Case Study in Resilience:
A First-of-its-Kind Microgrid in New York City

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Enel X
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The Enel Group Worldwide
The world’s largest utility, changing the way the world uses energy

- Publicly Committed to UN Sustainable Development Goals
- 65,000 Employees
- 31 Countries
- 42 GW Renewable Capacity
- 50+ Yrs Experience
- $84 B Annual Revenue
- No. 20 Fortune’s Change the World List
The Enel X Vision
Enel’s 2017 acquisitions form the basis of Enel X

- Innovative energy storage and microgrid projects
- Optimization of Distributed Energy Resources
- Global leader in demand response
- Strategic commercial & industrial energy management provider
- Market-leading smart EV charging hardware
- Optimization of EV charging for load balancing and sustainability
Enel X portfolio of solutions

4 Global Product Lines

- **e-Industries**
  - Consulting and auditing service
  - Distributed generation on/off site
  - Energy efficiency
  - Demand response and storage solutions

- **e-City**
  - Smart lighting
  - Fiber optic wholesale network
  - Distributed generation & energy services
  - Demand response and storage solutions

- **e-Home**
  - Installation, maintenance and repair services
  - Automated home management
  - Financial services
  - Home 2 Grid

- **e-Mobility**
  - Charging infrastructure (public & private)
  - Maintenance and other services
  - OEM back-end integration
  - Vehicle Grid Integration

Addressing new customer needs with innovative technologies
Enel X Product Categories and Clusters
An Integrated Solution Offering

Key Products

- Consulting / Auditing service
- Energy Procurement
- Premium services & UBM
- Energy certificates optimiz.
- Monitoring and verification
- Energy Efficiency
  - Product & systems. Opt
  - Private lighting
  - Industrial equipment
- PV
- CHP
- Energy infrastructure
- Demand Response
- Storage Solutions
- Microgrid solutions
- Direct marketing
- O&M

Global portfolio structured in 4 categories and 14 products clusters
How we will achieve our vision: Connect any asset to any product anywhere in the world

Connect all types of distributed energy assets… … and optimize across all available grid and retail products … using a flexible and scalable global technology platform

Der Management System

Virtual Power Plant Optimization

Cloud Based Architecture

* Ancillary Services includes primary, secondary, and tertiary reserves. “Fast DR” refers to Ancillary Services and other fast-response, higher-value DR and DSM products such as facility peak management and energy arbitrage.
Proprietary DER Optimization Software

Cloud-based platform enables real-time optimization engine to produce predictable financial returns from any combination of DER assets across any market and timeframe

Utility & Market Interfaces
- Utility tariffs
- Electricity prices
- Demand response

Site Awareness
- Demand profile
- Weather
- Time of day

Cloud-Based Platform
Network Optimization Engine
- Intelligent aggregation
- Global modeling and analytics

User Interface
- View real-time performance
- View value streams
- View historical information

Site-Level Controls
- Site Optimization Engine
- Real-time demand management
- Connection to site utility meter

Distributed Energy Resources
- Battery Storage
- Solar PV
- Generator
- Fuel Cell
- E-Vehicle
- Etc.

Cloud-based platform enables real-time optimization engine to produce predictable financial returns from any combination of DER assets across any market and timeframe.
U.S. non-residential market drivers

Non-residential market struggled in 2018, but 2019 and 2020 will be breakout years

- Incentives are critical to the non-residential market. The Self-Generation Incentive Program has been the key driver in California, especially in the period 2014-2017. The SMART program in Massachusetts and the Bridge Incentive in New York are the frameworks that will open up these markets in 2019.

- Demand-charge management historically has been the major use case for non-residential storage. In general, C&I customers with predictable, peaky loads on tariffs with demand charges above $15/kW-month see clear economic cases for storage.

- Grid services will be a key value stream in the early 2020s. Already, non-residential storage is being deployed to provide resource adequacy in California. ISO-NE and NYISO are expected to see storage development for capacity as well. The resolution of FERC Order 841, which directs independent system operators and regional transmission organizations to allow storage to participate and be compensated for wholesale market services provided, will open more doors for non-residential storage to provide grid services.

- Resilience is increasingly becoming a piece of the non-residential storage conversation. Regions like the Northeast and Southeast U.S. already grapple with outages from inclement weather. Massachusetts, New Jersey and New York are the vanguard of states promoting storage with an eye to provide resilience. However, resilience value is challenging to quantify economically, and thus these projects will require government incentives and/or additional value streams to be viable.

