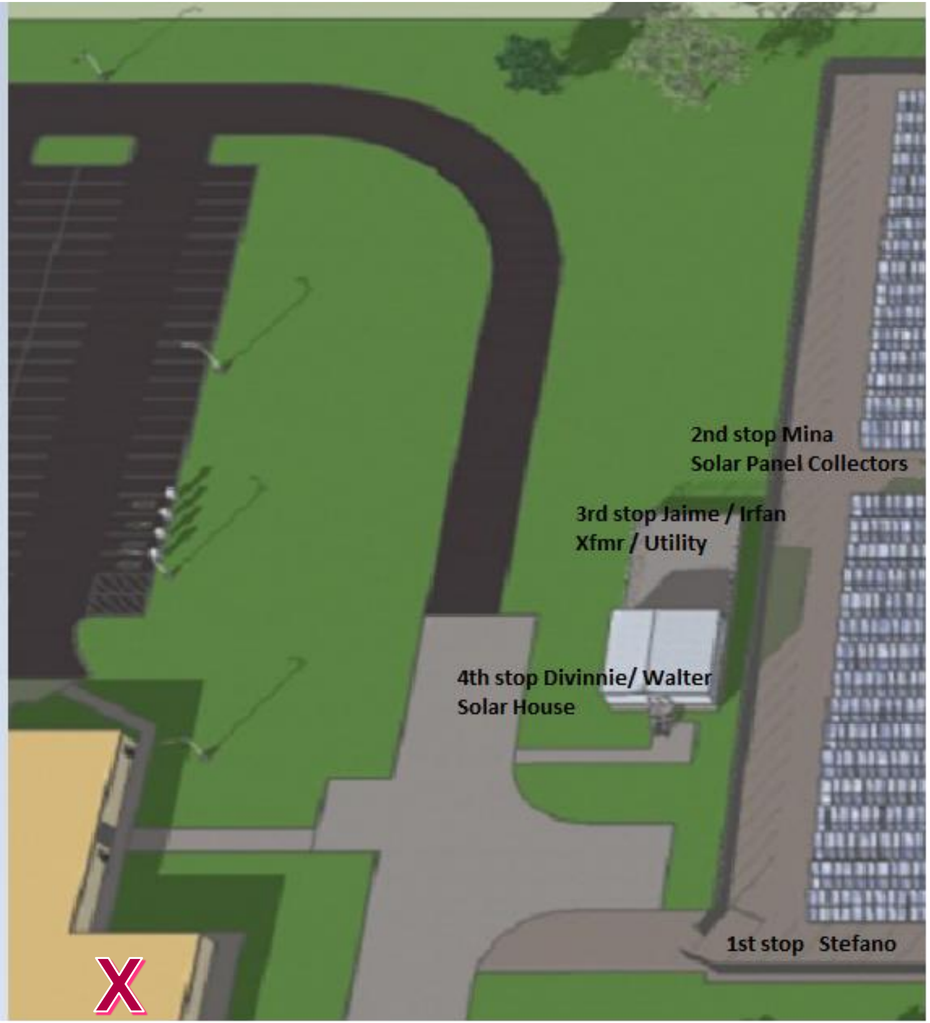
Agenda

- 9:00 – 9:45 AM
  - Mark Feasel (Microgrids)
- 9:45-10:10 AM
  - Bill Brown (Design of this generating station)
- 10:10 – 11:10 AM
  - Break and tour
- 11:10 – 12:00 PM
  - James Stacy (Switchgear Design)
- 12:00 PM
  - Lunch
- 12:30 – 1:30 PM
  - Tour of Powerful Solutions Room



Microgrid

Evolving Business Models in the New Energy Landscape

Presented By: Mark Feasel

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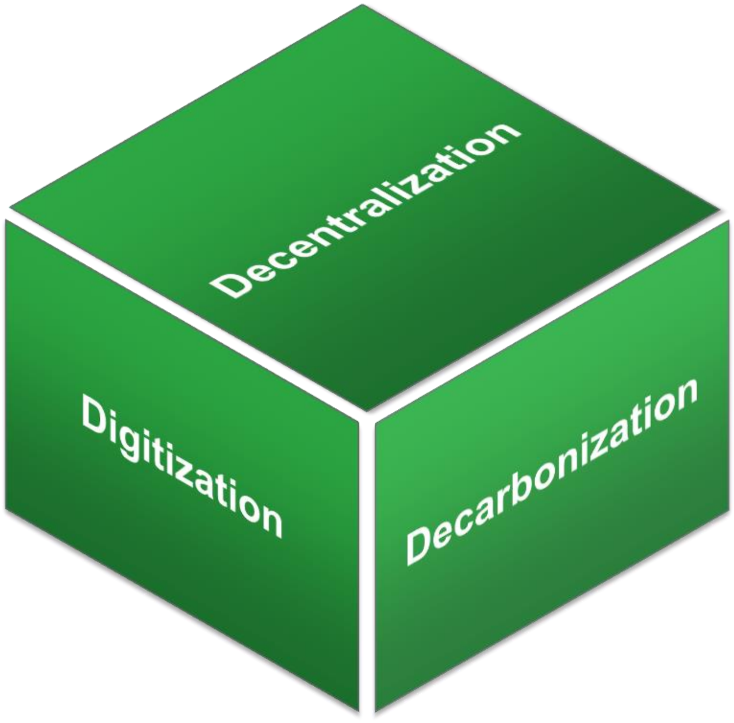
The New World of Energy in 3Ds



