GLOBAL ENERGY SOLUTIONS SUMMIT
March 28 to 29, 2019
Embassy of Canada, 501 Pennsylvania Ave NW
Washington, DC
Welcome & Opening Remarks

Martin Loken
Minister
Embassy of Canada

Scott Pattison
President & CEO
National Governors Association
GLOBAL ENERGY SOLUTIONS SUMMIT

Opening Keynote Speaker

Ethan Zindler
Head of Americas
Bloomberg New Energy Finance
Opening Remarks & Thank You

Thank You to the Summit Planning Team

**NGA**
- Jessica Rackley
- Abigail Hunter

**Embassy of Australia**
- Sarah Storey
- Anthony Orford
- Meredith Jones

**Embassy of Canada**
- Aaron Annable
- Dan Abele

**Embassy of Denmark**
- Jeppe Helsted
- James Glennie

Sue Gander
Division Director
Environment, Energy & Transportation, National Governors Association
Offshore Wind Program: Opening Remarks

Lone Dencker Wisborg
Ambassador-designate of Denmark to the Untied States of America
The Embassy of Denmark
GLOBAL ENERGY SOLUTIONS SUMMIT

State of the Offshore Wind Market

MODERATOR

Amy Harder
Energy Reporter
Axios

Ned Lamont
Governor
State of Connecticut

Morten Bæk
Permanent Secretary
Danish Ministry of
Energy, Utilities and
Climate

Alicia Barton
President and CEO
NYSERDA

Thomas Brostrøm
CEO
Ørsted US Offshore
Wind

Walter Cruickshank
Acting Director
Bureau of Ocean
Energy Management
Keynote: Advancing Offshore Wind Through Regional Support

Morten Bæk
Permanent Secretary
Danish Ministry of Energy, Utilities and Climate
Networking Break

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Opportunities & Next Steps: What Does it Take to Unlock the U.S. Market for Offshore Wind?
Lunch with Keynote on the Future of Offshore Wind

Joe Balash
Assistant Secretary for Lands and Minerals Management
U.S. Department of the Interior
Training Session: Workforce Development for Emerging Energy Technologies

MOTERATOR

Stephen Pike
CEO
Climate and Massachusetts Clean Energy Center

Mary Sotos
Deputy Commissioner for Energy
Connecticut Department of Energy & Environmental Protection

Angela Navarro
Deputy Secretary of Commerce and Trade Virginia

Cory Channon
Assistant Director of Construction Sector Operations International Brotherhood of Boilermakers
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Trivia & Transition

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Opening Remarks

Hon. Peter McGauran
Consul-General, Senior Trade and Investment Commissioner to Houston, TX
Australia
State of the Energy Storage Market
Case Study on Energy Storage Project Keynote

John Zahurancik
COO
Fluence
Energy Storage: Lessons from Australia; coming to a T&D network near you

John Zahurancik, Chief Operating Officer, Fluence
Transmission/Trading Enhancement

AusNet / Energy Australia
Ballarat, VIC, Australia
30 MW / 30 MWh

SERVICES
• Local capacity
• Peak/off-peak management
• FCAS/Ancillary Services

IMPACT
• Competitive selection
• Maximizes transmission
• Strengthens network
Renewable Integration

Nexif Energy
Port Augusta, SA, Australia
10 MW / 10 MWh
Under construction adjacent to new wind generation

SERVICES
• FCAS/Ancillary Services
• Renewable integration
• Peak/off-peak management

IMPACT
• Grid stability
• Meet regional connection requirements
Fluence is the global leader in utility-scale energy storage

- 760+ TOTAL MW
- 70+ PROJECTS
- 17 COUNTRIES
- 11+ YEARS
- 6,000+ GW-Hours of Delivered Service globally

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Energy storage continues to gain momentum worldwide

Battery-based energy storage assets are serving constrained power systems with fast, flexible power

- **California**
  - Target for 1,325 MW by 2020
- **New York**
  - Target for 1,500 MW by 2025
- **Hawaii**
  - Storage Procurement
- **Mexico**
  - Storage in Market Reform
- **Puerto Rico**
  - Storage for Renewables & Microgrids
- **Dominican Republic**
  - Storage for Frequency & Resiliency
- **Chile**
  - Storage for Ancillary Services
- **Brazil**
  - Storage for Remote Grids
- **United Kingdom**
  - Capacity & Grid Support
- **Germany**
  - Storage for Frequency
- **Italy**
  - Island Microgrid
- **Japan**
  - Wind Storage, Changing Market Structure
- **Korea**
  - 200+ MW Installed
- **Philippines**
  - Storage for System Security
- **India**
  - Solar + Storage
- **Australia**
  - Supporting Transmission Stability
The duck curve is coming faster and bigger in the U.S. than we thought

