Economic & Technical Aspects of California’s Distributed Generation Development

November 16-18, 2016 • Budapest, Hungary

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Distributed Generation: Economic vs/& Technical. Can’t have one without understanding the other.

New market model with distributed generator
- Potential benefits of system with distributed generation
- Complexity of managing and controlling huge number of small generation sources connected to distribution system
- Impact of distributed generation model on traditional utility business models
- Disincentive of DSOs connecting DG

Technical aspects of distributed generation connecting to the system
- Specialities of different DG technologies
- Network/system connection aspects of different DG technologies
- Potential regulatory measure reducing disincentives of DSOs
My background

• Lawyer
• Distribution Grid Interconnection – power engineers & protection
• Smart Inverter Working Group separated technical and money issues
• No Water Advisor - drought impact, water energy footprint, water-energy nexus
• Legal Advisor
DG is a people problem that will be solved by people:

*Silos! Every Utility, Every Service. Everything is interconnected!*

**AB 327 defines Distributed Generation in California:**

- Energy Efficiency
  - structural/behavioral
- Demand Response
  - auto DR, Internet of Things, High/Lo Tech
- Distributed Generators (solar, wind)
  - Grid Services?
- Storage
  - Grid Services?
- Electric Vehicles
  - Vehicle2Grid?
Microgrid

Distribution Study
Process Data

STORAGE/ EV/ Services/ Data

*Exporting Generators “Rule 21” basic data

“Additional Functionalities”
Potential benefits of system with distributed generation

SDG&E Grid Communication System
Smart Grid Challenges - Infrastructure
Network/system connection aspects of different DG technologies

- Market requirements @ transmission vs distribution levels
- Based on market participation, size, materiality of resource
## DG vs UEG

<table>
<thead>
<tr>
<th>Tariff</th>
<th>Resource Size</th>
<th>Jurisdiction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission Grid</td>
<td>CAISO Tariff</td>
<td>10 MW +</td>
</tr>
<tr>
<td>Distribution Grid</td>
<td>WDAT: Wholesale Distribution Access Tariff</td>
<td>1-20 MW</td>
</tr>
<tr>
<td>Distribution Grid</td>
<td>Electric Tariff Rule 21</td>
<td>Small – 20 MW</td>
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<tr>
<td>Behind-the-Meter</td>
<td>Rule 21 &amp; Net Energy Metering</td>
<td>1MW and smaller</td>
</tr>
</tbody>
</table>
DG vs UEG

- Net Energy Metering (NEM) Tariff
  - *Like UEG, must meet needs of the customer*
  - For distributed energy resources (DER)
  - Interconnected behind a customer meter or on the distribution grid and affiliated with a customer meter
  - Exchange of excess energy production for energy credits, can not earn money, can only create zero $ electricity bill
  - Not a "market," just a tariff for bill credits
## To Create a Market: Communications

<table>
<thead>
<tr>
<th>Interconnection Location</th>
<th>Resource Size</th>
<th>Communications Requirements</th>
<th>Market Available?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmission Grid</td>
<td>10 MW+</td>
<td>Direct Telemetry every 4 seconds depending on market</td>
<td>Yes - CAISO</td>
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<td></td>
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</tr>
<tr>
<td>Distribution Grid</td>
<td>1 MW – 9.9 MW</td>
<td>telemetry every 4 seconds: 3 data points: real power, reactive power, voltage 3 status updates: plant on, off, panel</td>
<td>Not at distribution level</td>
</tr>
<tr>
<td></td>
<td>9.9 MW - 20 MW</td>
<td></td>
<td>For CAISO market participation, utilize WDAT &amp; CAISO direct telemetry</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distribution Grid</td>
<td>&gt;1MW</td>
<td>No telemetry required</td>
<td>No</td>
</tr>
</tbody>
</table>
Impact of distributed generation model on traditional utility business models

1) Who gets the data
   – Grid visibility
   – Resource telemetry

2) How to call for services

3) How to pay for services
   → investigation: data transportation & the electric grid
Complexity of managing and controlling huge number of small generation sources connected to distribution system

Who sees/controls what?
At what cost?
Easy to do?
What are the pathways?
What are the rules?

https://www.fcc.gov/reports-research/maps/connect-america-phase-ii-initial-eligible-areas-map
Moving towards markets: DSOs connecting DG

New York REV vs California DRP
(Renewing the Energy Vision) (Distribution Resources Planning)

NY = picked DSO, top down, communications
CA = ?! “brains,” bottom up, standards based pathways, communications requirements
Specialities of different DG technologies

- Urban vs rural – feeder size, loading
- Knowledge of utility engineers/ protection engineers
- Costs associated with upgrade distribution grid to accommodate generation/ grid services
- Cost of communications services for telemetry
Potential regulatory measure looking towards some type of DSO

- (NY REV)
- CA Integrated Distributed Energy Resources: IDER – R. 14-10-003
- CA Water Energy Nexus – R. 13-12-011
- CA Interconnection Proceeding – R. 11-09-011