About Smarter Grid Solutions

- Enhancing grid flexibility, utilization and reliability with high penetrations of renewables
- Exploiting the full portfolio of DER and grid devices to generate new revenue streams and business models
- Serving regulated utilities and DER owner/operators with world-class technology coupled with power systems and market expertise

ESTABLISHED 2008
GLOBAL COMPANY
LAUNCHED US BUSINESS IN 2014

80+ EMPLOYEES
300+ MW OF DER MANAGED
FULL R&D LABS NY & UK

IIoT DER INTEGRATION PLATFORM
SOLUTION DELIVERY IN NA/UK
GLOBAL PARTNER NETWORK
Our Customers
Growth of DER

Diverse & intermittent resource mix

Complex distribution systems

Changing regulatory mandates

Visibility and control needed at the grid edge to support DER growth

Inability to coordinate resources leads to conservative operations at higher cost

Centralized and model based systems cannot meet all DER control requirements

New platforms are needed for utilities and third parties
Market Observations

• DER growth is impacting planning and operation of distribution networks
  • New tools, processes and technologies are being implemented
  • New frameworks and architectures are emerging
  • Interactions with wholesale and distribution markets are emerging

• How are distribution utilities responding? In general:
  • Waiting…. Watching
  • Some doing commercial DERMS procurement
  • Many trying to bend existing DMS/EMS/SCADA to accommodate DER
  • A smaller number are taking an incremental approach with sensible phasing of activity
Our DERMS Platform’s Use Cases

**INCREASE HOSTING CAPACITY**
Manage voltage and thermal constraints

**INTEGRATE DER**
Faster and cheaper interconnections

**COORDINATE MICROGRIDS**
Leverage assets more effectively

**NON-WIRES ALTERNATIVES**
Mitigate multiple constraints

**VISIBILITY**
Real-time monitoring at the grid edge

**STACKED VALUES**
Monetizing benefits for multiple stakeholders
Active Network Management (ANM)

- Our DERMS Platform is built on our unique ANM Technology
- Maximizes (2-3x) grid hosting capacity by managing DER in response to grid constraints in real time
- Layers between existing utility systems
- Aligns with REV principles as a Non-Wires Alternative (NWA) to traditional grid upgrades

Why pay for an expensive grid upgrade to cover a worst case scenario when ANM can monitor grid conditions and take action when the rainy day scenario arises?
DER hosting capacity and distribution constraint management
Energy storage management, scheduling and optimization
Demand response, aggregation and grouping

Electric vehicle fleet management
Non-wires Alternatives Coordination
Smart Campus and Smart Distribution use cases

Enterprise utility-grade DERMS software platform

- Most Mature and Most Deployed
  100 combined years of proven operational experience in 15 live distribution systems, on two continents.

- Most Adaptable
  Managing and controlling all sizes and types of DER using optimization and real-time control and coordination.

- Most Scalable
  Scalable to 1000s of DER and expanding.

- Most Reliable
  Failover, redundancy, high-availability and interoperability designed in and proven in the field.
ANM ELEMENT

Utility-grade software platform for the grid edge

- **Most Mature Grid Edge Solution**
  Site specific, autonomous control controlling 300+MW.

- **Localized Intelligence and Fail to Safe Functions**
  Import/export constraints, scheduling, real/reactive power, voltage management.

- **Fast Acting**
  Sub-second and deterministic, ready for closed loop mission critical power systems applications.

- **Interoperable**
  Full suite of protocol adapters for field devices.

- **Autonomous real-time control of DER**
- **Multi-DER coordination**
- **Real and reactive power control**
- **Scheduled control with real-time intervention**
- **Circuit breaker trip and delayed auto-reclose**
- **Gateway for market participation**
DER and the static grid today

At low DER penetration, the grid has inherent ability to accommodate DER in an uncoordinated manner.

Utility planning criteria determines when grid upgrades and reinforcements will be made based upon agreed upon operating criteria - many of which are used to evaluate DER seeking to interconnect with the distribution system.

The ability of the distribution system to “host” and interconnect distributed energy resources is typically evaluated using deterministic planning limits.

Developers/customers submit applications without knowledge of the full knowledge of hosting capacity limitations or other projects in the queue which may lead to restrictions.

Interconnection applications are approved or denied based using rudimentary screens or more advanced power flow analysis. Both methods are based upon worst case contingency analysis around static equipment/loading limits.

