



# Schneider Electric Microgrid Solutions

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

Andy Haun, Chief Technology Officer - Microgrids Business

<http://www.schneider-electric.us/en/work/solutions/microgrid-solutions/>



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

**×1.5**

Energy consumption  
will almost double

**÷2**

CO<sub>2</sub> emissions  
need to be halved

**↑ 3×**

We have to become  
3 times more efficient

*Note: Forecast for 2050 compared to 2009 levels*

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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

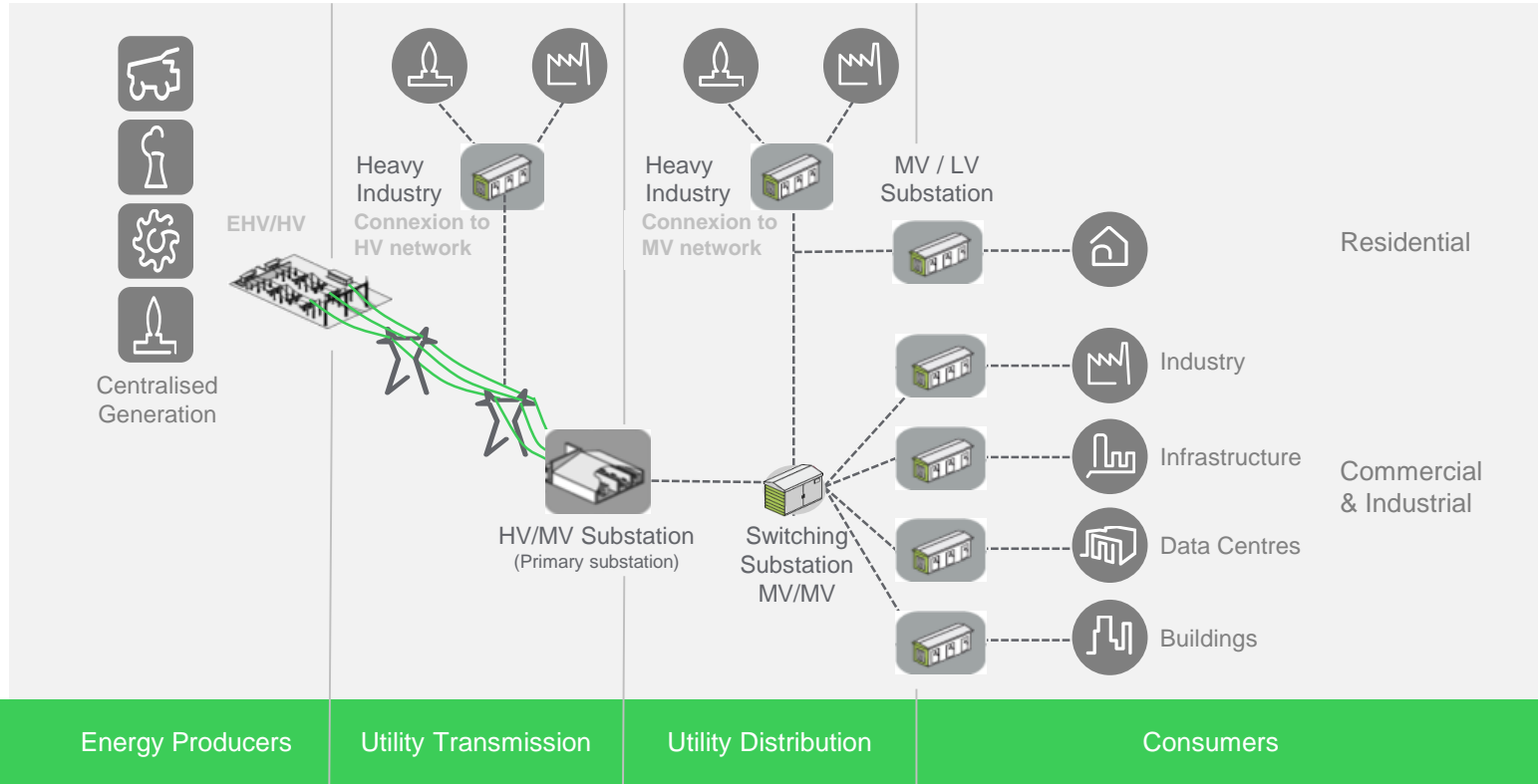
## More DISTRIBUTED

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

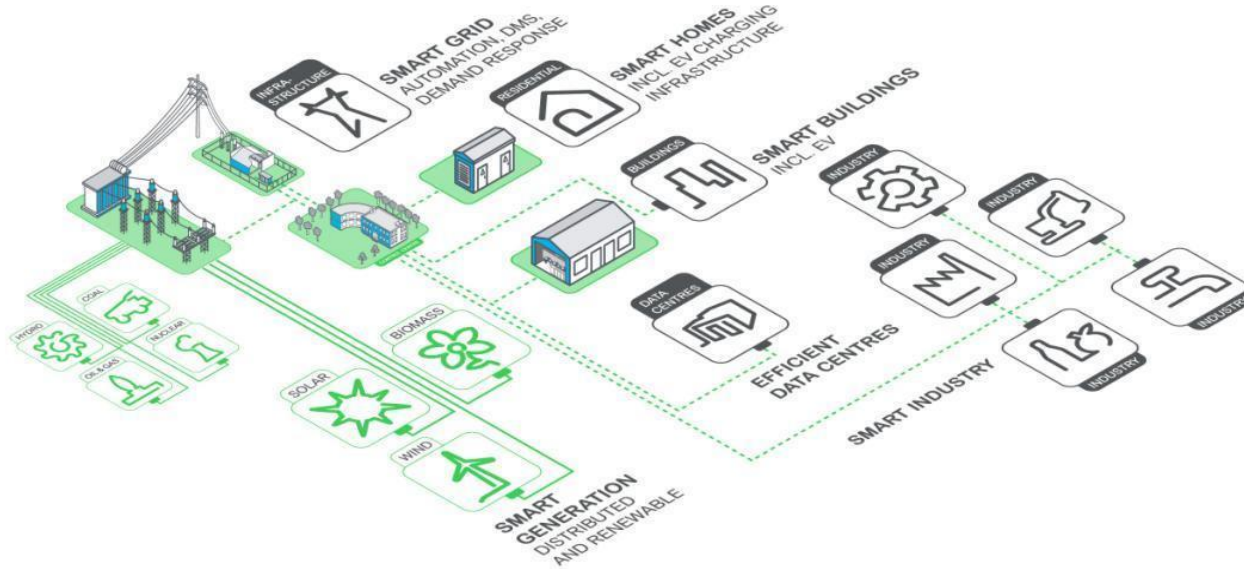
## More EFFICIENT

2/3 energy efficiency potential remains untapped

# The Old World of Energy: Singular flow of Electricity from Source to Load



# The new World of Energy: Electricity is... Distributed & Connected



Smart Grid

Distributed Generation

Efficient Demand

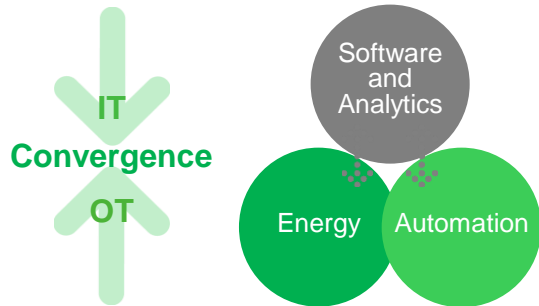
**CONNECTED FROM PLANT TO PLUG**



# Our Solution... *EcoStruxure*

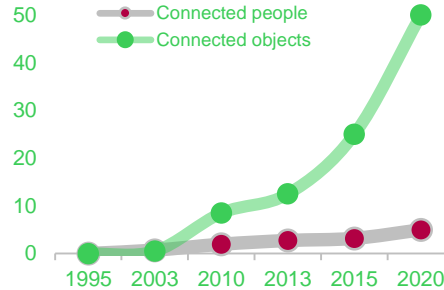
## Integration of Energy, Automation and Software