Unless we solve solar value deflation, solar growth will stagnate

Forecasted

Actual

12,000

2020

8,000

2018
A very similar picture is forming in Australia…

South Australia Average Operational Demand

Source: AEMO, 2018
AEMO’s First Integrated System Plan Provided a Look Ahead on Growing Need for Storage


Ramp Rates Will Become a Lot Higher, Making Storage a “Must Have” In Next 5-7 Years

Source: AEMO ISP, 2018
Applications Across the Entire Domain of Transmission & Distribution (T&D)

1. **T&D Capacity Release**
   - Automatic power injection to support grid stability during contingency events
   - Increase the operational capacity of existing line (value creation from existing assets)

2. **Peak Load Relief**
   - Injects power downstream of thermal constraints during peak hours
   - Avoids or defers new transmission capex to meet load

3. **Congestion Management**
   - Injects power downstream of congested transmission facilities
   - Reduces net load payment, adjusted production costs or other congestion related costs resulting in customer benefits

4. **Distribution System Reliability**
   - Supports greater penetration of intermittent renewable energy resources
   - Injects real and reactive power to maintain voltage stability, improve power quality

5. **Blackstart (System Restart)**
   - Provides blackstart capability to the grid
   - Capability to redefine the cranking path definitions

6. **Grid Reliability**
   - Frequency response or other reliability standards requiring fast response
   - Improving transmission reliability and related metrics
Storage is well suited for peak load/congestion relief

ConEdison Load Duration Curve (Illustrative)

Few hours where load is high – traditional T&D systems planning is performed based on deterministic power flow analysis for snapshot summer/winter peak conditions

Consideration of Critical Load at which violations occur could provide indications of feasibility of non-wires alternatives

Energy storage provides a unique capability to defer T&D investments
Mix of price volatility and grid congestion in Australia

- Resource mix change: rapid adoption of renewables, accelerating coal retirements
- Limited flexibility & transfer capacity between regions, creating congestion points on network and increasing likelihood of curtailments
- Volatility creates risk and uncertainty for generators and generator/retailers

Figure 1. Average Wholesale Electricity Prices in Q2 2018 in Australia’s NEM

Note: The average quarterly price is broken up into two parts, energy and volatility. Volatility refers to the contribution of high priced events (above $300/MWh) to the average price more commonly known as cap returns. “Energy” is therefore the remainder.

Source: AEMO Quarterly Energy Dynamics, Q2 2018, Aug 2018
Ballarat project’s commercial structure unlocks both network and market benefits

Offers paths forward for U.S. markets where utilities cannot own storage (e.g., Texas)

Multiple Commercial Structures for Value Creation

1. T&D (ASSET OWNER) | IPP/Third Party (LESSEE)
   - T&D company owns storage asset and leases it back to third-party market participant.

2. IPP/Third Party (ASSET OWNER) | T&D (LESSEE)
   - IPP/third party owns storage asset and leases it to T&D company for specific periods of the year at fixed capacity charge.

Layering of benefits:
- Flexible peaking capacity to help meet peak electricity demand
- Regulate frequency by participating in all Frequency Regulation & Ancillary Services (FCAS) markets
- Potential for other network services via agreement with T&D network provider
Potential for U.S. T&D Applications for Storage
Transmission & Distribution Enhancement

Arizona Public Service (APS)
Punkin Center, Arizona, United States
2 MW / 8MWh

SERVICES
• Transmission upgrade deferral
• Peak management

IMPACT
• Power reliability at half the cost of a transmission line
In Arizona, APS Example Highlights Value Proposition for Peak Load Relief Application in the U.S.

Energy Storage for half the cost of transmission upgrade

SERVICES
• Peak demand management
• Transmission investment deferral

IMPACT
✓ Defer or replace investment in 20-mi of transmission
✓ “We can take much smaller incremental steps to manage the need as it arises and not have to over-invest in some cases, as utilities have traditionally had to do in the past.”
In U.S., FERC's 2017 Policy Statement on Storage Was a Win for Multi-Use Applications

- Beginning of year 2017, FERC issued a policy statement clarifying that storage could be used to addressing transmission needs while participating in other revenue-producing markets.

