Demystifying Transactive Distribution Grid (TDG) and Finding Innovative Solutions

Usman Sindhu, Product Marketing Manager, eMeter/Siemens

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The next wave of innovation for the utilities [broadly] will incorporate Digitalization where Smart Grid, Market-Driven Operations, Transactive Distribution Grid (TDG), and Customer Engagement will play a key role.
Agenda

- Observations, market trends, and defining Transactive Distribution Grid (TDG)
- Is change towards transactive model really happening, where?
- A cross-industry example
- Path towards TDG in the next 3-5 years
- Key Takeaways
## Agenda

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What did I recently hear at the European Utility Week?

“Nest is not stealing customers from utilities. We're helping them get closer to the consumer. Nest is working with some utilities to drive their marketing campaigns”

Tony Fadell, Nest CEO

“Utilities need hardware now, and they will need it in the future. But hardware will get smarter. Hardware has been, and will remain, a critical piece to the electrification. However, digitalization will be the next frontier, bringing data-focused decision-making to utilities”

Dr. Weinhold, CTO Siemens Energy Management

“If utilities don't embrace change, consumers will become the disrupters. Consumers now have the power and influence to push utilities to change how they communicate, and offer new services”

Ian Merchant, Former CEO of Scottish and Southern Energy
The new wave of technology innovation for the utilities...

Gartner calls it Nexus of Forces
IDC calls it the Third (3rd) Platform
...Eventually utilities become a Digital Grid
Smart Grid and Transactive Distribution Grid feeds into the Digital Grid

Big Data  Analytics  Cloud  Social  Mobile
...but it’s also about people and things

The Digital Strategy is not complete without connecting smart devices with consumers

For utilities it means to engage customer with right tools such as analytics, demand response, demand management, market transactions, mobility, smart device management
Why utilities need to innovate or embrace the Transactive model? It’s the rate of change.
Solar, battery storage, and EV cost/ROI can reach grid parity in the next 5-10 years
Defining Transactive Distribution Grid

A TDG is an intelligent network platform that will provide safe, reliable and efficient electric services by integrating diverse resources such as distributed generation, demand response, energy efficiency, and energy storage. The TDG fosters broad market activity that monetizes system and social values, by enabling active customer and third party engagement that is aligned with the wholesale market and bulk power system.

Transactive energy model is an evolving framework of energy distribution and control among market participants and consumers.

Source: Adapted from “Reforming The Energy Vision - NYS Department Of Public Service Staff Report And Proposal”
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Key examples of transforming the Distribution Grid

- Pilots and active retail market in TX
- Active customer DER
- Regulatory reforms in NY, MA
- UK RIIO, Ofgem
- Spain and Portugal
- Pilots in Austria
- Active retail in MA
- Active retail in Canada
- Active retail in Australia
- UK RIIO, Ofgem
- Spain and Portugal
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- Active retail in MA
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## Common themes in grid reforms

<table>
<thead>
<tr>
<th></th>
<th>NY REV</th>
<th>CA DG Proceeding</th>
<th>MA Modernization Act</th>
<th>UK RIIO</th>
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<tbody>
<tr>
<td>Reinventing the distribution grid role</td>
<td>●</td>
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<td>Integration of DER</td>
<td>●</td>
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<td>New rate design model</td>
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<td>Customer-driven</td>
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<tr>
<td>Demand management</td>
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<tr>
<td>Network management</td>
<td>●</td>
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<td>●</td>
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<tr>
<td>Accommodate multiple players</td>
<td>●</td>
<td>●</td>
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<tr>
<td>Smart devices</td>
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</tbody>
</table>

- ●: Very clear vision
- ○: Less clear vision
- ○: Not mentioned
European Example

Salzburg AG – Building to Grid

- **Buildings as active smart grid participants**
- **Question:** How can buildings contribute to peak load reduction and enhanced energy efficiency in power grids by intelligent load management?
- **Field test** with 10 real-life buildings

Source: Salzburg AG
Salzburg AG – Building to Grid
Functional concept

Source: Salzburg AG
German aggregator Mark-E example

Mark-E’s overview:
Mark-E is one of the leading aggregators of control reserve capacity in Germany, with over 1 GW under management. Mark-E is also an aggregator PV- and Wind-generation for marketing at wholesale market. Aggregation and marketing of renewable energy and control reserve capacity is a low-margin game – Mark-E needs to scale up volume to stay competitive.