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<sup>1</sup>



1: Source Cisco IBSG April 2011 / Internet World Statistics

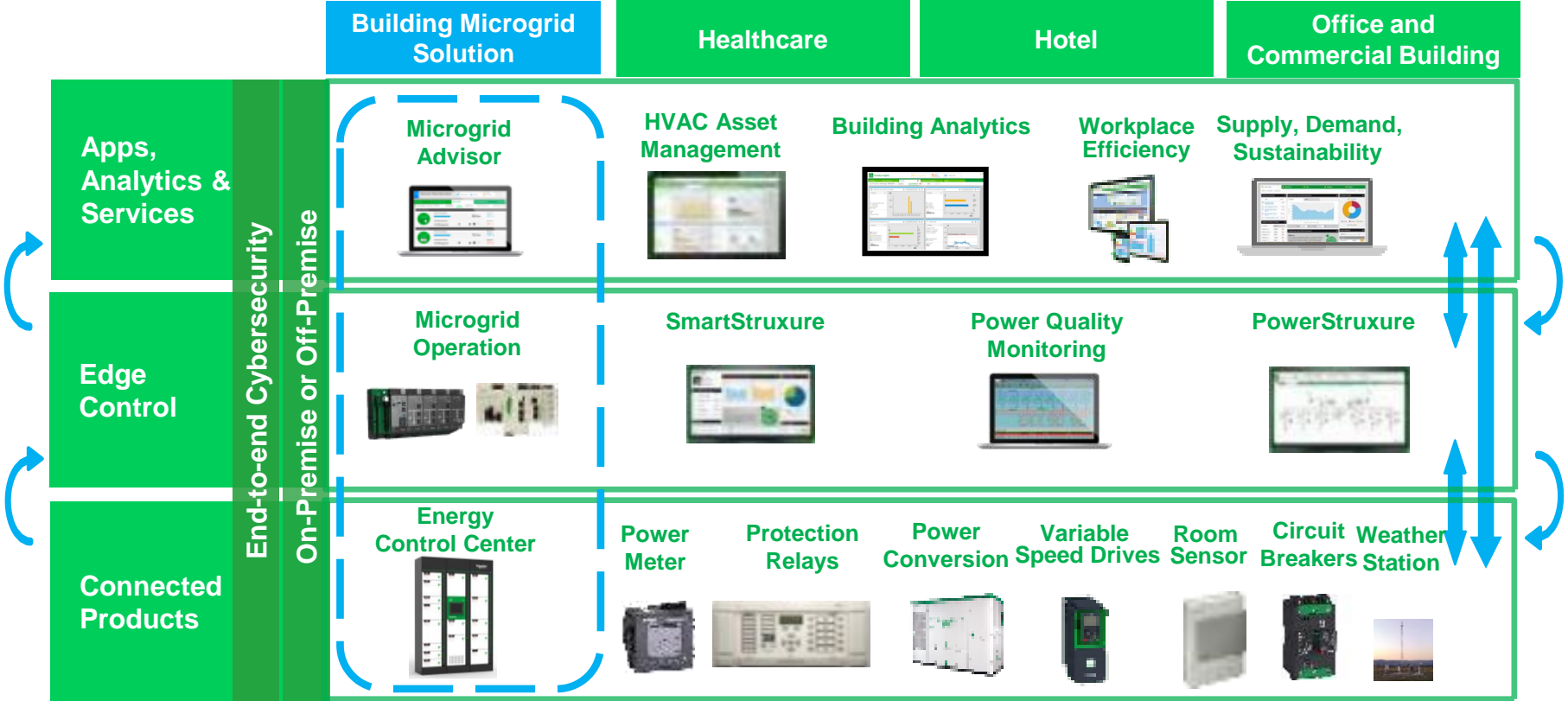
Energy optimization



Process optimization

# EcoStruxure™ Building

Innovation At Every Level