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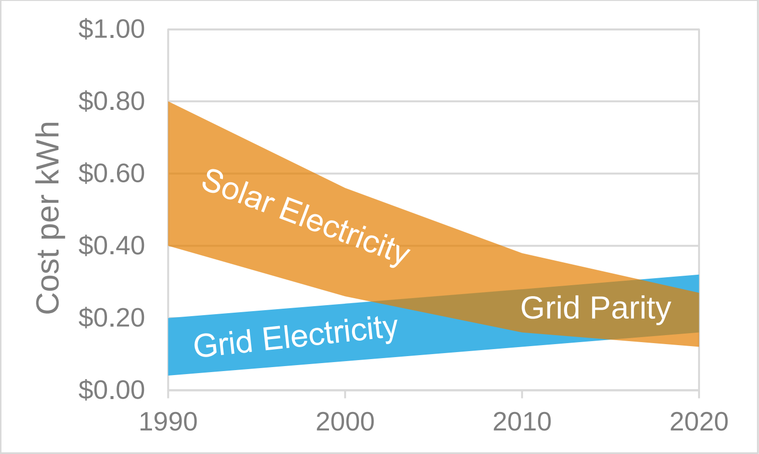
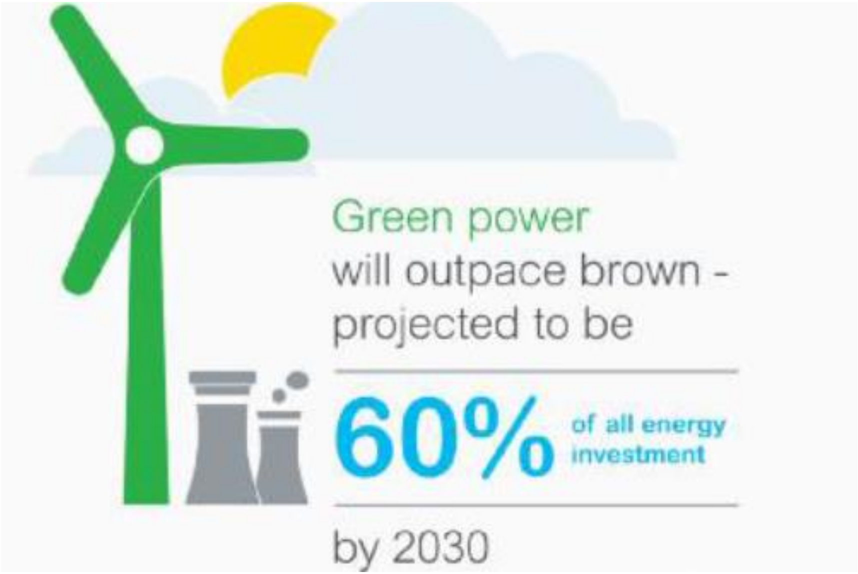
Decarbonization | Digitization | Decentralization

Reduced Cost for Renewable Energy



Make Renewable Energy Attractive



& Carbon Reduction Policy

SREC Markets (MA, NJ, PA, MD, DE, OH, etc.)

COP21 **EPA Clean Power Plan**

Decarbonization | **Digitization** | Decentralization

Proliferating automated devices connecting the “grid of things”

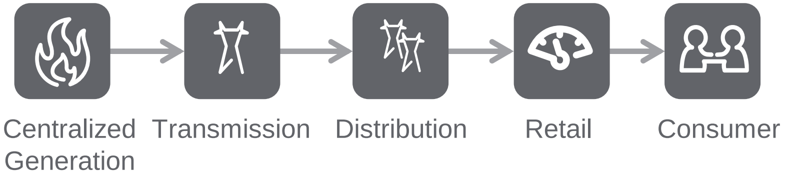
Big data integration
Internet of Things will connect
50Bn devices
by 2020

Data source: IDC

- more / better data unlocks better / faster decision making
- reduced investment to achieve situational awareness required for microgrid
- improved root cause analysis / troubleshooting
- better lifecycle management

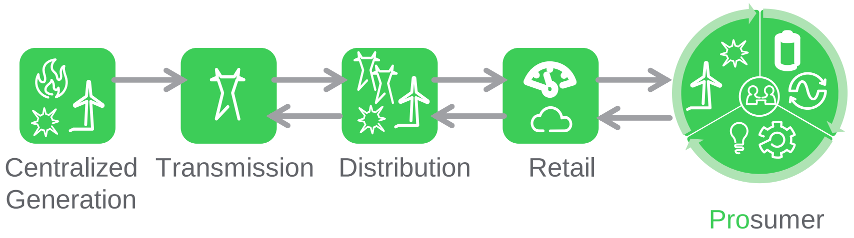
Decarbonization | Digitization | **Decentralization**

Historical Energy Value Chain



- one-way energy flow
- suboptimal utilization of centralized generation
- passive consumers / inelastic demand
- limited choice
- limited communication

The New Energy Landscape

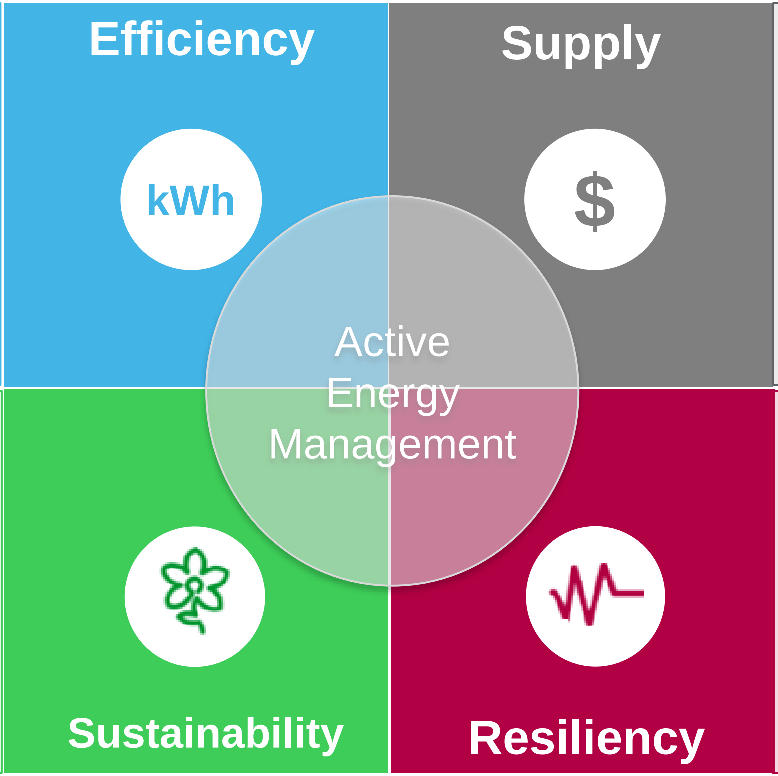


- n-way energy flow
- generation is local and green
- integrated and tailored energy supply chain
- connected, aware, and empowered consumers and suppliers

