Software engineering and solutions company connecting the distributed energy network

Delivering advanced capabilities through GridOS® intelligent energy networking platform

Core Innovation around state estimation, optimization, and transactive energy networks/markets
**INDUSTRY EVOLUTION**

**YESTERDAY**

- One-way “pipeline” model from centralized generation through to transmission and distribution
- Largely passive consumers
- Asset-based bricks and mortar platform (poles & wires)

**TODAY**

- Increased adoption of distributed energy resources (DERs), e.g., generation, storage, demand, microgrids
- DER accommodation to integration
- Friction between utilities/DER businesses
- Data-driven smart grid platform

**TOMORROW**

- Business and customer model transformation
- Utility as a service platform for DERs
- Integrative markets for win-win between utility/DER revenue models
- Value-based transactive platform

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CHAIN REACTION OF 5 CHALLENGES

Blind, Aging, Congested Grid

Visibility
- the distribution grid is blind...
  - DER types and locations?
  - Voltages?
  - Capacity?
  - Hosting Capacity?
  - Real Power?
  - Reactive Power?
  - Losses?
  - Unbalanced phases?

Control
- without sufficient controls...
  - Switching?
  - Topology?
  - Power quality?
  - Distribution assets?
  - DER dispatch?
  - Curtailment?
  - Ramping?
  - Frequency?

Optimize
- managed sub-optimally...
  - Right place?
  - Right time?
  - Right capacity?
  - Right power quality?
  - Right certainty of dispatch?
  - Min losses, demand, new capacity?

Valuate
- unclear about the value of DERs...
  - By location
  - By time
  - By phase
  - By service (capacity, losses, reliability, etc.)
  - By certainty
  - By DER type

New business models
- fails to evolve in business models
  - Revenue to utilities
  - Revenue to DERs
  - Rate impact to consumers
  - Customer service
  - Sustaining growth beyond “wires only”
5-STAGE STRATEGY FOR MANAGING DERS

1. Situational Awareness
   - 3Φ AC unbalanced estimation under 2-way power flow
   - Full visibility across the network beyond sensor/metering points

2. Constraint Management
   - Beyond “connect-and-forget”
   - Dynamic hosting capacity
   - Curtailment, tripping and DER dispatch

3. Optimization
   - DER optimal dispatch for stacked benefits
   - 3Φ AC unbalanced optimal power flow
   - Multi-objective optimization

4. Transactive Energy
   - DER valuation
   - Model-driven locational marginal pricing (DLMP)
   - Cascaded multi-timeframe ‘D’ market

5. Grid-of-Grids Management
   - Dynamic topology processing
   - Upon switching grid, power flow, dispatch, pricing, etc. gets updated

DER Operational and Business Models

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THE INTEGRATED ENERGY NETWORK

The distribution system has been a black box, but holds the key to unlock value in the integrated energy network.

Bulk Power
- Wholesale market participation
- G&T coordination
- Currently disconnected from distribution grid value

Distribution Grid
- DER impact and valuation
- Integrated planning
- Optimal operation and dispatch
- Greatest DER value potential along the stacked value chain

Edge-based DERs

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1. DER valuation along full value stacks (vertically) and networks (horizontally)

2. Dynamic hosting capacity analysis

3. Non-wires alternatives generation

4. Investment strategy and risk analysis

5. Generation & transmission coordination (fuel supply, bidding, etc.)

Largest IDP project, repository of DER valuation and NWA generation in the world

- 4,500 feeders
- 10 year planning horizon at 8760 intervals, at every asset level and every node
- Impact $25B capital investment plan over the next 10 years

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DERMS REFERENCE PROJECT: EMERA NSP

First-in-kind utility-scale microgrid with high DER penetration and DER value signals for operations
1. Calculate and generate location-based pricing signals based on LMP+D
2. Incentive generation from local DER owners
3. DER bidding agent
4. Market clearing
5. Adaptation of OpenADR 2.0

Distributed System Platform:

“an intelligent network platform that (1) provides safe, reliable, and efficient electric services by integrating diverse resources to meet customer’s and society’s evolving needs, and (2) fosters broad market activity by (a) including system and social values in product pricing and (b) aligning customer and third party participation in the retail market with the wholesale market and bulk power system.

Under this model, the DSP (1) offers services such as information, interconnection, or dispatch services at prices and terms regulated by the PSC and (2) compensates DER providers and their customers for the value they provide to the grid. The order states that the DSP market structure must exchange DER services in fair and open markets.”
MEMS REFERENCE PROJECT: SUDBURY

A grid-supporting microgrid that brings resiliency and energy management to both the customer and the utility

1. Resiliency via intentional islanding to critical loads
2. Solar/storage/EV/building load management
3. Reduce energy costs under time-of-use
4. Grid supporting applications including VVO using microgrid P and Q capacities