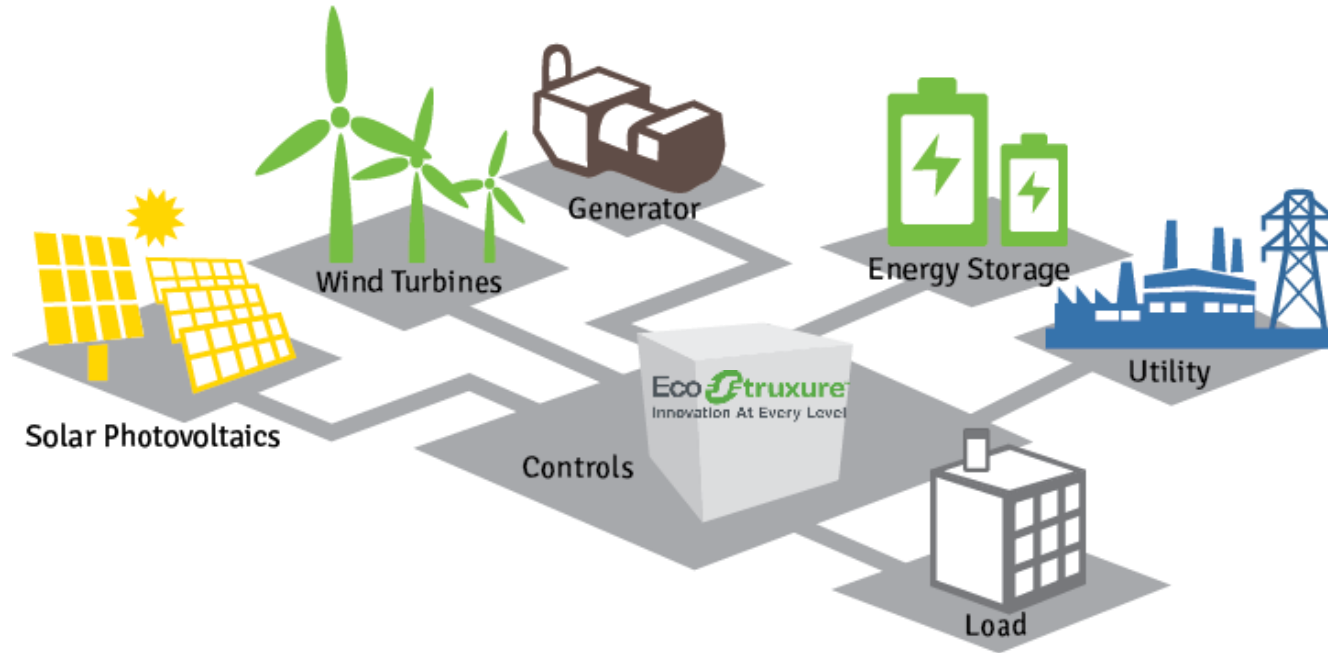


Connected devices, real-time control & open software, analytics & services



# What is a Microgrid?

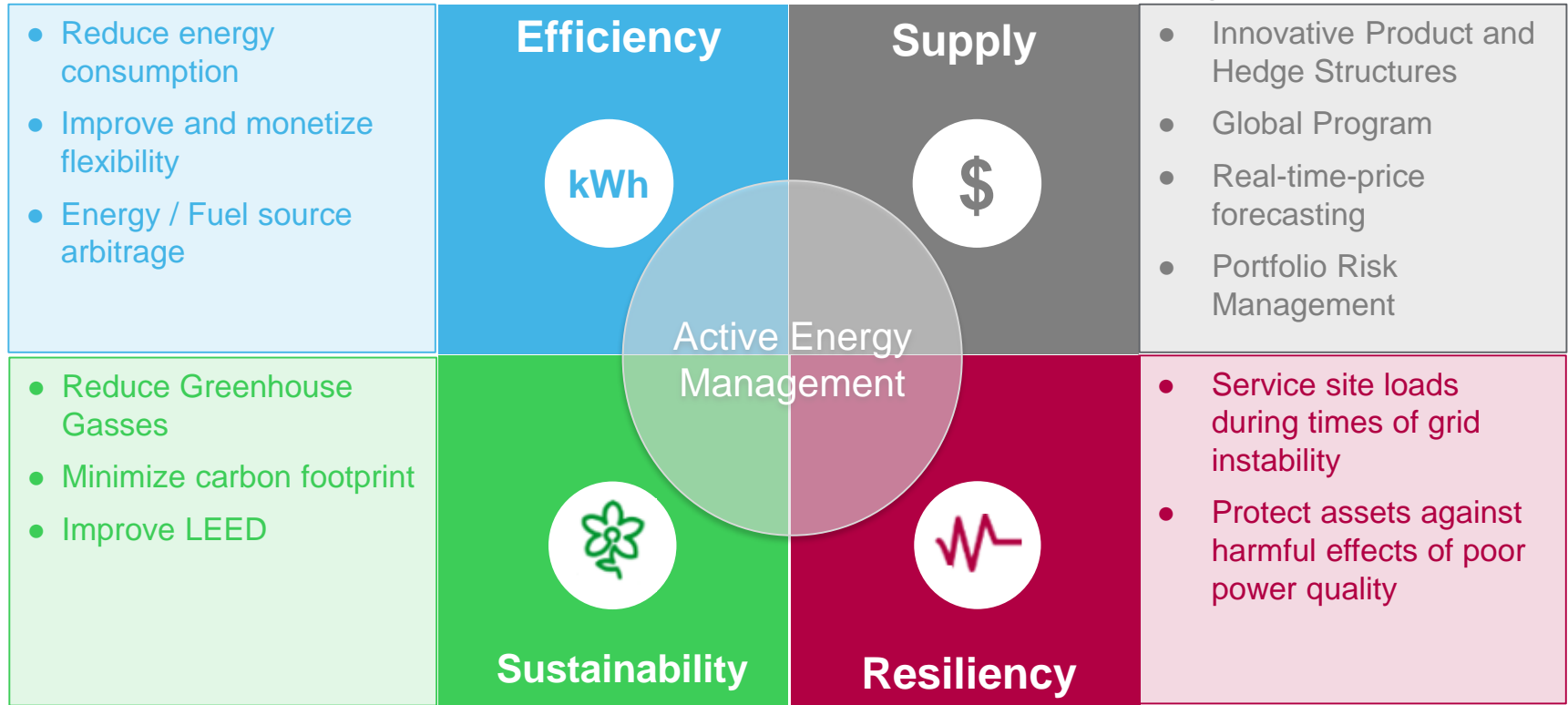
An **integrated energy system** consisting of **interconnected loads** and **distributed energy resources**...