Consumer Expectations in the New Energy Landscape

From Passive to Active and Integrated

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



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

- Reduce Greenhouse Gasses
- Minimize carbon footprint
- Improve LEED

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

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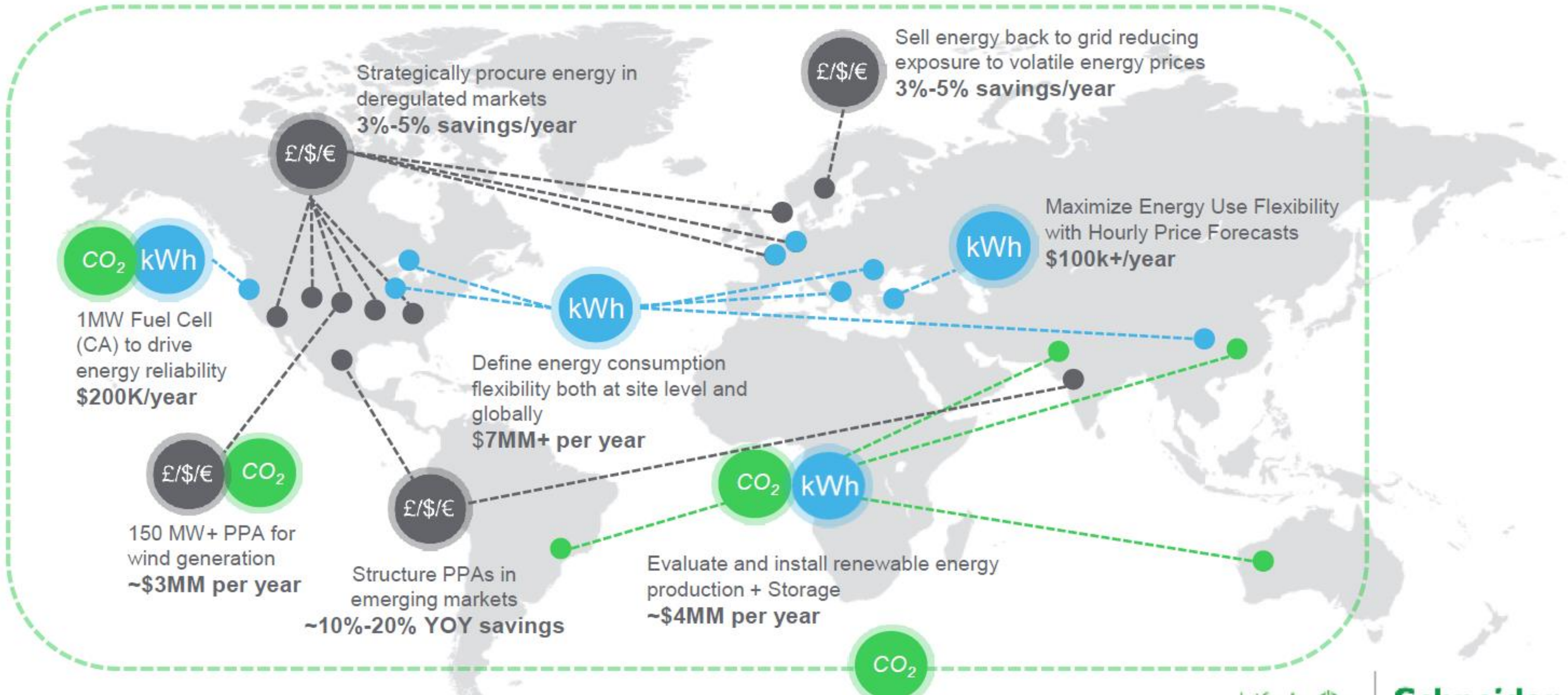
Each path to Active Energy Management is Unique



Meet global sustainability targets
by increasing renewable energy use

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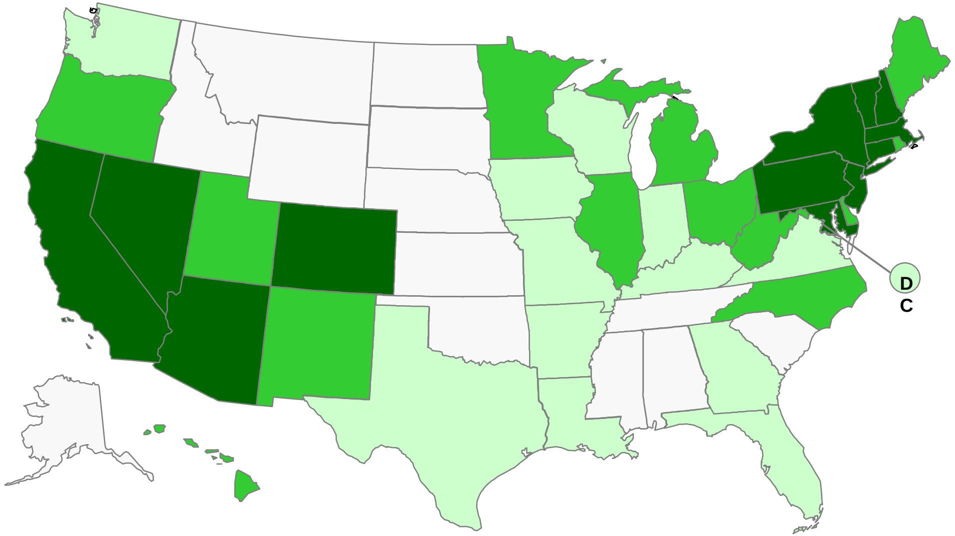
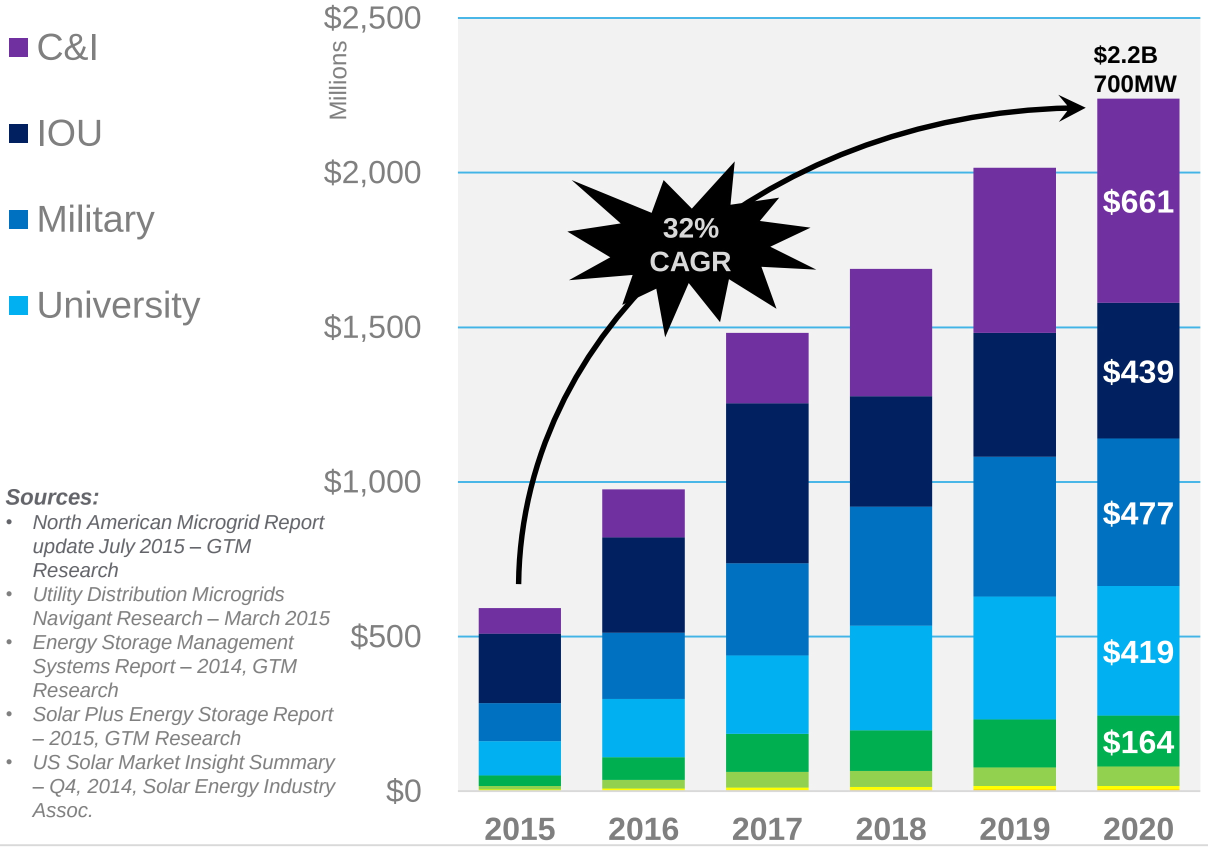
Catalysts for a New Energy Landscape in the US



