accelerating the energy transition through decarbonization and electrification, we have been listed on the Dow Jones Sustainability Index for 17 years and have been included on Fortune Magazine’s “Change the World” list (2015, 2017, 2018).

1. By number of customers. Publicly owned operators not included
2. By installed capacity. Includes managed capacity for 4.2 GW
3. Includes customers of free and regulated power and gas markets

Data as of 06/30/2021
Enel X is Enel's business line dedicated to the development of innovative products and digital solutions in sectors where energy is showing the greatest potential for transformation: cities, homes, industries and electric mobility. These innovations are key to driving the Energy Transition to be more digital and electric.

4.7 GW
Demand response capacity managed across utilities and businesses

MORE THAN 70
Behind-the-meter battery energy storage systems in operation or under contract

MANAGE OVER $10.5B
In customers' annual energy spend for about 4,500 business customers, spanning more than 35,000 sites

~80,000
JuiceBox electric vehicle smart chargers sold, powered by Enel X’s JuiceNet, IoT platform for smart management of vehicle charging
Enel has operated in Pennsylvania for more than a decade and has employees who live and work in the Commonwealth.

Currently have 484 MW enrolled in Demand Response programs for some of Pennsylvania’s largest commercial and industrial customers, generating ~$19 million in payments that go back to those customers.
Policy Implications: Federal and State
Storage Value Proposition: Federal Policy Impacts


- The federal Investment Tax Credit is expanded to include energy storage technology. Technologies such as energy storage will be **eligible for a 6% base credit rate or a 30% bonus credit** rate through the end of 2026.

- **Energy Storage Technology** – uses batteries and other storage technology to store energy for conversion to electricity and has a minimum capacity of 5 kWh, or stores energy to heat or cool a structure.
Storage Value Proposition: State and Regional Drivers

Technologies

Drivers & Big Picture

Economics

Integration & Deployment

Source: EPRI
Storage Value Proposition: State and Regional Drivers

Transmission:
- Wholesale market price signals
- Peak shaving
- Renewable Hybrid Integration – smoothing, avoid intermittency

Distribution:
- Non wires solutions
- Resiliency
- Electric transportation

Behind the Meter:
- Decrease energy supply portion of bill
- Peak shaving
- Meet local energy building codes / U.S. Green Building Council

Source: EPRI
Locational Value of Storage

- Centralized
- Substation
- Community
- Commercial & Industrial

Storage Value

- VALUE PROPOSITION
  - Ramping
  - Spinning Reserve
  - Supports Wind Farm Integration
  - Frequency Control
  - Black Start

- VALUE PROPOSITION
  - Reduces Transmission Congestion
  - Substation Overloading
  - Power Quality

VALUE PROPOSITION
- Leverage TOU Pricing
- Demand Charge Reduction
- Demand Response
- Firms Distributed Solar
- Critical Load support

Centralized Distributed
Value stacking for Storage Assets: Asset Management Team

“Market Services Revenue”
- Grid Products (DR / Check)
- Capacity
- Ancillary Services
- Energy

“On bill Savings”
- Retail Products (DSM / On Bill)
- Facility Peak Management
- System Peak Management
- Energy Arbitrage

“Incentives/Grants”
- Incentives/Grants
- State and Government Incentives
- Utility Incentive Awards (i.e. NWS)
- Private or Government Grant awards (ACES)

Optimize across value streams
“Total System Benefit”
Flexibility Solutions Platform
Connecting any asset to any value-stream

Connect all types of distributed energy assets…

… and optimize across all available grid and retail value streams

… using a flexible and scalable global “flexibility platform”

- Real-time Variable Loads
- PV & Other Distributed Generation
- Energy Storage
- EV Charging

- Grid Products (DR / Check)
  - Capacity
  - Ancillary Services
  - Energy
- Retail Products (DSM / On Bill)
  - Facility Peak Management
  - System Peak Management
  - Energy Arbitrage
Case Study: Utility-Scale Solar + Storage in PA

Enel is developing two utility-scale solar projects in York County with a combined capacity of over 120 MW of clean power.

- Pairing each project with a 20 MW battery system to help smooth energy supply to the grid and support grid reliability, stability, and resiliency for Pennsylvania consumers.

- One project = 339 jobs, $21.6 million in labor income and $55.1 million in local economic output for York County during construction.

- Agrivoltaics: Conservation grazing, planting native grasses and forbs, and crop production.
“Solar + Storage” Case Study

Making PV+S pencil for University

- Zero upfront capital investment by University that will deliver almost $2M in energy savings.

- Enel’s fees are entirely performance-based with fully aligned incentives. Particularly important with complex Application Stacking.

- While TPO solar with performance-based commercials (e.g., PPA) is not new, much of the BTM storage space still requires customers to bear merchant or performance risk.