...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

Michigan Public Act 341/342?



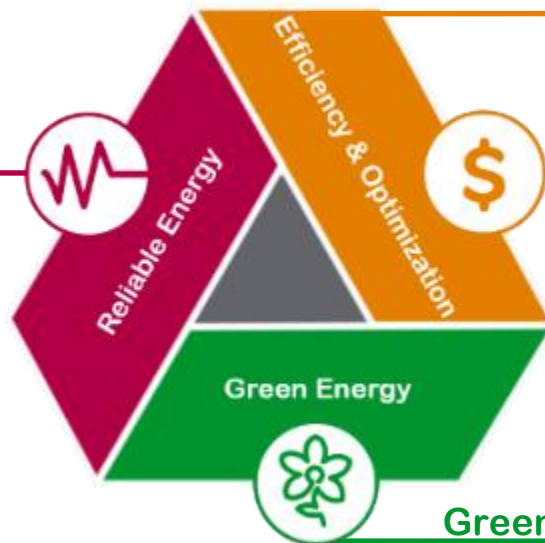
+ solution scales simply for entire enterprise

# 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



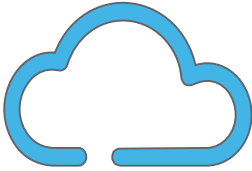
## Reliable Energy

- 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



Cloud

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



EcoStruxure  
Microgrid  
Advisor

Client  
Constraints



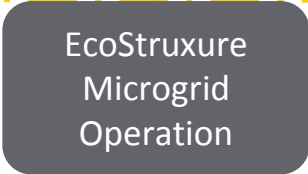
Weather  
forecast  
(DTN)



Energy  
market  
pricing

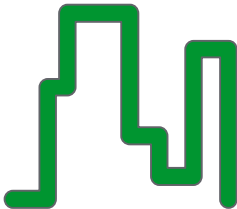


Demand  
response  
requests

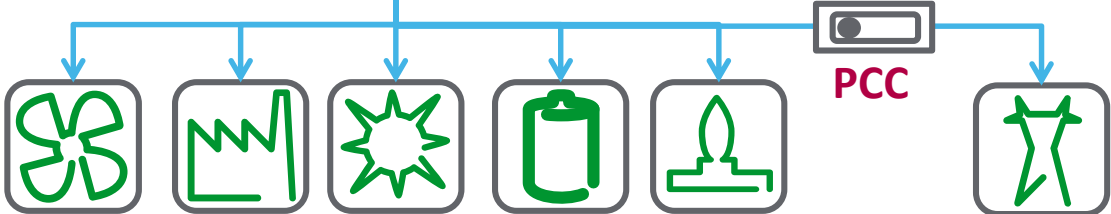


EcoStruxure  
Microgrid  
Operation

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



Client site



# Microgrid Topologies

Private Sector moving into utility services

Utilities moving toward the end-users



Private Commercial/Industrial Sites



Industrial, Education and Military Campus



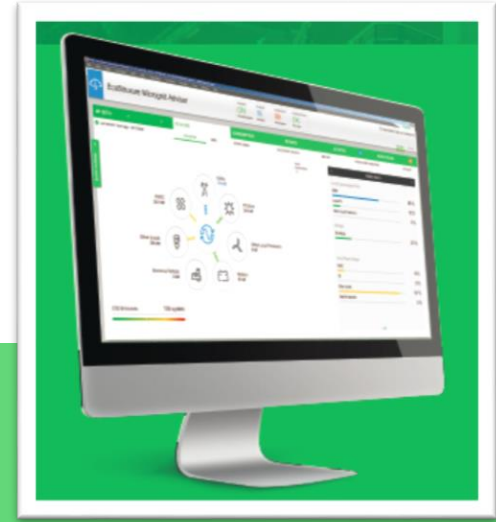
Municipalities and Utility Grid-Edge

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# How the BOC Microgrid Works

Andy Haun, Chief Microgrid Technology Officer



**EcoStruxure™**  
Innovation At Every Level  
with connected devices, real  
time control & open software,  
analytics & services.