1. Levelized Cost of Energy at or below Grid Parity (Deutsche Bank)
2. Credits for Net Excess Generation – Net Metering (DSIREUSA)
3. Aggregated, Virtual, or Community Net Metering (NCSL.org)
4. Prone to Power Outages / Severe Weather (US Blackout Tracker)
5. High MWs per Net Meter (EIA-826)
6. Forecasted Growth in non-Resi Solar PV systems (GTM)
7. Potential for Self-Supply (ScottMadden Mgmt Consultants)

US Microgrid Total Available Market (TAM)



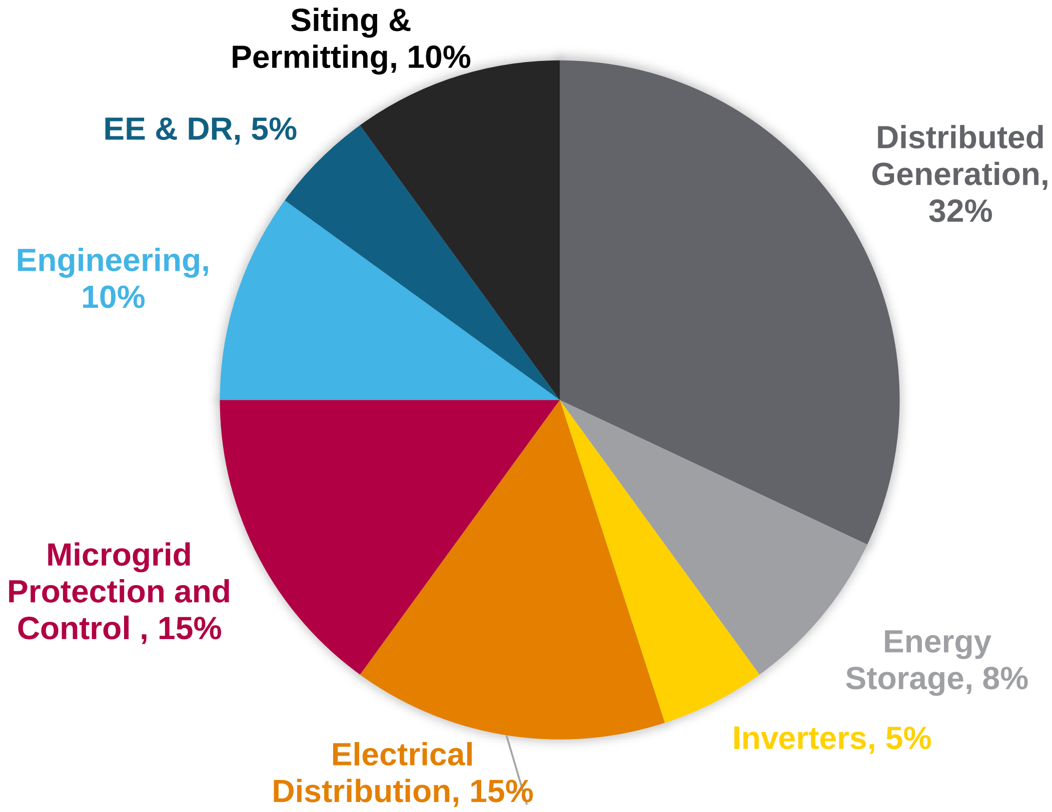
Sources:

- *North American Microgrid Report update July 2015 – GTM Research*
- *Utility Distribution Microgrids Navigant Research – March 2015*
- *Energy Storage Management Systems Report – 2014, GTM Research*
- *Solar Plus Energy Storage Report – 2015, GTM Research*
- *US Solar Market Insight Summary – Q4, 2014, Solar Energy Industry Assoc.*

Use Cases

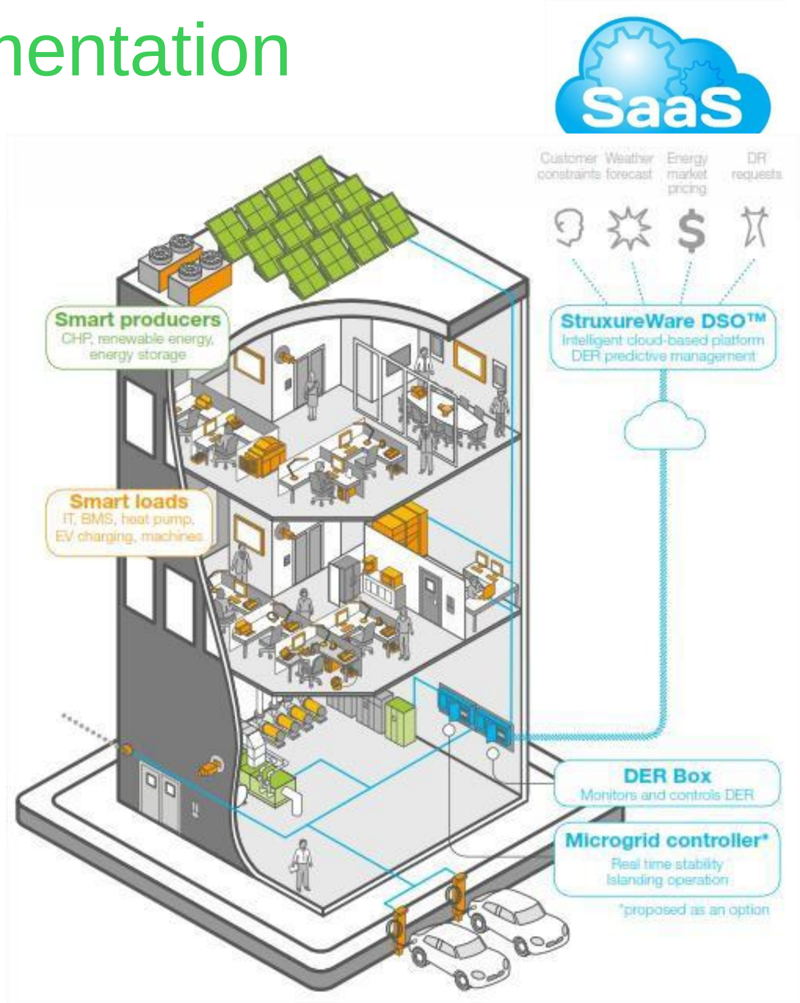
1. PV + Storage
   - Stand alone solar or storage not in scope are adjacencies to this market, and not included in forecast.
   - Residential not in scope
2. Advanced End User Microgrids
   - Sophisticated solutions, average size 10MW
3. Regulated Utility Distribution System Microgrids
   - Owned and operated by the Utility. Typically deployed to create an oasis of critical infrastructure for the public or relieve transmission constraints.