Source: Wood Mackenzie
“A microgrid is a distribution network that incorporates a variety of possible distributed energy resources that can be optimized and aggregated into a single system that can balance loads and generation with energy storage and is capable of islanding whether connected or not connected to a traditional utility power grid.”

**Defining features**

1. Networks (mixed asset fleets) of DERs capable of islanding
2. Sophisticated system with flexible management of generation and load
3. Software platform as microgrid controller (most advanced microgrids)
4. Project focused on resilience, renewable energy integration or economic optimization
Microgrid complexity can range from simple to large advanced system

<table>
<thead>
<tr>
<th>Inverter-based</th>
<th>Basic</th>
<th>Advanced</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Enel X Optimization capabilities and differentiating value</strong></td>
<td>Storage optimization (Battery + Curtailable DER with Backup power)</td>
<td>Multi DER optimization</td>
</tr>
<tr>
<td><strong>Size</strong></td>
<td>100kW – 1MW</td>
<td>1MW – 5MW</td>
</tr>
<tr>
<td><strong>Products</strong></td>
<td>Mainly Solar + Storage</td>
<td>Solar + Storage + Gensets</td>
</tr>
<tr>
<td><strong>Customer Type</strong></td>
<td>Small – Large C&amp;I</td>
<td>Large C&amp;I, Campus</td>
</tr>
<tr>
<td><strong>Software Capability</strong></td>
<td>Monitoring</td>
<td>Rules based</td>
</tr>
<tr>
<td><strong>Industrial Controls required</strong></td>
<td>Minimal</td>
<td>Basic</td>
</tr>
<tr>
<td><strong>Global market size (est)</strong></td>
<td>8GW+</td>
<td>5GW</td>
</tr>
<tr>
<td><strong>Level of commoditization</strong></td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td><strong>Avg Capex</strong></td>
<td>$100k - $10m</td>
<td>$1-10m</td>
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A general overview of our focus within the value chain for energy storage and microgrids

- **Hardware manufacture**
  - Design, manufacture and assemble generators, panels; storage, electric vehicle chargers, load controllers, inverter relays, etc.

- **Sales**
  - Origination
  - Technical Sales

- **System Engineering**
  - Design Overall Microgrid system
  - Control and operating philosophy

- **System Integration**
  - Assemble, engineer, integrate and deliver component subsystems into a customized working system

- **Installation & configuration**
  - Install components and/or system
  - Commissioning

- **O&M**
  - Provide ongoing operations and maintenance of microgrid system, power equipment and support system

- **Market access**
  - Monitize asset flexibility on relevant markets
Customer Spotlight: Marcus Garvey Village
Automated deployment of DERs for maximum resilience and value

Deployment Needs
- Renewable, self-sufficient power supply during outages
- Con Ed’s BQDM program
- NYISO demand response

Project Details
- NYC’s first solar + storage microgrid in an affordable housing development
- First lithium-ion battery system approved for a multi-family building in NYC
- BQDM requirements mandate that the site can self-consume all power it creates, without exporting to the grid
Establishment Labs

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<tr>
<th>Site</th>
<th>San Jose, Costa Rica</th>
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<tbody>
<tr>
<td>Load Profile</td>
<td>~1.4 MW Peak load</td>
</tr>
</tbody>
</table>
| Configuration | Storage - 500 kW/1000 KWh  
                Solar - 272 kW |
| Applications  | Multi-DER Aggregation  
                Critical Load Backup Power  
                TOU Energy Arbitrage  
                TOU Demand Charge Reduction |

- Storage + Solar + Backup Power/Microgrid for Critical Loads for this biomedical company
- Solar + Storage System designed to support Critical loads in the medical manufacturing clean room. Maintains all systems to ensure the room stays “clean” during an extended outage
Four Key Aspects of a Microgrid
Seamlessly deploying microgrid assets to capture multiple value streams

<table>
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<tr>
<th>Site-level Resilience</th>
<th>Local Grid Reliability</th>
<th>Sustainability Goals</th>
<th>Return on Investment</th>
</tr>
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<tr>
<td>Self-sufficient power supply in the event of grid outages</td>
<td>Participation in grid-level stability programs</td>
<td>Reduce reliance on fossil fuels for resilience</td>
<td>Maximize cost reduction, incentive payments</td>
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“This installation is an important part of a portfolio-wide effort to use renewable energy to enhance property sustainability and residents’ quality of life in line with our double bottom line approach to development.”

—Josh Weisstuch, Project Manager at L+M Development Partners
Thank You

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