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# Boston One Campus

**240,000+** square feet

Serves as North American **HQ**

**2** Building Campus

**750+** employees

**1** of **5** Global R&D Centers



# 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

# Boston One Campus Microgrid



Phase 1A & 1B



Phase 2

PPA  
EXECUTED

Roof Solar

AUG  
2016

Carpport Solar

JAN  
2017

Microgrid



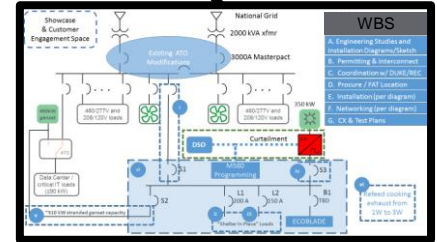
JAN 16



Original Rendering



Site Construction



Controls Installation

**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*

**Innovation** – New technologies to be tested and validated using the BOC Microgrid state-of-the-art “Living Laboratory”

# Typical Microgrid Sequence of Operations

## Boston One Campus

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

**Utility Outage** – Transition to Island Mode

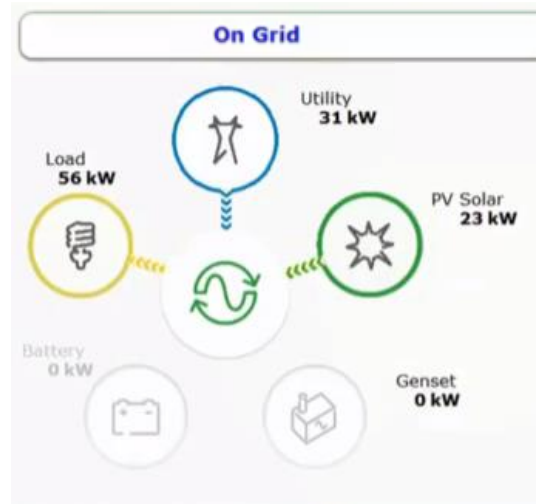
**Islanded Mode** – Generator Production Followed by PV Production

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

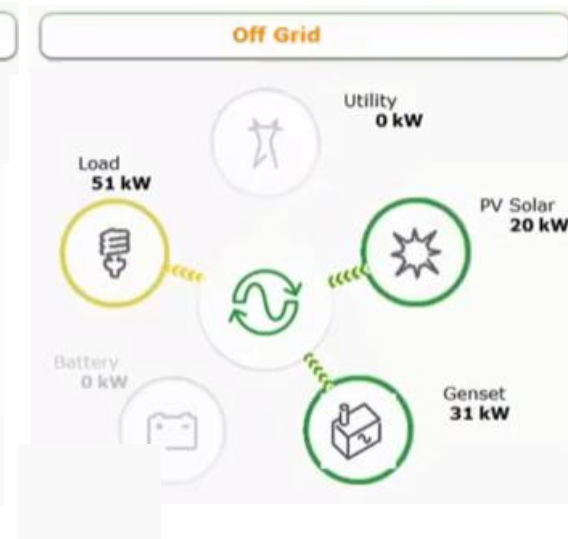
**Grid Returns** to Normal

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

Normal mode (Grid-tied)



