Distribution Market Designs and Business Models:  
*Who will capture the value of electricity?*

Presentation to  
United States Energy Association

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FIRE GREATEST OF DISCOVERIES
ENABLING MAN TO LIVE IN VARIOUS CLIMATES
USE MANY FOODS AND COMPEL THE
FORCES OF NATURE TO DO HIS WORK

ELECTRICITY - CARRIER OF LIGHT AND POWER
DEVOURER OF TIME AND SPACE - BEARER
OF HUMAN SPEECH OVER LAND AND SEA
GREATEST SERVANT OF MAN - ITSELF UNKNOWN

THOU HAST Put ALL THINGS UNDER HIS FEET
Some states are empowering consumers with Distributed Energy Resources (DER) to buy and sell electricity in a competitive market. Beyond Net Energy Metering (NEM) ...

- Various market concepts are proposed
  - Transitional” markets
  - Transactive Energy (TE)

- Most consideration has been given to market designs and new distribution functions, but...

- Markets for DER will work only if business models are viable for both consumers with DER and electric sector businesses.

What business models are viable for each market design?
States with activities supportive of retail DER markets.
Average Residential Electricity Price and Annual Consumption by State, 2015

Key
- Moving Toward TE or Transitional Markets
- Creating Potentially Enabling Conditions
- No Actions
States moving toward markets have relatively more affluent households.

**HOUSEHOLD DISTRIBUTION BY STATE CATEGORY AND INCOME RANGE**

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>No. of Households (Millions)</th>
<th>&lt; $35K</th>
<th>$35 - 99K</th>
<th>≥ 100K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total US</td>
<td>116.2</td>
<td>33.4</td>
<td>43.5</td>
<td>23.1</td>
</tr>
<tr>
<td>No Actions</td>
<td>41.1</td>
<td>34.8</td>
<td>44</td>
<td>21.2</td>
</tr>
<tr>
<td>Enabling Conditions</td>
<td>39.7</td>
<td>34.1</td>
<td>44.3</td>
<td>21.6</td>
</tr>
<tr>
<td>Moving To Markets</td>
<td>25.4</td>
<td>29.8</td>
<td>41.2</td>
<td>29.0</td>
</tr>
</tbody>
</table>
Why now?

Supply push by companies that would capture value as part of prosumer value chain or as market enablers.

Demand pull by consumers
- Increasing value of electricity
- Changing consumer values
- Government policy responds

Consumer Participation in Power Markets

Enabling Platform of Technologies and Grid Architecture

Smart Grid

IT Telecom

Consumer Tech
The move toward customer participation is global. 

Some examples:

- Ontario—Demand Response Auction
- Netherlands—PowerMatcher Pilot
- Denmark—Flexible Retail Market System
- Australia—”Power of Choice” Program
- Germany—Virtual Power Plants/Blockchain
- EU—”New Deal for Energy Consumers”
Policy decisions designing markets for DER will determine how much value goes to customers or others

Some Examples

- Types of transactions and market rules?
- Centralized or decentralized markets?
- Who can participate?
- Who performs each grid and market function?
- How will the prices be determined?
- Role of economic regulation?
- Interface with the wholesale market and FERC?
Transactive Energy (TE)  
*One type of market for DER*

**Definition**

*A system of economic and control mechanisms that allows the dynamic balance of supply and demand across the entire electrical infrastructure using **value** as a key operational parameter.*  
[Emphasis Added]

Visions of DER markets vary.

<table>
<thead>
<tr>
<th>Type of Market</th>
<th>Transitional</th>
<th>Transactive Market</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Procurement Program</strong></td>
<td>DER Performance</td>
<td>Spot and Forward Sales of Energy and Transport</td>
</tr>
<tr>
<td><strong>Products and Services Traded</strong></td>
<td>Spot or Forward Sales of Energy and Transport; grid services</td>
<td></td>
</tr>
<tr>
<td><strong>Financial Transactions</strong></td>
<td>Two-way Subscriptions</td>
<td>Cleared through DSO</td>
</tr>
<tr>
<td><strong>Buyers</strong></td>
<td>Regulated Utility</td>
<td>Consumers</td>
</tr>
<tr>
<td><strong>Sellers</strong></td>
<td>DER Provider (Prosumer)</td>
<td>DER Provider (Prosumer)</td>
</tr>
<tr>
<td><strong>Central Station Resources</strong></td>
<td>Central Station Resources</td>
<td>Central Station Resources</td>
</tr>
<tr>
<td><strong>Market Operator</strong></td>
<td>Regulated Utility (Example: NY REV DSPP)</td>
<td>Transaction Platform Provider (Examples: TeMIX, PowerMatcher)</td>
</tr>
<tr>
<td><strong>Pricing Mechanism</strong></td>
<td>Bids by DER offerors responding to solicitations Can be locational</td>
<td>Matching buyers with sellers in two-way auction</td>
</tr>
</tbody>
</table>
## TE Demonstrations in the United States

