Schneider Electric Microgrid Solutions

*Microgrids-at-Scale... based on Smartly-Connected Distributed Energy Resources*

Andy Haun, Chief Technology Officer - Microgrids Business

Energy is the base of life.

Life Is On
when energy is on......

We ensure energy is on by making it

• Safe
• Reliable
• Efficient
• Connected
• Sustainable
We believe access to energy is a basic human right

...and the present way of managing energy is unsustainable.
Our Challenge over the next 40 years

- Energy consumption will almost double (×1.5)
- CO₂ emissions need to be halved (÷2)
- We have to become 3 times more efficient (↑3×)

Note: Forecast for 2050 compared to 2009 levels
1.3 billion people currently do not have access to electricity

Another 1 billion people have unreliable and intermittent supply of electricity

Source: IEA, Economist
Our World Will Be...

More ELECTRIC
Increase by 80% in the next 25 years

More CONNECTED
Connect 50bn devices by 2020

More DISTRIBUTED
Solar PV and Storage to Account for ~50% of new capacity additions by 2030

More EFFICIENT
2/3 energy efficiency potential remains untapped
The Old World of Energy: Singular flow of Electricity from Source to Load

Energy Producers | Utility Transmission | Utility Distribution | Consumers
---|---|---|---
Centralised Generation | EHV/HV | Heavy Industry | MV / LV Substation
| Connexion to HV network | Connexion to MV network | Residential
| HV/MV Substation (Primary substation) | Switching Substation MV/MV | Industry
| Infrastructure | Data Centres | Buildings
| Commercial & Industrial

The diagram illustrates the flow of electricity from energy producers to consumers through various substations and networks.
The new World of Energy: Electricity is…
Distributed & Connected

Smart Grid
Distributed Generation
Efficient Demand
CONNECTED FROM PLANT TO PLUG
Integration of Energy, Automation and Software

Simpler, more scalable and flexible industrial architectures, leveraging the best of IT technologies

**INTERNET OF THINGS**
- Number of connected objects expected to double in the next 5 years

**Our Solution… EcoStruxure**

Energy, Automation and Software convergence

Energy optimization

Process optimization

1: Source Cisco IBSG April 2011 / Internet World Statistics
Connected devices, real-time control & open software, analytics & services
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.
Microgrids Value Proposition

- Reduce energy consumption
- Improve and monetize flexibility
- Energy / Fuel source arbitrage

Efficiency

- kWh

Supply

- $

Active Energy Management

- Innovative Product and Hedge Structures
- Global Program
- Real-time-price forecasting
- Portfolio Risk Management

Sustainability

- Reduce Greenhouse Gasses
- Minimize carbon footprint
- Improve LEED

Resiliency

- Service site loads during times of grid instability
- Protect assets against harmful effects of poor power quality

+ Solution scales simply for entire enterprise

Michigan Public Act 341/342?
Microgrid Value Proposition

We optimize DERs to enhance reliability; improve efficiency and drive environmental benefits.

Efficiency & Optimization
- Minimize energy costs
- Harness combined heat and power
- Maximize incentives
- Monetize energy flexibility with the grid

Reliable Energy
- Ability to intentionally “island” from utility
- Preserve critical loads 24/7/365
- Redeploy grid tied inverters for island mode operation

Green Energy
- Incorporate low cost solar & low emission DER
- Implement net-zero projects
- Reduce green house gases
Microgrid Controls & Event Management

- Predictive DER management
- Interfaces with energy markets
- Weather forecasts (DTN)
- Forecast when to produce & store
- Cloud based accessible anywhere

EcoStruxure Microgrid Advisor

- Reactive DER management
- Ensures microgrid real time stability & reliability
- Manage of connect/disconnect from the grid
- Optimize energy production & use

Client Constraints
Weather forecast (DTN)
Energy market pricing
Demand response requests

Predictive DER management
Interfaces with energy markets
Weather forecasts (DTN)
Forecast when to produce & store
Cloud based accessible anywhere

Client site

EcoStruxure Microgrid Operation

PCC

Cloud

Microgrid Controls & Event Management
Microgrid Topologies

Private Sector moving into utility services  Utilities moving toward the end-users

Private Commercial/Industrial Sites  Industrial, Education and Military Campus  Municipalities and Utility Grid-Edge
How the BOC Microgrid Works

Andy Haun, Chief Microgrid Technology Officer
Boston One Campus

240,000+ square feet

Serves as North American HQ

2 Building Campus

750+ employees

1 of 5 Global R&D Centers

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Partnering to Build the Boston One Campus Microgrid

- **Leader in developing** innovative wind and solar energy generation projects for customers throughout the United States.

- Growing portfolio of **commercial renewable assets** includes 20 wind projects and 55 solar facilities in operation in more than a dozen states, totaling about **2,900 megawatts** in electric-generating capacity.

- **Renewable energy provider** delivering complete commercial, public sector and utility-scale solar solutions

- Backed by Duke Energy, one of the largest energy companies in the world.

- 580+ successful **commercial solar** installations over the last 20 years
Innovation – New technologies to be tested and validated using the BOC Microgrid state-of-the-art “Living Laboratory”

Boston One Campus Microgrid

Pilot Project – Schneider and Duke form partnership for emerging microgrid market. BOC provided opportunity to “test drive” our approach to working together.