Island mode



# 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

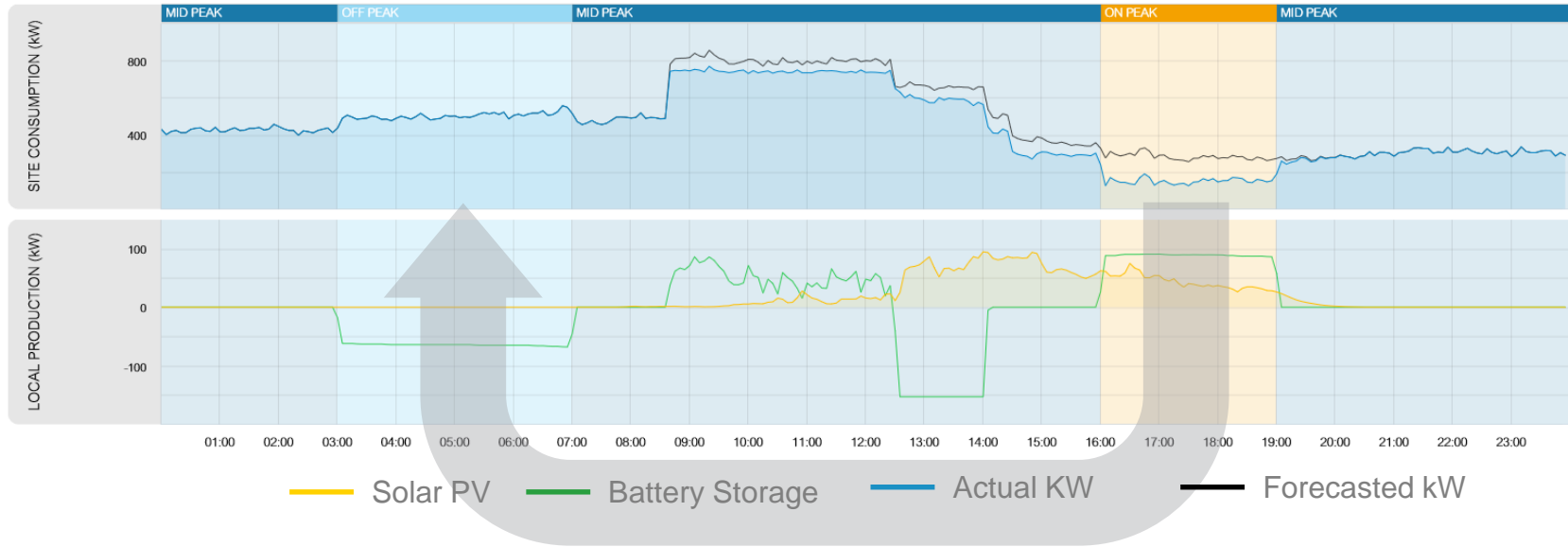
## Island Mode

- Leverage weather forecasts to anticipate black-outs



# Tariff Management

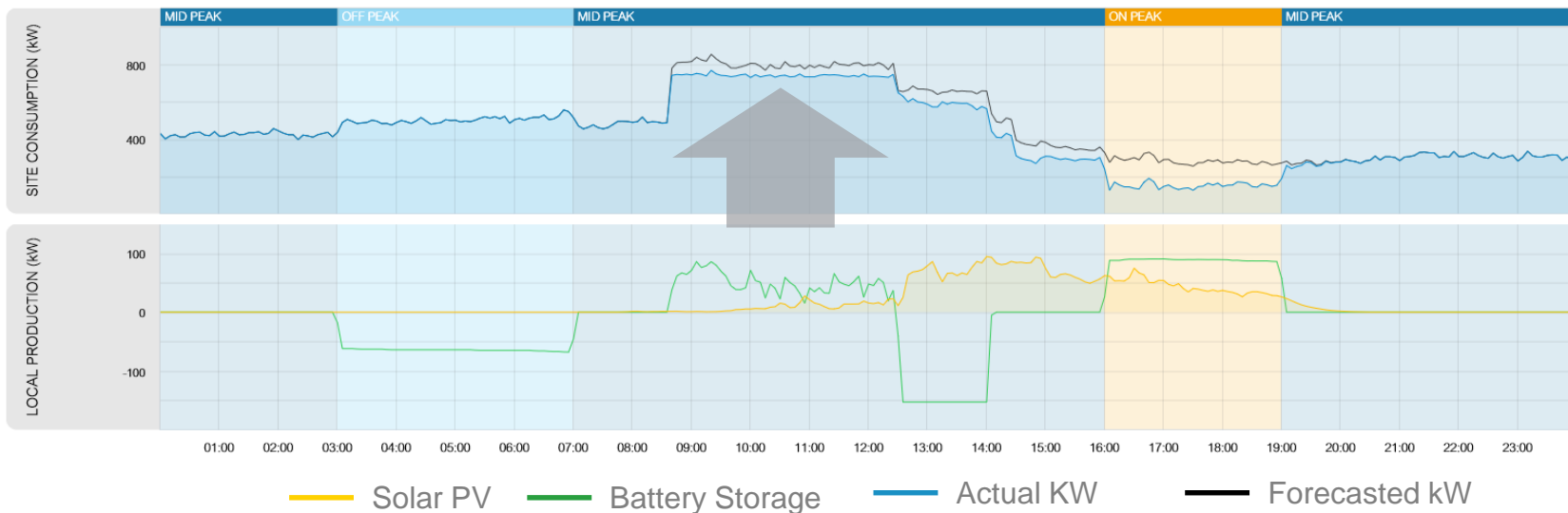
Shift consumption from times of high cost to times of low cost



- **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

# Demand Management

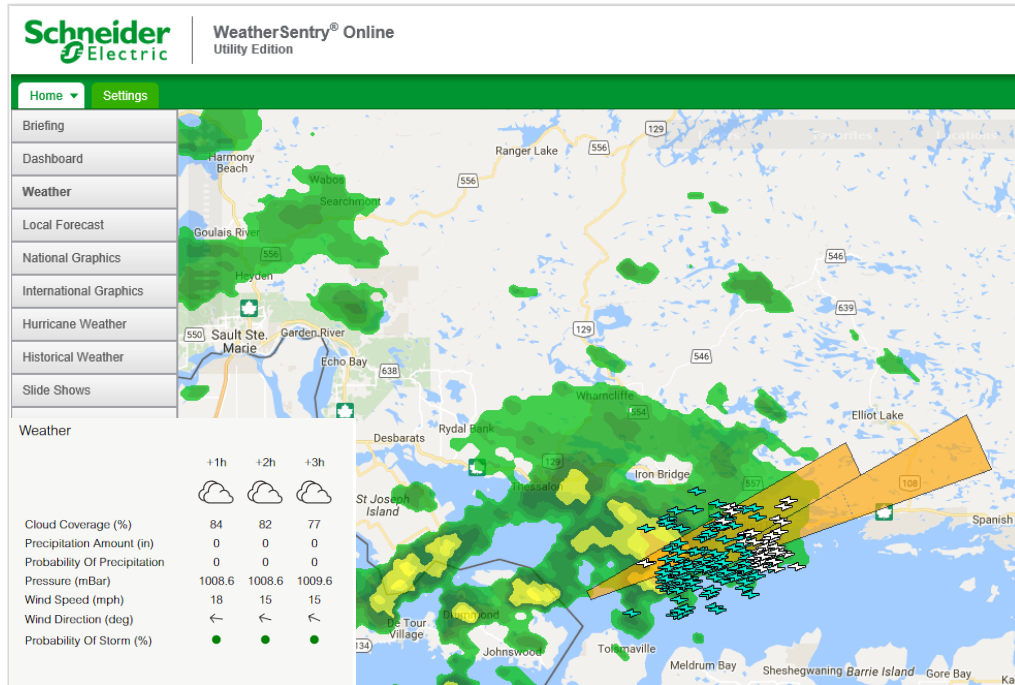
Minimize / avoid fees by shaving peak demand



- *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

# 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

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# Schneider Electric Energy Control Center