- This statement provided a strong signal towards encouraging multi-use applications, while reducing up-front cost for utilities seeking to leverage a storage asset for to meet T&D needs.

**Cost-based – reliability-oriented, T&D**

**Market-based – wholesale market participation**
CAISO selection of Storage as part of Regional Transmission Plan (PG&E OCEI) was a Win in 2018.

### Request Window Submission - Oakland Clean Energy Initiative

Pacific Gas & Electric (PG&E) proposed the Oakland Clean Energy Initiative (OCEI), targeting thermal overloads in Oakland area without local generation as a reliability need. PG&E proposed a combination of substation upgrades, in-front-of-the-meter energy storage, and preferred resources. The project includes the following:

1. Upgrades to Moraga 230/115 kV Transformer Bank 3 to remove limiting elements, as well as upgrades at Moraga 115 kV and Oakland X 115 kV substation buses;
2. Transmission line rerates on Moraga-Claremont 115 kV Lines #1 and #2, currently underway and scheduled for completion in Q1 2018;
3. A minimum of 10MW / 4 hour of in-front-of-the-meter Utility Owned Energy Storage within the Oakland C and Oakland L 115 kV substation pocket;
4. Competitive procurement of an additional 10 MW-24 MW of preferred resources sited within the Oakland C and Oakland L 115 kV substation pocket, of which at least 19.2 MW (measured at 4 pm in September) must be load modifying in nature; and,
5. Continued reliance on transferring Alameda Municipal Power load from Cartwright (North) to Jenny (South) during peak loading conditions and after an N-1, in preparation for an N-1-1.

<table>
<thead>
<tr>
<th></th>
<th>Estimated Capital Cost (2022 $M)</th>
<th>Total Cost (2022 $M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>OCEI</td>
<td>$56-$73$^1</td>
<td>$102$^2</td>
</tr>
<tr>
<td>115 kV</td>
<td>$193-$217</td>
<td>$367$^3</td>
</tr>
<tr>
<td>230 kV</td>
<td>$316</td>
<td>$574$^4</td>
</tr>
<tr>
<td>Generation</td>
<td>$232</td>
<td>$368$^3</td>
</tr>
</tbody>
</table>

Notes:
1. Proportion of CAPEX to contract spend will be determined by the most cost effective portfolio determined through the RFO
2. Calculated using unit costs of the expected portfolio, including land and O&M as appropriate
3. Based on the $193 CAPEX estimate assuming 2022 installation date
4. Based on the CAPEX estimate assuming 2022 installation date
5. Based on the CAPEX estimate assuming 2022 installation date

The ISO review found that the OCEI project address all reliability issues identified in the Oakland area without local generation. The ISO is recommending the approval of the transmission regulated assets of the Oakland Clean Energy Initiative project for the substation upgrades at Moraga and Oakland X, rerating of Moraga-Claremont 115 kV Lines #1 and #2 and the installation of the battery storage at the Oakland C and Oakland L 115 kV substations that are estimated to cost $56 to $73 million with an in-service date of 2022. The ISO is recommending PG&E to seek approval through the CPUC procurement process the additional identified preferred resources for the Oakland Clean Energy Initiative.

BESS was found to be economic compared to other traditional transmission options in the California Regional Transmission Expansion Planning Process in 2018. Cost recovery for BESS proposed in this case would occur through transmission rates.
Global Markets are Looking at Storage as Transmission – Examples from Europe, Asia Pacific and US

France’s RTE unveils "virtual power lines" project

March 9 (Renewables Now) - France’s electricity transmission system operator RTE unveiled a research project named RINGO that will seek to integrate energy storage solutions in “virtual power lines”.

At a presentation of its innovation policy on Tuesday, RTE said it wants to build the “first power grid to combine electricity and digital solutions”.

Besides plans for new generation substations which could potentially increase grid integration of renewable power by 30%, RTE is working on a concept of virtual power lines using energy storage as well as on an artificial intelligence solutions that could aid the dispatching process and optimise the management of electricity currents on the grid.

The “virtual power lines” concept essentially relies on using batteries to alleviate grid congestion. Instead of building back-up power lines to deal with congestions caused by physical limitations at critical points on the pathways linking power plants and population centres, RTE wants to deploy batteries to do the same.

