New utility business model: Why regulation, policies & markets need to change

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In a nutshell

- Power sector undergoing major transformation
  - Rapid growth of renewables
    - Compounded with rapid rise of distributed generation
  - Massive investment in transmission
  - New role for distribution as consumers become prosumers
- Implications?
  - Traditional “utilities” challenged as revenues erode
  - Thermal generators squeezed in wholesale markets
  - T&D reconfigured to cope with added grid complexities
  - New business model
The way it was
Centralized, one-way, highly predictable & plain dull
Generation

Flooded with intermittent renewables at zero marginal cost

- Flat or falling demand
- Flat or falling wholesale prices
- => Not good for thermal generators
Electricity demand growth?
Pattern common to mature economies

United States 1950-2010

Source: US Energy Information Administration
Flat in all sectors in US
And no prospect for a rebound except in transportation

Source: Americans are buying less electricity. That’s a big problem for utilities Brad Plumer, The Washington Post, 23 Dec 2013 based on data from EIA
Demand declining in Australia

Elect. consumption in Australia’s NEM, 2005-12, in TWhrs

Source: AEMO data; graph courtesy of greenmarkets.com.au
Depressed wholesale prices
German experience not atypical

Source: European exchange
Transmission
New role: integrating massive amounts of renewables

- Different role/different flows
- Acting as integrator for intermittent renewables
- => Requires massive investments
Stromautobahn
Transmission re-defined in context of rising renewables

Source: Germany’s expensive energy gamble,
Wind blows in wrong places
Massive investments needed to transmit to load centers
Distribution
Changing radically in response to decentralized generation

- Bi-directional flow
- Needs maintenance & upgrading
- => In need of new revenue model
Overloaded circuits in Oahu
Ditto in Queensland, etc., etc.
Rooftop power generators
Lennar Corp. 100% solar subdivision, solar housing codes
Coming next: BIPVs
Add to your vocabulary: “Building integrated PVs”
Consumer to “prosumer”

- Buy less from the grid
- Generate more from Dist. Gen.
- => consumers become “prosumers”
A man’s home is his castle
Largely beyond regulator’s reach

Source: The economics of grid defection: When & where distributed solar generation plus storage competes with traditional utility service, Rocky Mountain Institute et al, 2014
Big customer, no revenues
Apple’s new office building under construction in Cupertino, CA
Mid-day sun = “over-generation”

Hourly Average of Renewable Resources: Sunday, March 16, 2014

System Peak Demand (one minute average): 27,286 MW
(from the California Independent System Operator)

Instantaneous Peak Solar: 4,143 megawatts at 14:28

Source: ISO
CA Duck curve
ISO’s net load curves for March 31 – 2012 through 2020

Source: CAISO Discussion of Markets, Mark Rothleder, 3 June 2014
## Old vs. new
What is changing & why?

<table>
<thead>
<tr>
<th></th>
<th>Old</th>
<th>New</th>
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<tbody>
<tr>
<td>Demand</td>
<td>Growing</td>
<td>Flat or falling</td>
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<td>Bus. Paradigm</td>
<td>Centralized</td>
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<td>Generation</td>
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<td>Flow</td>
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<td>Customers</td>
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<td>Tariffs</td>
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<tr>
<td>Load</td>
<td>Inflexible</td>
<td>Price-responsive</td>
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</table>
We need a new business model
Thank you

Source: CAISO Discussion of Markets, Mark Rothleder, 3 June 2014
Bi-directional

Source: Evaluating the benefits and costs of NEM laws in California, prepared for Vote Solar, Jan 2013
Falling generator share prices
5-year performance

Source: Financial Times, 14 Feb 2014
US solar PVs on the rise
Germany has over 35 GW already

Source: Lighting the way, Environment America Research & Policy Center, Aug 2014
Australian PV uptake
Cumulative installed capacity of solar PVs in Australia, 2001-2012, in MW

Source: Clean Energy Council of Australia
If I were in your shoes …

… what would I be focusing on?

- Solar “grid parity”
  - Near or already here?
- Renewable/Dist. Gen subsidies/policies
  - The genie is already out
- Zero net energy (ZNE) buildings/codes
  - Look up Lancaster & Sebastopol, both in CA
- Storage technology & cost -- not just batteries
  - PVs + EVs = Game over?
- Evolution of “distribution network”
  - Regulators in NY & CA are redefining
Solar grid parity
Energy Potential from Unsubsidized $3/W Commercial Solar (Capacity and % of Sales)

Source: Commercial Rooftop Revolution, Institute for Local Self-Reliance (ILSR), Dec 2012
Winners & losers?

- **Incumbents**
  - Traditional “utilities” as the “Kodaks?”
  - Thermal generators not dinosaurs yet *seriously* challenged
  - T&D to gain from transformation of business

- **New players/Innovators**
  - Renewables, distributed generation & EE have room to grow
  - Tesla/SolarCity: EVs + PVs make sense
  - Google/Nest: Monetizing home energy management?
Declining growth rates
Economic growth sustained with minimal electricity growth

U.S. electricity use and economic growth, 1950-2040, percent growth (3-year compound annual growth rate) and trend lines

Source: U.S. Energy Information Administration, Annual Energy Outlook 2013 Early Release
Flat or declining demand?
0.9% growth may turn out to be 0.0%

Source: IEE white paper, May 2011
No coal, little gas in forecast
More likely: low demand growth scenario
Renewable Portfolio Standards
Demand for renewables driven by mandates, not markets

Source: 2011 Wind Technologies Market Report, DOE
PVs 4th largest source of capacity in QLD
Capacity in MW, April 2014

Source: Mike Swanston, Energex
Tesla: Battery on wheels

Source: www.tesla.com
Home energy management

Source: Google.com
Zero Net Energy

Source: NREL
“Transactive”

Transactive Energy
A Sustainable Business and Regulatory Model for Electricity

Stephen Barrager, Ph.D.
Edward Cazalet, Ph.D.

BAKER STREET PUBLISHING
Price responsive demand

CA will need 13 GW ramping in 3 Hrs by 2020

Net Energy Metering (NEM)
The industry’s nemesis

Net metering spreading across the land

Source: DSIRE USA
US Per Capita Elect. Consumption
1990-2011, kWh/pp

Source: Smart Grid Watch, How fast is U.S. electricity consumption growing? April 6 2012