## For Distributed Energy Resources

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



# 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

## \$ 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*



The most advanced microgrid in the US, located near Dallas, Texas



## 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

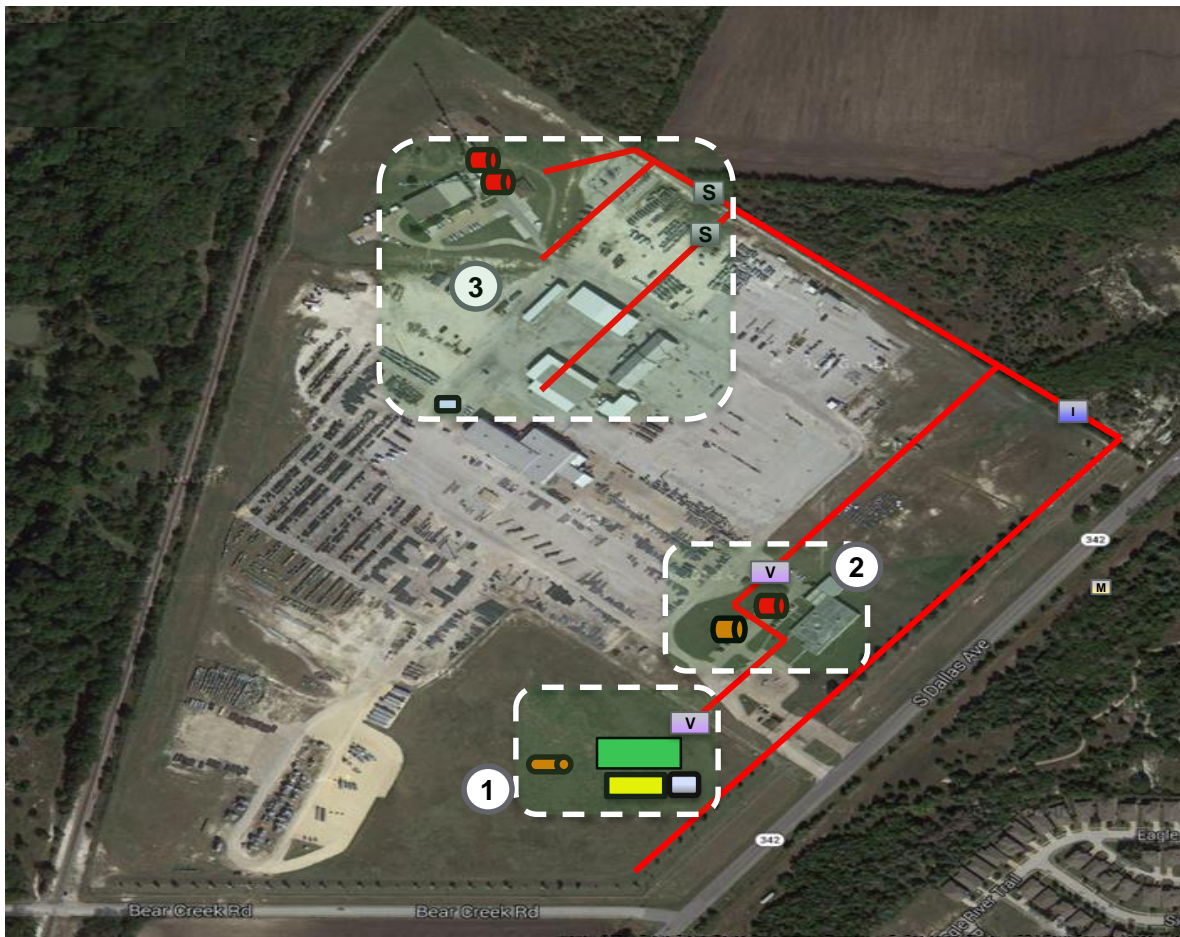


Site microgrid controller + DSO hardware

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# Oncor Microgrids



## Site:

- M** Primary Meter Point
- I** IntelliTeam on Grid Source
- V** 2 – Vista Switchgear
- S** 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

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Schneider Electric

# 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



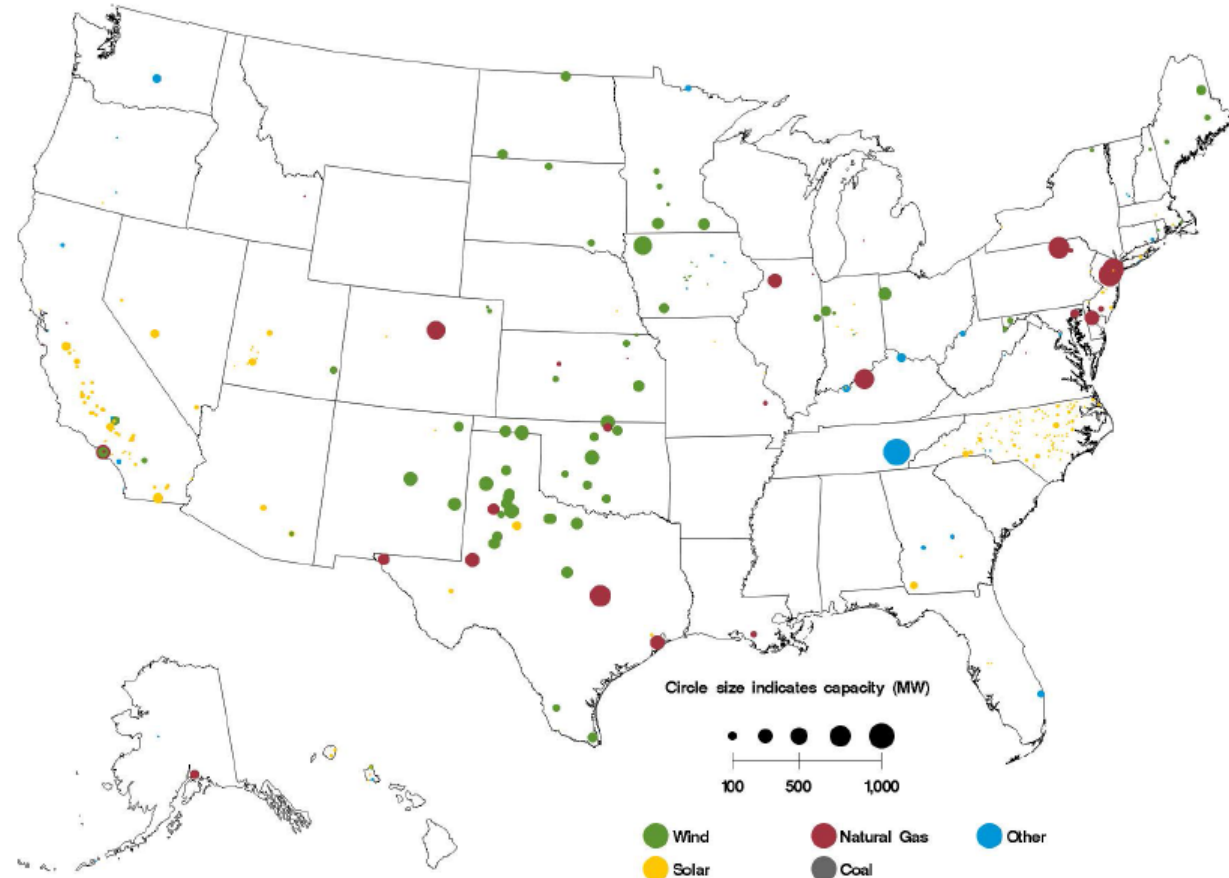


# Cooperative Policies to support the New Energy Landscape



# Why Microgrids, Why Now?

Figure 6.1.C. Utility Scale Generating Units Planned to Come Online from March 2015 to February 2016