<table>
<thead>
<tr>
<th>Demonstration</th>
<th>Dates</th>
<th>Number of Customers Involved</th>
<th>Pricing Mechanism</th>
</tr>
</thead>
<tbody>
<tr>
<td>PNNL Gridwise Olympic Peninsula Project</td>
<td>2006-2007</td>
<td>112 Home water heaters 2 distributed generators 5 municipal water pumps</td>
<td>Congestion pricing on virtual feeder</td>
</tr>
<tr>
<td>AEP GridSmart Project in Ohio</td>
<td>2010-2014</td>
<td>100,000 Residential 10,000 Commercial/Industrial</td>
<td>Prices varied with PJM LMP</td>
</tr>
<tr>
<td>Pacific Northwest Smart Grid</td>
<td>2010-2015</td>
<td>60,000 customers of 11 utilities in 5 states</td>
<td>Modeled forward prices with 5-minute price signals</td>
</tr>
<tr>
<td>Clean Energy and Transactive Campus</td>
<td>2015-</td>
<td>3 multi-building campuses with PV, storage, and DR (3 more campuses planned)</td>
<td>Agent-based transactive controls</td>
</tr>
<tr>
<td>Southern California Edison/Temix Peer-to-Peer</td>
<td>2017-</td>
<td>~200 planned</td>
<td>Tenders to buy, sell &amp; transport electricity</td>
</tr>
<tr>
<td>Connected Building Challenge</td>
<td>2017-</td>
<td>TBD</td>
<td>Software integrating smart devices with price signals</td>
</tr>
</tbody>
</table>
Consumers are the source of electricity’s economic value. *Business models explain how market participants capture some of that value.*

Creating value for customers...
- Who are the customers
- What products and services
- What is the value proposition
- Pricing strategy
- What customer relationships
- What marketing channels

Capturing a share of that value...
- Cost structure
- Capital requirements
- Financing sources and methods
- Operational considerations
- Managing business risks
- Value chain

What business models could be viable in a high-DER-participation marketplace?
Where are we now?
Current Business Models Serving Ultimate Customers

Retail Electric Utility Service
- Investor Owned Utility
- Distribution Cooperative
- Public Power Utility

Competitive Market Businesses
- Retail Power Marketer
- Demand Response Aggregation
- Community Choice Aggregation
- Community Solar

Some customers already provide grid services using DER with photovoltaics, backup generators, CHP or demand response.
Market Shares for Electric Services to Ultimate Customers, 2014

Number of Customers

- Investor Owned Utilities: 68.4%
- Cooperatives: 11.1%
- Power Marketers: 4.3%
- Publicly Owned Utilities: 14.5%
- Federal Power Agencies: 1.0%

Sales (kWh)

- Investor Owned Utilities: 52.3%
- Cooperatives: 11.2%
- Power Marketers: 20.2%
- Publicly Owned Utilities: 15.4%
- Federal Power Agencies: 0.4%

Revenue (Dollars)

- Investor Owned Utilities: 59.0%
- Cooperatives: 11.2%
- Power Marketers: 20.2%
- Publicly Owned Utilities: 14.8%
Value chains illustrate how the value of serving customers is allocated among primary and support activities to create margin.

Example: Vertically Integrated Utility
Common Utility Value Chains Now

**Some Utility Examples**

Vertically Integrated Utility—Investor Owned or Public Power

- Resource Procurement
- Generation
- Transmission
- Distribution
- Management (including Regulatory Affairs)
- Power Marketing
- Grid Operation
- Customer Relations

Margin determined by cost of service regulation

Distribution Company—Most are Coops or Public Power but Some Investor Owned

- G&T Ownership
- (Member) Management
- Distribution
- Customer Relations
- G&T Member

- Wholesale Power Purchases
- Management
- Distribution
- Customer Relations
- Non G&T Member

Generation Unbundled in a Retail Competition State

- Management, Administration and Regulatory Affairs
- POLR Service
- CHINESE WALL
- Competitive Retail Marketing

But not for retail marketing

G&T Member

Non G&T Member
Some Possible Emerging Business Models

- Plain Old Electric Service

**Consumer Entities**

**New Market Participants**
- **Prosumer**
  - Distributed Generation
  - Distributed Storage
  - Demand Response

**Prosumer Combinations**
- Prosumer Aggregator
- Virtual Power Plant
- Microgrids
- Community Choice Aggregation
- Community Solar