Microgrid TAM Breakdown (Implementation Phase)

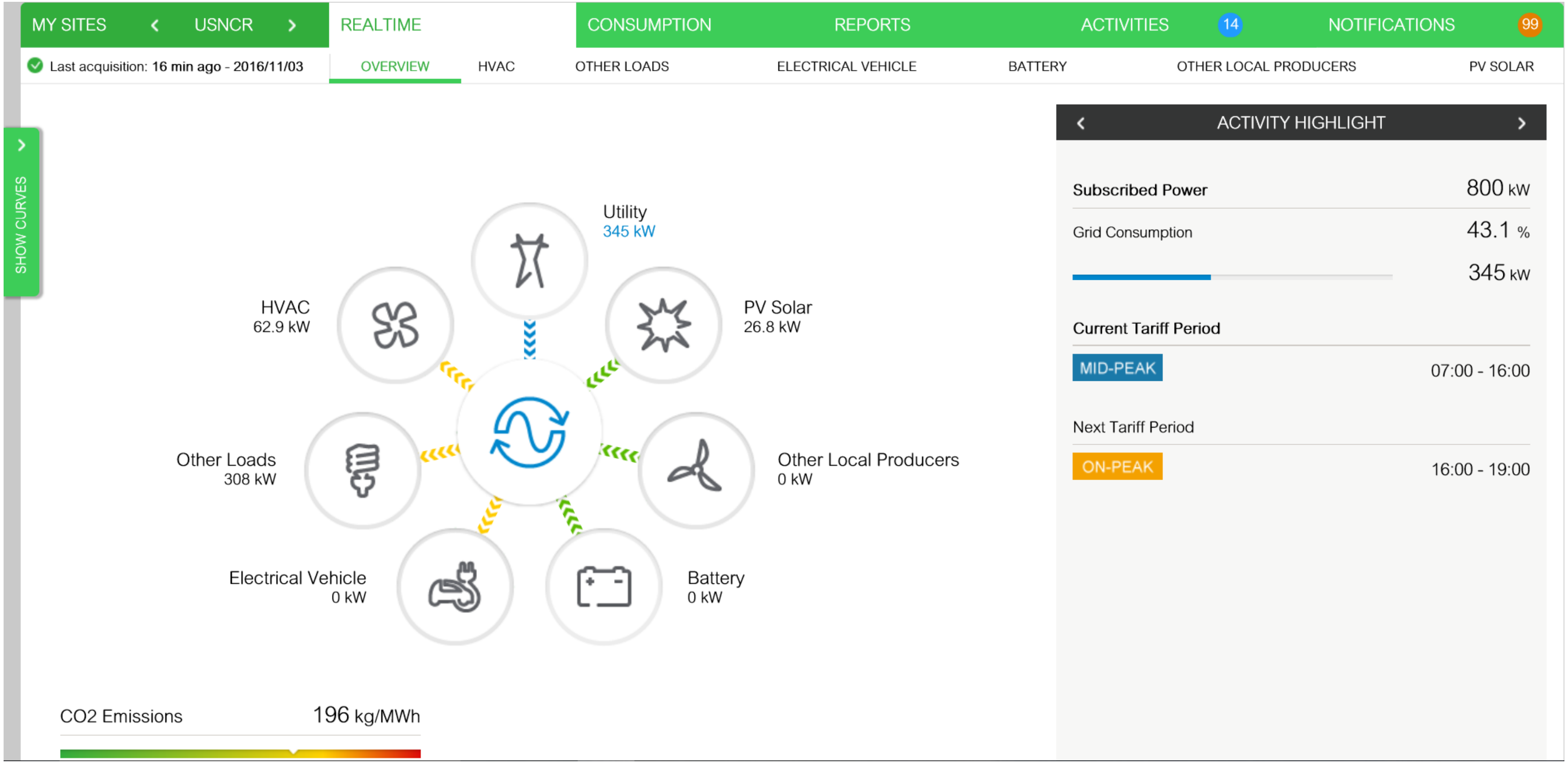


Microgrids: Beyond Implementation

- Economic Optimization
  - Tariff Optimization
  - Peak Shaving
  - Demand Response
  - Ancillary Services
  - Self Consumption
- Power Quality / Availability Optimization
  - Severe weather prediction
  - PQ measurement and trending
- DER Asset Performance Management
  - Remote Monitoring
  - Sequence of Event Reporting
  - Root Cause Analysis
- Energy Supply / Procurement Optimization

