Microgrids-as-a-Service

A New Approach to Solve Resiliency, Efficiency and Sustainability Challenges
Chris Dunlap, Power Generation BDM, Americas
More ELECTRIC

2X faster growth of electricity demand compared to energy demand by 2040

Source: IEA WEO 2014

DIGITIZATION

10X more incremental connected devices than connected people by 2020

Source: Cisco, Internet World Statistics

DECARBONIZATION

82% of the economic potential of energy efficiency in buildings and more than half in industry, remains untapped

Source: World Energy Outlook 2012, Internal Analysis

DECENTRALIZATION

70% of new capacity additions will be in Renewables by 2040

Source: BNEF
Energy Megatrends – Creating the New Energy Landscape

**Decarbonization**

**Digitization**

**Decentralization**

+ More Energy

Historical Energy Value Chain

Centralized Generation ➔ HV Transmission ➔ MV/LV Distribution ➔ Retail Meter ➔ Energy Customer

The New Energy Landscape

Centralized Generation ➔ Transmission ➔ Distribution ➔ Retail ➔ Prosumer

- Utilities house significant Grid-Connected 3rd party owned Solar PV plants with complementing BESSs. In some cases the developer is the utility, but in others it is a 3rd party or a new “Prosumer”.

- Larger Prosumers and Municipalities use PPA and ESCO/IPP PPA/Lease models to leverage existing and build new DERs

- Reduction in costs for DER technologies, increase in reliable delivery + new business models for Energy Services result in the new Energy Landscape
What New Energy “Prosumers” are looking for

**Cost**
- Lower / More Predictable Energy Costs
- Energy / Fuel Source Arbitrage
- Flexibility drives savings / incremental revenue

**Resilience**
- Serve loads during times of grid instability
- Oasis for employees / customers – shelter in place
- Protect power sensitive / critical assets from poor power quality

**Sustainability**
- Reduce carbon footprint
- Improve brand image
- Attract / Service carbon sensitive customers
What is a Microgrid?

An integrated energy system consisting of interconnected loads and distributed energy resources…

…which as an integrated system can be controlled as a single entity and operate in parallel with the grid or in an intentional islanded mode.
Combined Heat and Power & Microgrids

CHP provides superior reliability, meeting a site’s thermal needs in addition to its electrical needs, round-the-clock, even in the event of a grid outage.

- Steam, hot water and chilled water is produced at District Energy Centers
- Environmentally Sound
- Individual buildings do not need their own chillers/boilers
- Easy to operate and maintain
- Comfortable and Convenient
- Provides Architectural Flexibility
Business and Delivery Models: EPC to “Microgrid-as-a-Service”

**CAPEX (or EPC) Business Model**

- **Supplier develops and builds**
- **Customer owns, operates, & maintains**

- Plant Construction
- Power Plant Operation
- Customer

**OPEX (As a Service or PPA/Lease) Business Model**

- **Supplier & Partner develop, build, & own**
- **PPA/Lease with Customer**
- **SE & Partner O&M**

- Plant Construction
- Power Plant Operation
- Customer
Microgrid-as-a-Service or Energy-as-a-Service

Today's Model
You pay Electric and Gas
You pay demand charge
You pay to O&M

As-A-Service Model
You pay for energy
Demand charges eliminated
Net Savings

Microgrid as a Service (MGaaS)

- Low Upfront Capital
- Infra-structure Upgrade
- Energy Security & Price Hedge
- Better Sustainability
- Higher Resiliency
- System Maintenance
- Monitor & Optimize

You pay for energy
Demand charges eliminated
Net Savings
Microgrid-as-a-Service Case Study
Montgomery County, MD

- **Project Cost:** $16M
  - (SE $6M, Duke Energy Renewables $10M);
  - SE 25 year service contract $2.25M

- **Client Requirements:**
  - Deliver Two Advanced Microgrids
  - Increase resiliency and sustainability at Public Safety HQ and Correctional Facilities
  - Incorporate solar and CHP into off-grid operation
  - Deliver via MGaaS model eliminating host up-front costs

- **Details:**
  - Include clean on-site power generation through solar energy systems and natural gas generators
  - Schneider to play comprehensive role designing & implementing solution
  - Project includes protection control & optimization, electrical equipment, DER management, electrical design services, cybersecurity and network design.
## Situation
- Boston One Campus is the North American headquarters of Schneider Electric.
- Constructed in 2014, 240,000+ sqft.
- +750 employees
- 1 of 5 global R&D centers
- **Sustainability**
  - SE has a public commitment to be carbon neutral by 2020
  - North America represents 31% of Schneider Electric’s global emissions
- **Resiliency**
  - Site was averaging >3 outages per year with significant impact on R&D

