Meeting the technical challenge of the new energy landscape

NYSERDA 2019 Workshop
April 9, 2019
General theme

• The utility industry in general, and Con Edison specifically, is supportive of the goal to reduce emissions and to increase renewable sources of electricity.

• Con Edison is moving forward in a variety of ways to create a path towards a new energy landscape.

• There are some barriers to full implementation that the industry and the company are working to overcome.
Utility industry has been embracing new generation types

Data compiled March 8, 2019.
Source: S&P Global Market Intelligence
Utility industry has been embracing new generation types (2)

![Graph showing US utility-scale solar capacity by quarter in service]

Data compiled March 12, 2019. Source: S&P Global Market Intelligence
Con Edison Incorporated

Utilities
- Consolidated Edison Company of New York, Inc. (CECONY)
  - Orange and Rockland Utilities, Inc. (O&R)
    - Rockland Electric Company (RECO)

Transmission
- Con Edison Transmission, Inc. (Con Edison Transmission or CET)
- Con Edison Gas Pipeline and Storage, LLC (CET Gas)
- Consolidated Edison Transmission, LLC (CET Electric)
- Mountain Valley Pipeline, LLC
- Stagecoach Gas Services, LLC
- New York Transco LLC
  - 12.5%
  - 50%
  - 45.7%

Clean Energy
- Con Edison Clean Energy Businesses, Inc. (Clean Energy Businesses or CEBs)
  - Consolidated Edison Development, Inc. (Con Edison Development or CED)
  - Consolidated Edison Energy, Inc. (Con Edison Energy or CEE)
  - Consolidated Edison Solutions, Inc. (Con Edison Solution or CES)

a. As of 12/31/17.
b. Senior unsecured ratings and outlook shown in order of Moody's / S&P / Fitch. Ratings are not a recommendation to buy, sell or hold securities and may be subject to revision or withdrawal at any time.
Not your “typical” Con Edison generating station!
Three areas of new technology – what are the barriers to implementation?

- Utility scale battery storage
- Utility scale solar generation
- Off-shore wind
Utility scale battery storage

- Energy “footprint”

<table>
<thead>
<tr>
<th>Project</th>
<th>Power (MW) / Energy (MWh)</th>
<th>Footprint (sq ft.)</th>
<th>Power Density (sq ft per MW)</th>
<th>Energy Density (sq ft per MWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BQDM Floral Park</td>
<td>2 / 10</td>
<td>9,000</td>
<td>4,500</td>
<td>900</td>
</tr>
<tr>
<td>Mira Loma - SCE</td>
<td>20 / 80</td>
<td>64,000</td>
<td>3,200</td>
<td>800</td>
</tr>
<tr>
<td>Altagas Pomona</td>
<td>20 / 80</td>
<td>10,800</td>
<td>540</td>
<td>135</td>
</tr>
<tr>
<td>GE – LMS100</td>
<td>100 / 2400</td>
<td>37,500</td>
<td>375</td>
<td>16</td>
</tr>
</tbody>
</table>
Utility scale battery storage

- Safety focus:
- Company has worked with FDNY and NYC DOB to do fire testing, establish setbacks, separation distances, etc.
- Some utility installations have advanced R&D in off-gas monitors to determine potential for adverse outcomes
- Korean experience:
  - 20+ battery fires over last 18 months
  - All lithium ion, majority linked to wind and PV balancing
  - Precautionary de-rates: 5%/95% to 10%/90%
  - Developing new siting standards
Con Ed initiatives – battery storage

• First affordable housing microgrid in NYC
  – Fuel cell, solar, battery

• Ozone Park BQDM battery installation
  – 12 MW-hr installation on company-owned land
  – Neighborhood-focused demand response tool
  – Developed extensive emergency response plan with FDNY and community groups

• Commercial Battery Storage pilot project
  – 1MW/1MW-hr front-of-meter installations
  – Creates three value streams, simplifies implementation
Utility scale solar generation

• Energy “footprint” also presents complexity – finding open space near load
  – New Jersey facility: 50 acres / 12 MW /17% capacity factor
  – Property former farmland crossed by existing transmission line

• “Duck curve” issues – greatest power available when power demand is lowest

• End of life issues
  – Recycling industry nascent
  – Increasing waste stream

• Avian issues
Waste volumes will be significant (IEA 2016)

U.S. modelled results
end-of-life waste volumes, (metric tons)
Let’s Just Recycle Everything!

Waste volume
78 million metric tons by 2050 globally

Material value
$3–$13 worth of metals per panel

Challenges
• Presence of heavy metals
• Poor quality of recovered silicon

Select recycling process
Pyrolysis to recover silicon followed by acid/electrolysis process to recover copper and silver

Reuse alternative
Reuse of panels rejected by high-efficiency energy plants

Content breakdown
- Glass: 76.0%
- Polymer: 10.0%
- Aluminum: 8.0%
- Silicon: 5.0%
- Copper: 1.0%
- Silver: <0.1%
- Tin, lead: Trace

Chemical & Engineering News
Avian interactions – ongoing studies

Argonne National Laboratory photo
Con Edison initiatives – utility solar

New York City – affordable housing “sharing”

Large scale national level purchase
Offshore wind

- Siting timeframes
- Construction and natural resources interactions
- End of life issues
Federal leasing and permitting process

**Planning & Analysis**
- 2 Years
- BOEM publishes call for information & nominations of potential offshore wind areas to auction.
- BOEM identifies priority Wind Energy Areas
- BOEM prepares EA for lease

**Leasing**
- 1-2 Years
- BOEM determines competitive interest
- BOEM holds auction after public notice, awards/negotiates lease

**Site Assessment**
- 5 Years
- Lessee conducts site studies, submits Site Assessment Plan (SAP)
- BOEM reviews SAP; approves, modifies or disapproves
- If approved, lessee conducts studies

**Construction & Operations**
- 2 Years (+25)
- Lessee submits Construction & Ops Plan (COP) to BOEM
- If approved, lessee commences construction.
- Lessee decommissions at end of life.
Natural Resources Interactions


- January 2019: Agreement among Vineyard Wind, the National Wildlife Federation, the Natural Resources Defense Council, and the Conservation Law Foundation
  - Sets out mitigation and protections for the North Atlantic right whale
  - “…intended to serve as a model for similar agreements pertaining to offshore wind projects along the East Coast.”
  - May set the pace of construction
Illustrative provisions – Vineyard Wind / NGO agreement

• January 1 – April 30: no pile driving

• November 1 – December 31 & May 1 - 14: Enhanced mitigation protocol required for pile driving
  – No night work*
  – 10,000 meter clearance zone
  – Trained observers to monitor presence of whales

• May 15 – October 31: Comprehensive monitoring & clearance zone protocols for pile driving
  – No night work*
  – 1000 meter clearance zone with passive acoustic monitors
Illustrative provisions (continued)

• Geophysical surveys during construction / post construction
  – None over specific sound levels Jan 1 – May 14
  – Clearance zone protocols remainder of year
  – Site assessment survey restrictions TBD

• Vessel speed restrictions
  – Limit of 10 knots in Dynamic Management Areas

• Underwater noise attenuation
End of life issues

EPRI estimates based on EIA 2017 annual energy outlook
Con Edison and offshore wind

- Committed to participate in study announced by Governor in summer 2018

- NYPA will lead study, Con Edison will collaborate with NYISO, NYSERDA, and LIPA
  - Learn from European infrastructure design
  - Identify best practices in connecting wind-generated power
  - Identify successful efforts to reduce consumer costs

- Will work with NYC to develop landside facilities as opportunities arise
Summary – change is never simple!