**The New Electric Power Industry**

**Market and Infrastructure**
- Transaction Platform Provider
- Market Maker
- Distribution System Operator (DSO)
- Distribution Owner (DO)
Plain Old Electric Service (POES) Consumer

One-stop Shopping: It’s Easy

Electric Bill

Payment

Electric Utility

The Rate

PUC
Value Propositions for Prosumers Aggregation

**Economies of Scale and Financing**
- Community choice aggregation
- Community solar
- Community storage?

**Market Power and Responsiveness**
- Demand response aggregation
- Prosumer aggregation
- Virtual Power Plant

**Resiliency**
- Microgrids
Prototype Microgrid Value Chain

Divergent views on how microgrids create value.

Other than loads, a microgrid may not have every physical component shown.
Lots of possible future distribution functions. **Who performs them? What value does each have?**
Distribution system functions have been proposed for utilities.

Prototype Distribution System Operator (DSO)

- Management (including Regulatory Affairs)
- Interface with DER
- Distribution Market Operation
- Interface with Transmission System Operator
- Customer Relations
- Network Planning, Construction and Ownership
- DER Planning & Interconnection
- Coordination w/ DO
- Customer Billing Coordination
- Coordination w/ DSO & TSO
- Customer Relations

Prototype Distribution System Owner (DO)

- Management (including Regulatory Affairs)
- Network Planning, Construction and Ownership
- DER Planning & Interconnection
- Customer Billing
- Billing Coordination
- Customer Relations
- Interface with DER
- Distribution Market Operation
- Interface with Transmission System Operator
- Coordination w/ DO
- Customer Relations
DER markets in some form are likely, but questions abound…

- How many customers want TE and how many don’t?
  - Who and where are they?
  - What exactly do they want?

- How will TE markets be designed and perform?
  - Will markets be transitional, decentralized or centralized?
  - What roles will incumbent utilities be allowed?
  - How well will the markets work?
  - What are the risks and who will bear them?

- How and when will relevant technologies advance?
  - Which technologies?
  - How will cybersecurity be addressed?

- What is the future of federal and state policy?
  - What will be the demonstration projects and incentives for TE?
  - Who will pay to upgrade the distribution infrastructure?
  - How will seams be addressed (among feeders, markets, states)?
  - What will happen to renewable and DER incentives?
How will DER energy markets emerge and evolve?

Market activities enabled as DER penetration increases.

Advance by fits and starts into an uncertain future.

- Piecemeal by state and within states
- Balkanized decision making
- Varied market designs
- Diverse customers
- False starts and changes in direction
- Technology challenges

Source: Graphic Courtesy of Paul De Martini.
Raising capital will be an evolving challenge.

Source: Energy Information Administration
Growing Competition and Conflicts

Evolving Competition and Conflicts
- DER vs. Central Generation and Storage
- Federal vs. State Government.
- Large vs. Small Consumers.
- Utilities vs. Others Serving Customers
- Investor-Owned vs. Coop & Public Power
- Retail Natural Gas vs. Retail Electricity

New Competition and Conflicts
- Transmission vs. Distribution
- Prosumers vs. “Plain Vanilla” Consumers
- Affluent vs. Less Affluent Consumers
- G&T vs. Distribution Cooperatives
- Joint Action vs. Public Power Distribution
- Oil and Gas vs. Electricity
- Tech Company vs. Tech Company
- DER vs. DER
- Distribution System Operator vs. Owner
Venues of Future Competition and Conflicts

- Power markets, wholesale and retail
- Legislatures and policy makers
- Regulatory agencies, both state and federal
- Courts, both state and federal

Public Opinion
Creating viable retail markets for DER will be a challenging, long-term, evolving endeavor.

Public Policy Perspective

- What are the objectives and how do those affect both consumers and the businesses that must serve them?
  - Consumers and their needs will be increasingly diverse.
  - Industry will also become increasingly diverse.
- Visions of DER markets vary and require different organization types.
- Many uncertainties about future markets must be faced.
- Market transitions will likely proceed by state and in fits and starts.
Realizing opportunities and managing risks in an era of value creation and destruction.

- Market design and continuing regulation will be key.
- Opportunities will become more diverse and change over time.
- Strategic market segmentation will grow in importance.
- Flexibility and market timing will be critical.
- Alliances and M&A may become increasingly important.
- Risks and risk management will become more consumer/prosumer facing.
Electric power decision-making faces multiple challenges:

- Differences among customers and their needs
- Evolving technology options
- Unknown and changing markets dynamics
- Further balkanization of decision making
- Building viable businesses for consumer participation
- New and evolving competitions and conflicts
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https://bwres.com/rising-power-report/