Solution:
Phase 1 – Set up DER integration software and service to integrate assets on time & material basis. Mark-E remotely operates software to market renewable energy and control reserve capacity at energy markets.
Phase 2 - Siemens is responsible for the technical integration into the Service Center, Mark-E is responsible for the commercial aggregation.
PJM coordinates the movement of electricity in all or parts of 13 states and the District of Columbia. It services 60 million US customers. PJM monitors and coordinates more than 1,365 electric generators, 61,591 miles of high-voltage transmission lines and 6,224 substations.

<table>
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<th>Business Problem</th>
<th>Solution</th>
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<tbody>
<tr>
<td>- Enhance grid reliability and sustain wholesale power market innovations</td>
<td>- The grid management system integrates the Siemens Spectrum Power™ energy management system and is based on a secure and model-driven integration platform -jointly developed with PJM</td>
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<tr>
<td>- Integrating PJM’s diverse set of legacy systems e.g Energy Management (EMS), Market Management (MMS) and emerging Smart Grid applications</td>
<td>- Two fully-staffed primary control centers at different locations are fully functional and capable of running the grid either independently or jointly as a single virtual control center</td>
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<td>- Embedded security into all data-driven operations</td>
<td>- A Web-enabled user interface (UI) framework provides situational awareness, with capabilities for advanced visualization of data and system information</td>
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<td>- Technology architecture and process to coordinate operations of power generation, utilities, and power markets. In turn, improving important reliability metrics</td>
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Source: Siemens Project
NY REV / DSPP scope of market and grid ops

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<tr>
<th>Grid</th>
<th>Customer/DER/Microgrid</th>
<th>Market</th>
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<tbody>
<tr>
<td>• Real-time load monitoring</td>
<td>• Direct load control</td>
<td>• Dynamic event notification</td>
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<tr>
<td>• Real-time network monitoring</td>
<td>• DER power control</td>
<td>• Dynamic pricing</td>
</tr>
<tr>
<td>• Adaptive protection</td>
<td>• DER power factor control</td>
<td>• Market-based demand response</td>
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<tr>
<td>• Enhanced fault detection and location</td>
<td>• Automated islanding and reconnection</td>
<td>• Dynamic electricity production forecasting</td>
</tr>
<tr>
<td>• Outage and restoration notification</td>
<td>• Electricity storage</td>
<td>• Dynamic electricity consumption forecasting</td>
</tr>
<tr>
<td>• Automated feeder and line switching (FLISR/FDIR)</td>
<td>• Algorithms and analytics for Customer/DER/Microgrid control and optimization</td>
<td>• M&amp;V for producers and consumers (premise/appliance/resource)</td>
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<tr>
<td>• Automated volt/VAR control</td>
<td></td>
<td>• Participant registration and relationship management</td>
</tr>
<tr>
<td>• Real-time load transfer</td>
<td></td>
<td>• Confirmation and settlement</td>
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<tr>
<td>• Dynamic capability rating</td>
<td></td>
<td>• Billing, receiving and cash management</td>
</tr>
<tr>
<td>• Diagnosis and notification of equipment condition</td>
<td></td>
<td>• Free-market trading</td>
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<tr>
<td>• Power flow control</td>
<td></td>
<td>• Algorithms and analytics for market information and operations</td>
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<tr>
<td>• Automated islanding and reconnection (microgrid)</td>
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Source: Adapted from NY REV Proceedings
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A system of Tokenization in the retail industry