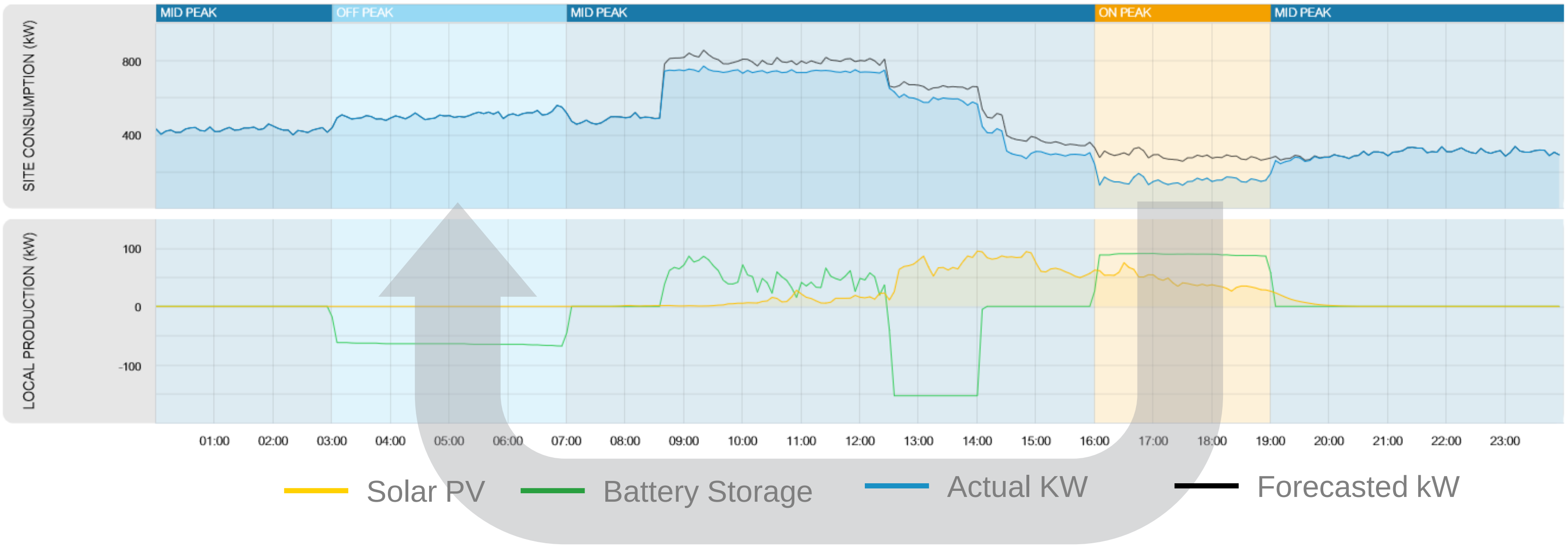


Microgrid Remote Optimization



Tariff Management

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

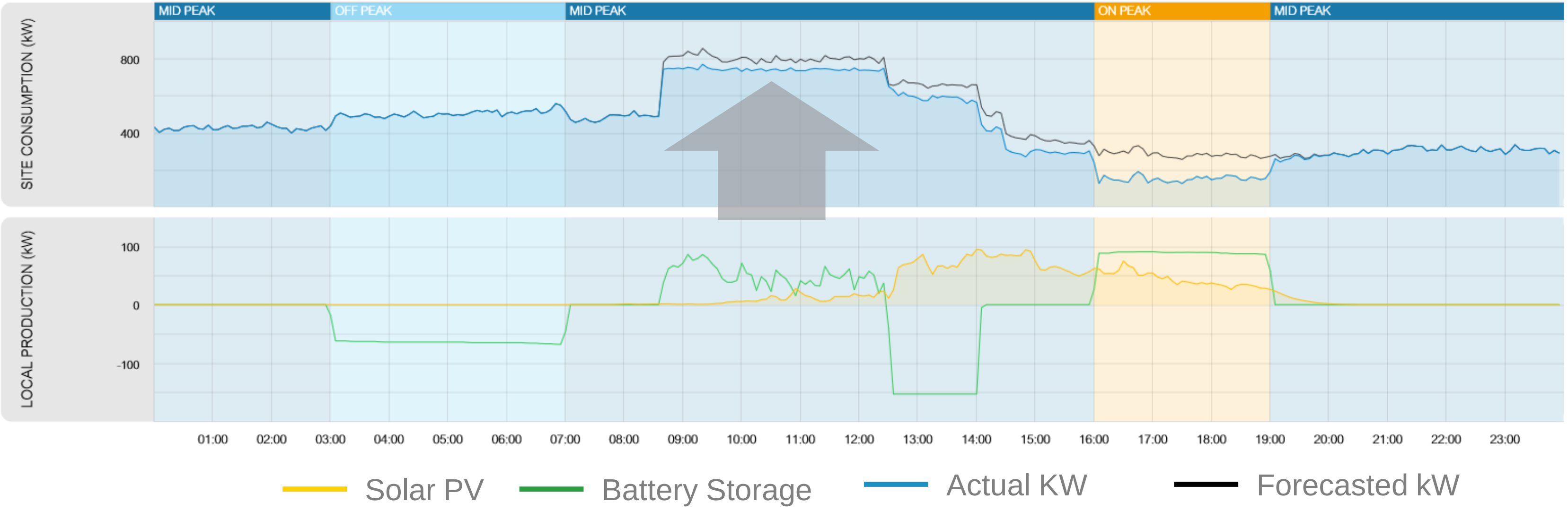


- *Example 1:* charge an energy storage system during “off peak” period and discharge it during “on peak” period
- *Example 2:* consume energy with HVAC during “off peak” period (pre heating or pre cooling) and coast to reduce energy consumption during “on peak” period

Source: Oncor – May 27, 2015

Demand Management

Minimize / avoid fees by shaving peak demand



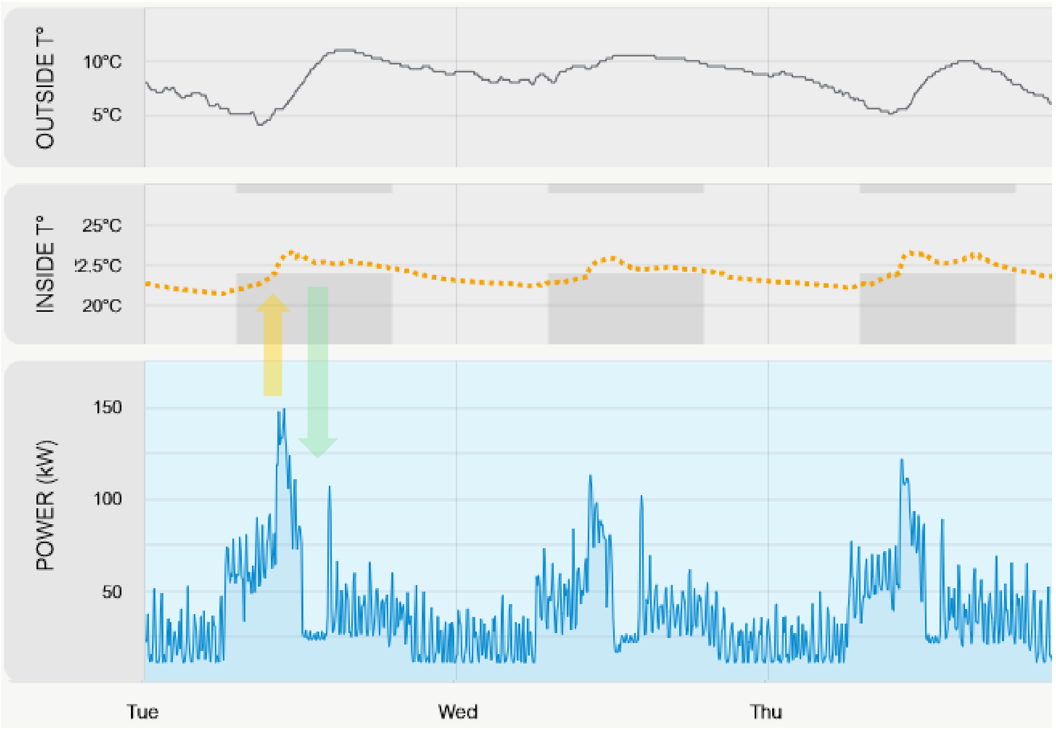
- *Example 1:* dispatch energy storage to supply some load to avoid a peak
- *Example 2:* shed loads (HVAC, EV Chargers, etc.) to avoid setting a peak
- *Example 3:* Sequence the start of large loads to avoid coincident peak demand