Solution Showcase – BOC Microgrid showcases new technologies that support numerous microgrid use cases. BOC Microgrid incorporates 400KW PV generator and 500KW battery system that uses EcoStruxure Microgrid Advisor and sophisticated microgrid controller technology
Typical Microgrid Sequence of Operations
Boston One Campus

**Normal Grid Operation** with On-site PV Production

**Utility Outage** – Transition to Island Mode

**Islanded Mode** – Generator Production Followed by PV Production

**Islanded Mode** – Dynamic Production Management to Match Load

**Grid Returns** to Normal

**Transition to Normal Grid Operation** with On-Site PV Production
Microgrid Advisor

DER Monitoring & Autonomous Optimization
  • Accessible multi-stakeholder dashboards

Tariff Management
  • Consume or produce energy at the most advantageous time based on variable utility rates

Demand Response & Control
  • Reduce peak demand charges
  • Partner with curtailment service providers for grid ancillary services

Self Consumption
  • Toggle from economic optimization to resiliency storm mode

Island Mode
  • Leverage weather forecasts to anticipate blackouts
Tariff Management
Shift consumption from times of high cost to times of low cost

- **Example 1:** charge an energy storage system during “off peak” period and discharge it during “on peak” period

- **Example 2:** consume energy with HVAC during “off peak” period (pre heating or pre cooling) and coast to reduce energy consumption during “on peak” period

Source: Oncor – May 27, 2015
Demand Management
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
Storm Hardening
Optimize for resiliency when weather threatens site operation

Weather prediction and power quality monitoring can proactively trigger resiliency optimization measures including:

- Charge the battery to full capacity
- Warm and pre-lube emergency generation
- Adjust protective relay settings
- Proactively island the site
- Shed non essential load
- Electrically isolate sensitive equipment
This modular power control center is designed to be repeatable, scalable and FUTURE READY providing optimized power and energy management to make it simpler to achieve your savings, sustainability and resiliency goals.

Easier
• ‘Configured to Order’ approach simplifies the ordering process reducing lengthy design and order time
• Factory wired, programmed and tested streamlines commissioning

Adaptable
• Scales from small/simple to large and complex
• Allows for future facility expansion and for integration of additional DERs

Smarter
• Intelligent metering modules provide insight into savings, usage, DER production and power quality
Interesting microgrid examples
The most advanced microgrid in the US, located near Dallas, Texas

**Oncor Microgrids (Campus)**

A truly **Autonomous & Dynamic** Microgrid completed in **under 6 months**

**Project at a Glance**

Management of 9 different DER types

- 200 kW BES
- 120 kW Solar PV
- 06 kW Solar PV
- 65 kW Microturbine
- 45 kW Gas recip
- 560 kW Diesels
- Wind - considered

Square D Switchboards
S&C Intellirupter
Schneider Electric Controllers and software

**Green Energy**

- Solar and cleaner gas (vs. just diesel)
- Low emission CHP (not utilizing thermal)
- Serves as a best practice to deploying an environmentally sustainable Microgrid, using solar in island mode

**Efficiency & Optimization**

- Predictive and real-time control of DER
- StruxureWare Demand Side Operation software platform for economic optimization and dispatch
- Load preservation features for ensuring the most critical loads are served Integration of MG Controller with BMS
- 4 separate Microgrids, **autonomous and dynamic**
  - Coordinated Automatic Islanding and Reconnect
  - Dynamic management of critical loads and generation and storage assets
On cor Microgrids

Site:
- Primary Meter Point
- IntelliTeam on Grid Source
- 2 – Vista Switchgear
- 2 – Remote Switch

Area (3):
- 2 – 175 kW Diesel Backup Generators
- 1 – 25 kW/25kWh Battery

Area (2):
- 1 – 45 kW Propane Backup Generator
- 1 – 200 kW Diesel Backup Generator

Area (1):
- Environmental Lab + Microgrid Demonstration/Education Center
- Solar – 112 kW south-facing & 2kW west-facing
- Battery – 200 kW / 400 kWh
- Microturbine – 65 kW
Town of Fairfield
Public Services

Powers critical facilities during electrical grid outage

Project at a Glance
• Modern and harden public safety infrastructure to withstand severe weather supporting 59,000 residents
• Using distributed generation sources, a Microgrid control system was installed to control power distribution both in grid parallel and islanded modes
• Harness Solar and gas powered generation

Efficiency & Optimization
• Distributed generation to provide 120% of critical power demand during all peak periods
• Reduce demand and consumption at Police and Fire HQ over 2 years by about 60 kW and 250,000 kWh annually

Reliable Energy
• Ensure 365/24/7 operations of critical infrastructure, including police and fire HQ, emergency comm center, cell phone tower service, and homeless shelter.

Green Energy
• Installed PV system at Fire HQ
• Use natural gas fired CHP generators
Cooperative Policies to support the New Energy Landscape
Utility generation mix is changing, led by natural gas, wind and solar.

About 10% of the US grid is based on DER, with solar representing the fastest growing DER and Cogen.

Many utilities are buying solar integrators, and will increasingly use battery energy storage and generators as “anchor” resources to make this DER work without the grid.

SE is an expert at adapting switching, control, protection and grounding systems for DER to “island.”
Policy Considerations

- Allow for competitive utility asset ownership in “behind the meter” commercial markets.
- Drive Integrated Resource Plans inclusive of DER and Microgrids
- Coordinate clean and reliable energy planning with state emergency agencies.
Our technologies ensure that Life Is On everywhere, for everyone and at every moment.
Life Is On | Schneider Electric

Take our virtual tour to see how a microgrid works

https://youtu.be/Ej9K3xk0n48
CHP-driven Microgrid & District Energy

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