## Approach
- Implemented Microgrid as a Service contract with an equity partner
- Added 465kW of Solar
- Microgrid controls allow operating solar in parallel with backup gas generator when isolated from the grid
- Upgraded electrical infrastructure to support better resiliency

## Outcomes
- **Reduced energy price by >10% from green tariff offered by utility**
- Energy price is fixed for 13 years
- Improved resiliency – site now capable of providing energy to all critical assets during outage.
- Improved carbon footprint – solar capable of providing 50% of site load.
- Shelter in Place – provide a safe haven for employees during storms
- Solar canopies provide covered parking for employees, more EV charging parking spaces, and increased security through installed cameras and lights.
- Brand value: Solar canopies now the defining external feature at our facility.
- **No Capital Outlay**
Prosumers have varying degrees of supply and demand flexibility.

The more flexibility the better the optimization.

- **Prosumer 1**: Lights and Motors, Grid and Solar
- **Prosumer 2**: Lights and EV Charging, Grid, Solar and Storage
- **Prosumer 3**: Lights and EV Charging, HVAC and Cold Chain, Grid, CHP, Solar and Storage
Peak Electric or Gas Pricing – Tariff Optimization
Shift consumption from times of high cost to times of low cost

Mixed Use Case at the Prosumer Microgrid

- Prosumer optimization of battery charge, discharge and peak shaving
- However a utility demand response (DR) event may “interrupt” prosumer operation and execute based on what utility wants.
- Algorithm abandons Peak Shaving, and must recharge to prepare for DR event. We have left the Prosumer benefit and shifted to the Utility benefit.

Source: Oncor – May 27, 2015
Demand Limit Management – Peak Shaving
Minimize / avoid fees by shaving peak demand

- **Example 1:** Dispatch energy storage to supply some load to avoid a peak
- **Example 2:** Shed loads (HVAC, EV Chargers, etc.) to avoid setting a peak
- **Example 3:** Sequence the start of large loads to avoid coincident peak demand

*Source: Oncor – May 27, 2015*
Microgrid Architecture – Building or Facility

DERMS Cloud

Microgrid Advisor

Customer constraints
Weather forecast
Energy market pricing
Demand response requests

Advanced Microgrid with CHP, Solar PV, Energy Storage
Electric and Thermal Load Optimization for Grid-Connected and Islanded Operation

BESS Solar PV Thermal Loops/Loads Electric Loads CHP Utility Grid

Secure Gateway Microgrid Energy Control Center

Building Automation Process Automation
Microgrid Architecture – City, Complex, Campus or Facility Fleet

DERMS Cloud

Campus or Fleet of Buildings

Microgrid Advisor

- Customer constraints
- Weather forecast
- Energy market pricing
- Demand response requests
Termis Software: CHP/District Heating and Cooling Optimization

Differential Pressures and temperatures optimized for max Energy Savings
Microgrid Energy Control Center

**DERs**
- Wind
- Genset(s) & CHP
- Solar PV
- Battery Energy Storage

**Loads**
- Industrial Plant or Process Loads
- Pumps, VFDs and Motors
- HVAC System
- Lighting
- EV Charging

AC or DC or Hybrid AC/DC with Intelligent Fast Load Shedding
## EcoStruxure Battery Energy Storage System - NEW

<table>
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<tr>
<th>Configuration</th>
<th>125kW/250kWh</th>
<th>250kW/500kWh</th>
<th>500kW/1MWh</th>
<th>1MW/2MWh</th>
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<tbody>
<tr>
<td>Power Cabinets</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Battery Cabinets</td>
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<td>6</td>
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<td>Power Cabinet</td>
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<td>500</td>
<td>700</td>
<td>1400</td>
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<tr>
<td>Est. Weight - kg</td>
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<td>5850</td>
<td>11700</td>
<td>21450</td>
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<tr>
<td>Battery Cabinet</td>
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<td>6350</td>
<td>12400</td>
<td>22850</td>
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<tr>
<td>Est. Weight - kg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BESS</td>
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<tr>
<td>Est. SQ. FT</td>
<td>37.5 (3 x 2.5’ x 5’)</td>
<td>50 (4 x 2.5’ x 5’)</td>
<td>87.5 (7 x 2.5’ x 5’)</td>
<td>162.5 (13 x 2.5’ x 5’)</td>
</tr>
</tbody>
</table>

Note: If bumpless “UPS quality” BESS is needed, we have Galaxy VM series Used on 60%+ of datacenters globally.
Closing Thoughts

- A New Energy Landscape is here – be ready!
- Microgrid-as-a-Service is real: Maximum benefits with little/no capital outlay
- Energy Optimization requires integrated electrical and thermal (CHP) systems
- Dynamic Microgrid operation needed to achieve optimal:
  - Resiliency
  - Efficiency
  - Sustainability
Questions? Thank you!

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