Source: Oncor – May 27, 2015

Demand Response & Ancillary Services

- Balancing swings in load and generator availability on the grid requires infrastructure, software, and automation. Historically, electric utilities have earned revenue by serving this need.
- Through microgrids, end users can generate money by performing these services

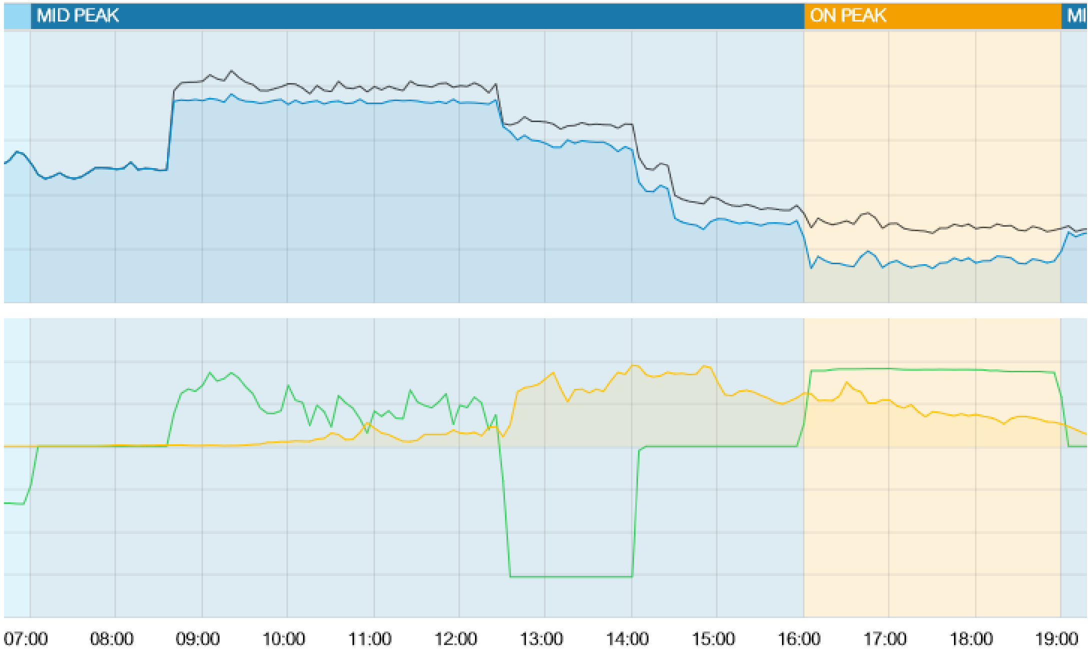
  - *Example 1:* dispatch energy storage to supply some load to avoid a peak
  - *Example 2:* shed loads (HVAC, EV Chargers, etc.) to avoid setting a peak
  - *Example 3:* Sequence the start of large loads to avoid coincident peak demand

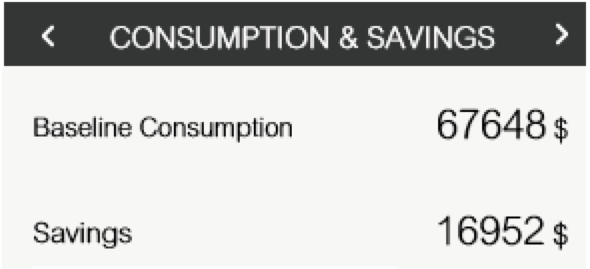


Pre-Heat   HVAC Demand Response

Source: GEG Electropole Dec 8, 2015

Illustrating the benefit

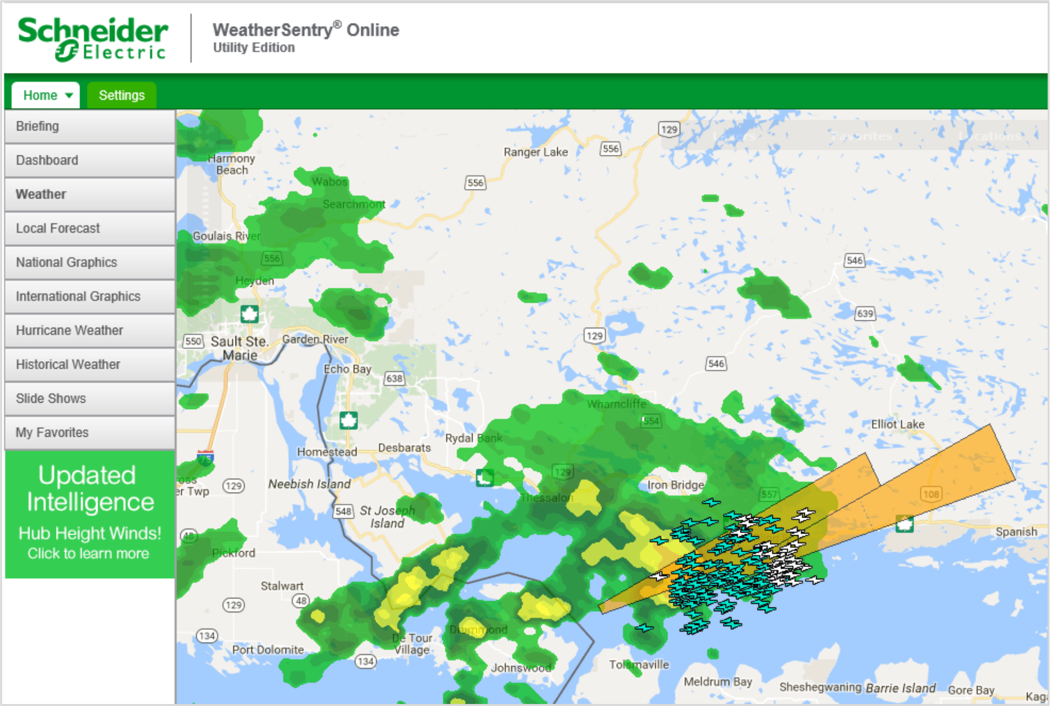




Subtracting actual energy procured vs. modeled consumption allows us to calculate the financial savings and net carbon reduction