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However, increasing penetrations of DER pose new challenges without visibility and control.

As DER penetration increases, static, “set it and forget it” interconnection becomes more challenging, which can lead to:

- Time delays
- Costly upgrades
- Project downsizing

DER Penetration

- DERs can be integrated without causing any violations
- DERs can be integrated in limited sizes / locations
- DERS cannot be integrated at any size / locations
Active Network Management is an innovative solution to getting projects interconnected at their proposed size and expected energy yield.

DERs can be integrated anywhere without causing violations

Active Network Management

DERs can be integrated in limited sizes / locations

Uneconomic Curtailment

Active Network Management unlocks additional hosting capacity by eliminating network constraints through tactical curtailment.

<table>
<thead>
<tr>
<th>Generator</th>
<th>Size (MW)</th>
<th>Production Factor AFTER Curtailment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.9</td>
<td>37.1%</td>
</tr>
<tr>
<td>2</td>
<td>2.3</td>
<td>47.7%</td>
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<tr>
<td>4</td>
<td>4.5</td>
<td>45.4%</td>
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<tr>
<td>5</td>
<td>0.9</td>
<td>37.2%</td>
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<tr>
<td>6</td>
<td>0.9</td>
<td>40.1%</td>
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<tr>
<td>7</td>
<td>0.9</td>
<td>40.8%</td>
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<td>9</td>
<td>0.9</td>
<td>31.8%</td>
</tr>
<tr>
<td>10</td>
<td>0.9</td>
<td>34.0%</td>
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</table>
## ANM Cost-Benefit Example

<table>
<thead>
<tr>
<th>Capacity (MW)</th>
<th>Generator Type</th>
<th>Business as Usual Interconnection Cost</th>
<th>Flexible Interconnection Cost</th>
<th>Curtailment</th>
<th>Capacity Factor after Curtailment</th>
<th>Lifetime Savings</th>
<th>% Lifetime Savings</th>
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<td>10.0</td>
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<td>28.4%</td>
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<td>Wind</td>
<td>$1,200,000</td>
<td>$236,000</td>
<td>5.3%</td>
<td>28.4%</td>
<td>$788,040</td>
<td>66%</td>
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<tr>
<td>0.5</td>
<td>CHP</td>
<td>$3,800,000</td>
<td>$176,000</td>
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<td>98.6%</td>
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<td>6.6</td>
<td>PV</td>
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<td>2.6%</td>
<td>10.9%</td>
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<td>10.3</td>
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<td>1.5</td>
<td>Wind</td>
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<td>28.4%</td>
<td>$3,802,040</td>
<td>72%</td>
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Key Ongoing Projects: New York

FLEXIBLE INTERCONNECT REV DEMONSTRATION
Smarter Grid Solutions is working with AVANGRID subsidiaries NYSEG and RG&E as part of one of the first Reforming the Energy Vision (REV) demonstration projects to integrate increasing quantities of renewable generation with the distribution system using its Active Network Management technology as an alternative to network upgrades.

INTEGRATED ONLINE APPLICATION PORTAL
Smarter Grid Solutions is working with AVANGRID, Clean Power Research and CYME to document and revise the interconnection process to facilitate developers to apply for interconnection using the FICS technology solution as an alternative to incurring costly upgrades.

CONSERVATION VOLTAGE OPTIMIZATION
Smarter Grid Solutions has designed and tested algorithms specifically built to optimize voltage profiles on Con Edison’s distribution system, with specifications that can be deployed using SGS’ ANM Strata platform.

INNOVATIVE MODEL FOR FTM STORAGE
Smarter Grid Solutions is working with Con Edison and GI Energy to provide the control systems and architecture for an innovative in front of the meter energy storage demonstration project, allowing multiple value streams be realized. GI will finance and develop the battery while providing Con Ed priority dispatch rights for load relief and contingencies.

DISTRIBUTION STATE ESTIMATION
Smarter Grid Solutions is working with NYSERDA to review the state of the art in distribution state estimation (DSE), examine the dependencies on data sets and provide a toolkit for utilities and vendors to tackle the deployment of DSE techniques.

OPTIMAL EXPORT REV DEMONSTRATION
Orange & Rockland is partnering with Smarter Grid Solutions and working with the project development community to identify 3-5 solar PV projects and deploy our local, intelligent ANM Element controller. This will enable projects to be built at/near full proposed size without incurring system upgrades which would typically makes projects uneconomic.
Questions?

Thank you for listening!