Figure 1: High-level example of a tokenization process

Figure 2: High-level example of a de-tokenization process

Source: PCI DSS Tokenization Guidelines
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How to address an emerging Transactive Distribution Grid

Basic Goals
Enable utilities with proven, near term solutions that provide options to meet evolving future needs

Future Vision
Deliver future-ready applications for grid control, market and customer operations

Key Players
Support our ecosystem of global and regional partners to offer superior value to our customers

Key Technologies
Real-time / event-driven software, analytics in everything, management of digitalization & devices

Source: Siemens Transactive Distribution Grid Ecosystem
Three focus areas in the near future for TDG

- **Grid Control**
  - Observable with sensors and dynamic operating models
  - Loosely coupled network of networks
  - Control points with closed loop operation
  - Forecasting to support a dynamic market environment
  - Information security

- **Transactive Distribution Grid**
  - Market-aware grid-friendly devices to serve the consumer & grid
  - Autonomous rules or goals-based operations
  - IPv6 & Std protocols
  - Secure e.g. PKI
  - Management of devices and distributed apps

- **Smart Devices**
  - Transparent Pricing
  - Energy & Transport priced separately
  - Grid connection location matters
  - Fluid movement among product & service choices & payment options
  - Interval meter settlements
  - Information security

Source: Siemens Transactive Distribution Grid Ecosystem
Example solutions to some areas of the TDG market

Key Operations
- Energy Demand / Supply Balancing – Market Operations
- Transmission Operations
- Distribution Operations
- Customer Services
- Ancillary Services

Example Areas
- Price/rate calculations
- Settlement
- Demand calculation
- Consistent delivery
- Energy Shift
- Dashboard
- System reliability
- Bulk DER supply
- Portfolio mgmt
- Energy balance calculation
- Energy mgmt
- Resource balance
- Energy mgmt
- Demand Response
- Power quality
- Voltage optimization
- System reliability
- DER storage
- Outage mgmt
- Energy efficiency
- Integrate customer DER
- Energy consumption / monitoring
- Smart metering
- Customer engagement / DR
- Net metering calculation
- Billing
- Energy mgmt
- Repair / installation
- Home energy mgmt
- Risk mitigation
- 3rd party services
- Repairs / installation
- Home energy mgmt

Software Applications
- Meter Processing and Settlement Platform
- Energy management systems
- DR applications
- Market management and comm. apps
- DER integration apps
- Visualization apps
- Smart device mgmt
- Customer engagement apps
- Analytics
- Meter data processing
- Partners / local providers
- Real-time / time constraints
- Time constraints but variable

Source: Adapted from GridWise Transactive Energy Framework
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How solution providers and utilities’ partners can take part in the TDG ecosystem

Evaluate market development
- Market specific analysis
- Solution ready to support IoT and Digitilization
- Derive examples from existing engagements

Engage stakeholders
- Work with utilities and partners to drive vision
- Use existing customer examples to engage industry participation
- Influence policy and regulators

Build framework
- Develop framework based on local regulations and market demands
- Utilize existing centre of excellence to speed delivery in a phased approach
- Include industry and solution specific standards

Deliver people, process, and technology
- Combination of COTS and custom solutions per local drivers
- Make processes efficient enterprise-wide and focus on cost-effective ways
- Create people education, awareness, and skills onramp

Fine-tune and evolve
- Use new tools and applications to keep utilities evolving
- New idea immersions and centre of excellence
- Knowledge sharing with influencers and industry participants
Questions to address and future exploration

- Cybersecurity – Concept of an open market, a stock exchange. B2B security needs to be in place
- Data and transaction management - Who has the control and who governs data transaction?
- Data visualization and situational awareness- How to pin-point problems when market transaction takes place? Who will remediate and who will be penalized?
- Regulatory policy– Which regulatory body will govern different sets of transactions? How will demand & supply transactions be visualized and which parties can take action?
- Scope of distribution grid – How much control and functions does distribution grid has? Will economics work well with putting or relieving control of market transactions?
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