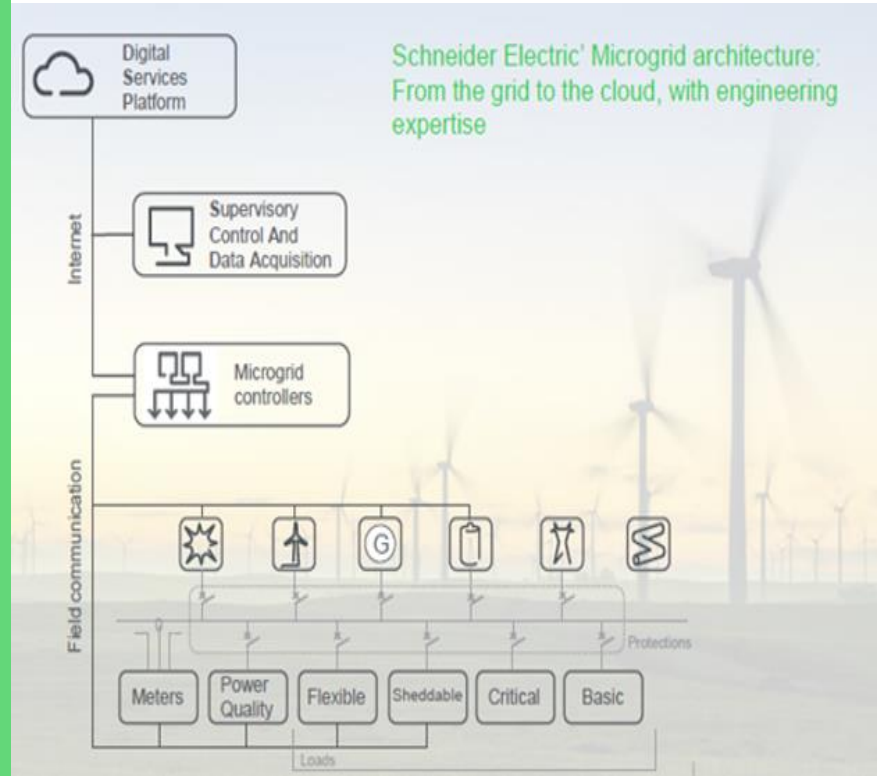
- Utility **generation mix is changing**, led by natural gas, wind and solar.
- About **10% of the US grid is based on DER**, with solar representing the fastest growing DER and cogen
- Many **utilities are buying solar integrators**, and will increasingly use **battery energy storage and generators** 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.

# Technology Enabling the Transition



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Our technologies ensure that **Life Is On**  
**everywhere, for everyone and at every moment.**

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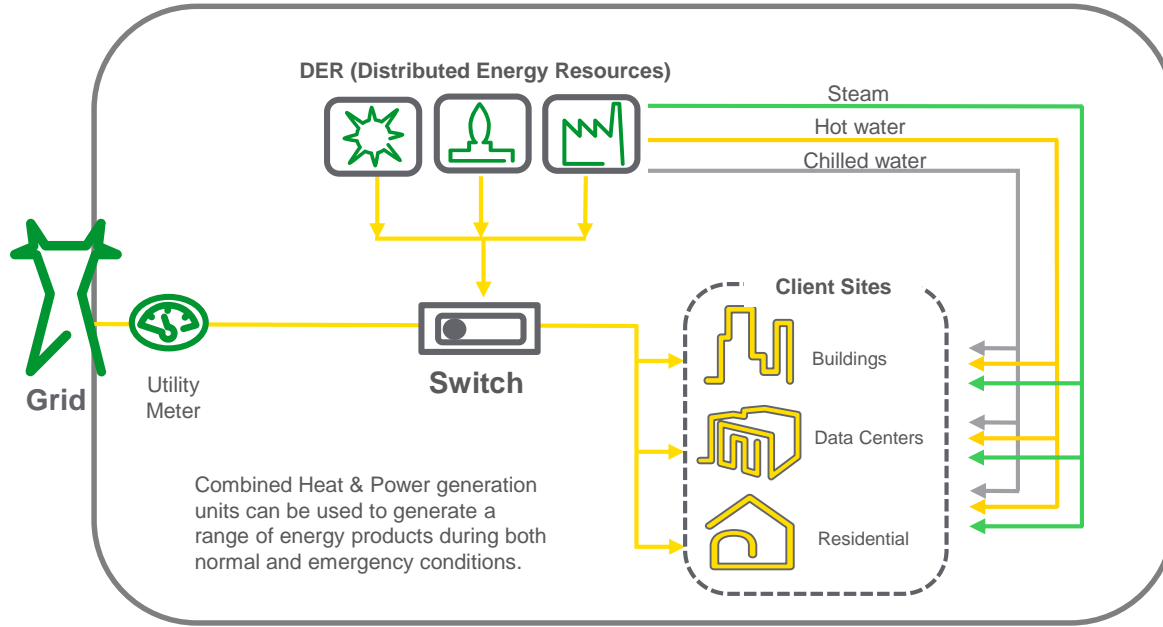
Take our virtual  
tour to see how  
a microgrid works

**Schneider**  
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<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