- Revenue Stacking, underwritten by Enel X:
  - Demand charge management
  - Energy Arbitrage
  - Coincident peak management
  - capacity + energy + reserves
  - Utility Daily Dispatch Programs

- Grid services revenues realized via smart EV chargers also shared between Enel and University.
Enel Green Power

Investing in the long-term sustainability of our host communities

**CREATING SHARED VALUE**

- Civil Infrastructure Improvement
- Community Well-being, Recreation & Cultural Events
- Education
- Economic Development
- Environment
- Resilient and Sustainable Communities

STEM Class, OK

Tarkio School District, MO

TioGA Community Center, MN

Aurora Solar, MN
Thank You

Joel Harrington
Director of Public Policy & Institutional Affairs, Eastern U.S. Region
joel.harrington@enel.com
Appendix
Enel business

Global Power Generation
Accelerates a sustainable energy transition, increasing renewables capacity growth and decarbonizing our fleet

Global Infrastructure & Networks
Guarantees reliability and quality of service in the energy supply, through efficient, resilient and digital networks

Energy & Commodity Management
Optimizes the Group margin as a single portfolio, finding its best balance

Enel X
Enables the energy transition boosting electrification and decarbonization of customers, by providing innovative services and system flexibility

Retail
Increases customer value through commodities and “beyond commodities” services also thanks to customer satisfaction and experience improvement
UGI Case Study: Battery Storage Deployment

Presented by: Jessica Rogers, Director – Regulatory Strategy, UGI Utilities, Inc.
Overview of UGI Electric

• Electric distribution company providing service to approximately 65,000 customers
• Service territory includes parts of Luzerne and Wyoming Counties
• Affiliate of UGI Gas, which serves more than 650,000 customers in 45 of Pennsylvania’s 67 counties.
• UGI Electric’s system contains more than 1,200 circuit miles of overhead and underground distribution lines.
• The service territory is primarily rural in nature.
UGI Electric Battery Project

• Battery project to address a specific reliability issue on a rural radial circuit
  • Terrain surrounding the distribution circuit provides limited options for reliability solutions
    • Steep slopes; railroad tracks; extensive dense foliage
    • Company had already exhausted non-capital solutions, including vegetation management

• UGI Electric evaluated other traditional capital solutions
  • Company concluded the battery was the most cost-effective approach
  • Battery would have covered the entire outage duration for 22 out of 26 outages experienced between 2016 and 2020, and would have reduced the longest outage experienced during those years by more than 50% of its duration.
UGI Electric Battery Statistics

• 1.25 megawatt-hour capacity lithium-ion battery
• 67 customers served by the project
  • The project would have saved over 250,000 customer interruption minutes between 2017 and 2019.
• Cost of the project: $1.5 million
  • Other reliability solutions were projected to cost anywhere from $3.0 to $5.1 million.
• To improve cost effectiveness, UGI Electric proposed that it be allowed to use the battery to participate in the PJM Frequency Regulation Market
• UGI Electric proposed the project in a base rate proceeding before the Pennsylvania Public Utility Commission

• Project was opposed by the Bureau of Investigation and Enforcement, the Office of Consumer Advocate, and the group representing Marketers and Suppliers

• Arguments in opposition included the following:
  • Insufficient evidence supporting selection of the project
  • Project would only provide reliability support for a limited number of customers
  • Storage should be classified as a generation asset and not a distribution asset
  • Batteries should not be utility-owned; private developers are better situated to provide the service
  • Proposal to participate in PJM Frequency Market may violate the Competition Act
  • Allowing UGI’s proposal would harm the competitive market
  • Revenues associated with participation in the PJM Frequency Market are speculative
Terms of Settlement

• Allows for the inclusion of the battery project in rate base

• Requires additional reporting requirements

• Does not allow UGI Electric to participate in the PJM Frequency Regulation Market

• Specifies that the battery storage proposal is non-precedent setting
  “This Settlement reflects a carefully-crafted compromise of the parties’ positions and is based on the small size of the battery and the unique circumstance of the Ruckle Hill Road distribution circuit, including its voltage, its status as a worst performing circuit, the surrounding terrain, the nearby vegetation, and the load served by this circuit.”
Challenges to Further Deployment of Battery Storage Technology by Pennsylvania Utilities

• Reducing barriers to project implementation will be critical to further deployment of storage technology by electric utilities
  • Regulatory certainty that appropriate projects will be approved and not cause excessive delay in the litigation process
  • Timely cost recovery is a critical consideration for utilities
  • Striking a balance between competitive market needs and utility/customer needs

• Allowance in Long Term Infrastructure Improvement Plans and cost recovery through the Distribution System Improvement Charge would make battery storage technology more comparable to traditional solutions
Concluding Thoughts