PJM – 2017 – Congestion Relief – ITC Proposal in Market Efficiency Window

a. 17RTEP1-212: Peach Bottom to Pyle Road to Fallston Road to Old Post 230-kV Transmission Line and Battery Project

The Peach Bottom to Pyle Road to Fallston Road (and battery at Fallston Road) to Old Post 230-kV line is a streamlined solution to address the Market Efficiency congestion identified as a part of the 2016/17 RTEP Long Term Proposal Window. This project, referred to as 17RTEP1-212, consists of constructing approximately 37.5 miles of new 230-kV (36.5 miles single-circuit and 1.0 miles double-circuit) overhead line from the existing Peach Bottom substation (PBCO) to a new ITC owned Pyle Road switchyard to a new ITC owned Fallston Road switchyard and to a new ITC owned Old Post switchyard. A new 20MW / 40MWh AES Advancion battery array is connected to the 230-kV system at the new Fallston Road switchyard.
Global Markets are Looking at Storage as Transmission – Examples from Europe, Asia Pacific and US

Australia – Nov 2018 Transgrid/Powerlink Over 1 GW BESS for transmission

<table>
<thead>
<tr>
<th>Table E.1 Summary of potential flexible options</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Option description</strong></td>
</tr>
<tr>
<td>Option 1A – Uprate Liddell to Tamworth Lines and install new dynamic reactive support at Tamworth and Dungars</td>
</tr>
<tr>
<td>Option 1B – Uprate Liddell to Tamworth Lines only</td>
</tr>
<tr>
<td>Option 1C – Install new dynamic reactive support at Tamworth and Dungars and shunt capacitor banks</td>
</tr>
<tr>
<td>Option 1D – SAP Substation and a mid-point switching station between Dungars and Bull Creek</td>
</tr>
<tr>
<td>Option 2 – 330 kV single circuit between Braemar and Liddell</td>
</tr>
<tr>
<td>Option 3A – 330 kV double circuit line from NSW to Queensland</td>
</tr>
<tr>
<td>Option 3B – 330 kV double circuit line between Braemar and Liddell via Ubra and establishment of 330 kV substation</td>
</tr>
<tr>
<td>Option 3C – 330 kV double circuit line between Braemar and Ubra and establishment of 330 kV substation</td>
</tr>
</tbody>
</table>

India – Jan 2019 AP State Filing with Commission – 250-500 MW BESS

**Background:**

AP Transco as a state transmission utility and SLDC as a system operator are contemplating to set up a battery energy storage system (BESS) with a capacity of 250-500 MW with 2-4 hours of storage, under Opex Model, to address morning and evening/night peak deficits (shorter durations), intermittency problems owing to high RE penetration (15-30 mins) and also smoothening of curves. AP Transco and SLDC as a system operator, may plan to set up storage system under Opex Model by paying annuity charges to the Developer. AP Transco may invite bids for the selection of developer based on lowest quoted annuity charges (INR/Annum). Storage system can be planned either at substation level or at source/generation level or at a centralized location i.e. at a substation owned by AP Transco for charging. Storage system, at a centralized location would be a cost effective option on account of scale. The total annuity charges paid to the developer by AP Transco will be socialized and shall be recovered based on the applicability and the usage of the BESS.

**Storage systems are planned to be used for the following purposes**

a) **Peak Load Management (during the day and night):**

Though there is surplus generation during day-time, Discoms are facing peak deficits for 2-3hrs during mornings and evenings, across the year. These deficits can be overcome by planning a thermal plant but it is an inefficient way as the plant will have lower utilization.
Energy Storage is available and transforming power

- Reduced cost by optimization
- Lower emissions & renewable support
- Greater reliability
- Impacting market prices, procurement, and planning
Fluence is the global leader in grid connected Energy Storage
Joint Venture of Siemens & The AES Corporation delivers complete, proven storage systems

- 11+ Years
- 17 Countries
- 75 Projects
- < 700 MW
- 6,000+ GW-Hours of Delivered Service globally
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Intermission

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Opportunities & Next Steps: State & International Perspectives on Energy Storage

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Research and Programs Director
Energy Storage Association

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Director of Energy Storage Research in the Office of Electricity U.S. DOE

Kevin Moriarty
Executive Chairman
1414 Degrees

Scott Bordenkircher
Director, Technology Innovation & Integration
Arizona Public Service Company (APS)
Closing Remarks

Sue Gander
Division Director
Environment, Energy & Transportation,
National Governors Association
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Adjourn to Evening Reception

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