• Commission’s existing electric storage policy proceeding may provide necessary clarity on the use of battery storage technology for reliability projects
  • For ratemaking purposes, when is battery storage technology a “distribution” versus “transmission” versus “generation” asset; should allocations apply, and if so, how?
  • What consideration for possible cost offset, such as participation in the PJM Frequency Regulation market, should be made?
  • Battery storage may be a space for innovative utility-private market solutions (e.g., asset management arrangements); should such possibilities be recognized?
  • As a growing technology, how can the Commission encourage innovative deployment and not be tightly proscriptive?
Thank you!
PPL Case Study: Battery Storage Deployment

Presented by: Dave Gladey, Director of Management & Engineering, PPL Electric Utilities
Battery Energy Storage

David Gladey
Director of Distribution Asset Management & Engineering
December 7, 2021
Our Journey

Problem: Annual Reliability Concerns
• Repeated customer outages in a rural area near Harrisburg
• Traditional solutions were cost prohibitive

Solution: Battery Storage
• Battery storage can be a cost-effective, innovative solution to improve reliability while simultaneously reducing the need for expensive new tie lines
• This location was perfect since it was at the end of a single-phase tap over 10 miles from a substation on a circuit with reliability challenges
Why Battery Storage?

• Improved grid reliability
• Operational efficiency
• Reduced outage duration
• Cost-effective solution
• Reduced human intervention and reduction of human error
How it Works

- Activates automatically when needed to keep customers in power
- Can be controlled remotely from Operations Center
- Associated with a new single-phase Viper for isolation
- Comprised of stacked banks of lithium-ion batteries
- Provides power to at least 8 customers for 6+ hours
Lessons Learned

• How to maintain public safety and the distribution system's integrity

• How to communicate with the battery using our Distributed Energy Resource Management System

• How to safely isolate our system from the "intentional island" we create when using the battery to restore customers during an outage

• How to protect the distribution system and the public if a fault were to occur on the "intentional island"
Next steps

- Battery storage is a non-wires alternative solution that we actively consider when evaluating reliability improvements.

- We continue to evaluate key areas within our distribution grid where battery storage would provide significant value to our customers.
Thank you!
PA PUC: Utilization of Storage Resources as a Distribution Asset

PUC Policy Proceeding: Utilization of Storage Resources as a Distribution Asset Overview
Background

• Secretarial Letter issued December 3, 2020
• Three questions asked
  • What applications can electric storage provide as a distribution asset for utilities that would facilitate improved reliability and resiliency?
  • What are the defining characteristics of electric storage used for distribution asset planning as distinguished from generation resources? What thresholds, if any, would classify electric storage as a generation resource and therefore outside permitted distribution ratemaking and recovery?
  • Is it prudent for utilities to include electric storage in their distribution resource planning and, if so, where and under what circumstances? Further, is it appropriate for utilities to include such investments in rate base?
Outcomes of December 2020 Secretarial Letter

• Two prominent themes
  • Agreement that energy storage can enhance reliability and resiliency on the distribution grid
  • Disagreement on how energy storage should be *deployed* on the distribution grid
• Several more questions raised
• Second Secretarial Letter issued August 12, 2021
August 12 Secretarial Letter

• Seven additional questions

1. What are the parameters that would allow for the use of energy storage on the distribution grid? For example, what factors should be used in the consideration of the energy-storage project? Should the energy-storage project meet certain thresholds and demonstrate certain requirements, e.g., demonstration of cost-effectiveness as compared to alternate measures, demonstration of need, required RFPs to solicit potential third-party providers, limitations on project size and scope, etc.?

2. What EDCs have undertaken energy-storage initiatives as a pilot program and what were the results and lessons-learned?

3. Under what circumstances is it appropriate to deploy energy storage as compared to traditional infrastructure upgrades?

4. Who should own an energy-storage asset? EDCs, third-party vendors, or some combination of both?

5. What processes should the Commission use to review requests to utilize energy storage as a distribution asset and recover associated costs?

6. What cost recovery mechanisms should be implemented for the ownership and operation of energy-storage assets?

7. What are the appropriate models and limitations necessary to allow energy storage to participate in wholesale power markets?
Panel

Moderator: Ed Burgess, Senior Director, Strategen
Dave Edinger, Fixed Utility Financial Analyst, Pennsylvania Public Utility Commission
Jessica Rogers, Director – Regulatory Strategy, UGI Utilities, Inc.
Dave Gladey, Director of Management & Engineering, PPL Electric Utilities
Joel M. Harrington, Director of Public Policy & Institutional Affairs - Eastern U.S. Region, Enel North America, Inc.
Stakeholder Discussion

- Any additional work that needs to be done between this meeting and future meetings in terms of additional analysis on sort of value proposition?

- In addition to or building off the Strategen "PA Energy Storage Assessment" report, what are folks interested in seeing beyond that to help move ball forward in various policy discussions?
Wrap-Up & Next Steps

Next Consortium Meeting Date:

• **March 1st, 1:00-3:00 PM EST**

Stakeholder Engagement & Feedback:

• [PA_energystorage@strategen.com](mailto:PA_energystorage@strategen.com)