Storm Hardening

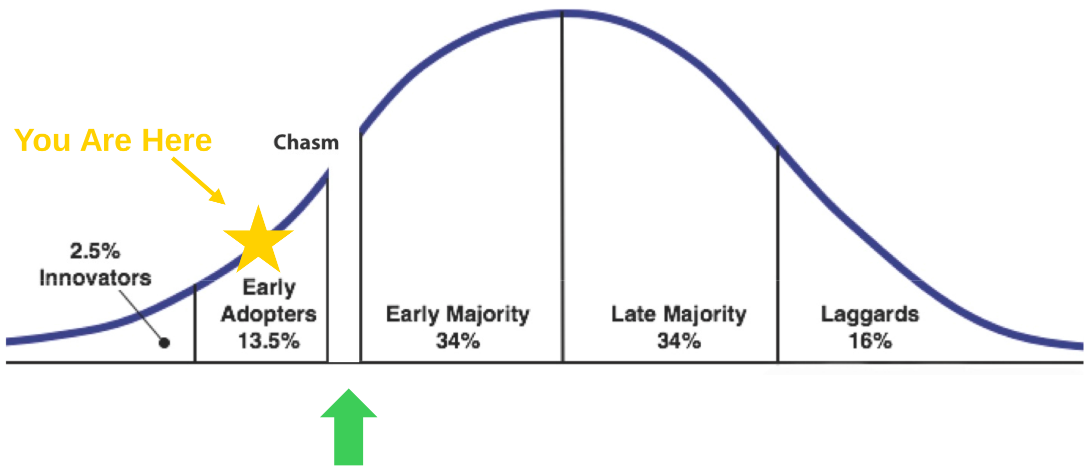
Optimize for resiliency when weather threatens site operation



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

Crossing the Chasm in the New Energy Landscape



The offer required to cross the chasm:

- Allows consumers to co-optimize for energy and process
- Aligns ownership of assets to those with a prospectus based upon long term stable returns.
- Delivers an enduring outcome for the economic useful life of the asset
- Shields consumers from technical risk of emerging technology

Early market participants are advanced energy prosumers who can quantify the value of improved reliability, flexibility, sustainability, and security to their corporate mission.

Reaching the larger market now requires overcoming high barriers to entry:

- Microgrids are expensive to deploy and require extensive engineering to implement.
- Optimized operation requires insight into:
  - Utility rate structures
  - Commodity energy trends
  - Weather and other correlated variables.
  - Analytics and Sophisticated Controls

Our Solution: Energy as a Service

1

We engage energy consumers and help them define energy objectives

2

We design a solution that achieves supply, efficiency, sustainability, and resiliency requirements of the consumer through both contractual mechanisms and engineered solutions

3

We introduce the consumer to an investor (often a Utility partner) whose business model is built upon the expected return of energy assets

Schneider Electric

Investor procures solution and multi-year service contract from SE

Consumer signs multi-year energy contract with investor. Gets benefits today without CapEx

Montgomery County Maryland

Office Of Energy and Sustainability

About Montgomery County

- Approximately 1 million people
- High tech knowledge based economy
- 400+ facilities
- Leader in Advanced Energy
    - 11 megawatts of solar across 18 sites
    - Procure 100 percent clean energy for County facilities
    - Inaugural Partner in the U.S. DOE’s Combined Heat and Power for Resiliency Accelerator
    - First CHP system installed in 2016

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Montgomery County Maryland

Project Objectives

- Improve resiliency of county operations
  - Upgrade existing aging electrical distribution infrastructure
  - Ability to island operations for >7 days without grid support
- Mitigate risk of escalating energy price over 15 years.
- Upgrade infrastructure without capex
- Reduce greenhouse gas and other emissions
- Create replicable models for other facilities and governments

Public Safety Headquarters

- Large electrical upgrades
- New 2 MW Solar
- Load management with BAS
- New Cogen
- Integrate Existing gas generator

Correctional Facility

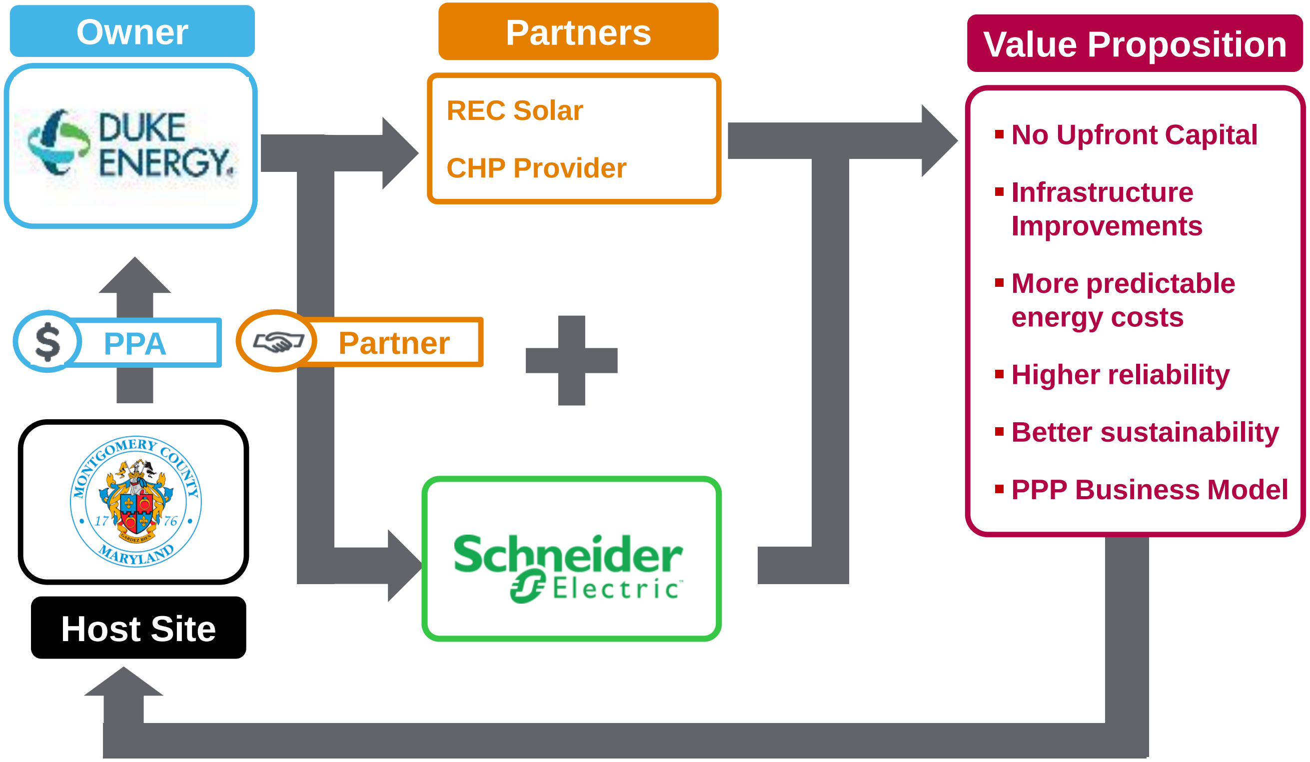
- Minor Electrical Upgrades
- New 250 kW Cogen
- Integrate existing Diesel

Montgomery County Maryland

Project Challenges

- Capital procurement not an option
- Some aspects of the solution can be tied to a volumetric charge, others cannot.
- Competitive Bid Process Required
- Multi-Site
- Multi DER type
- Required assets have varying economic useful lives
- Rebate & Incentives in flux
- Relatively small (<$25M)

Microgrid as a Service



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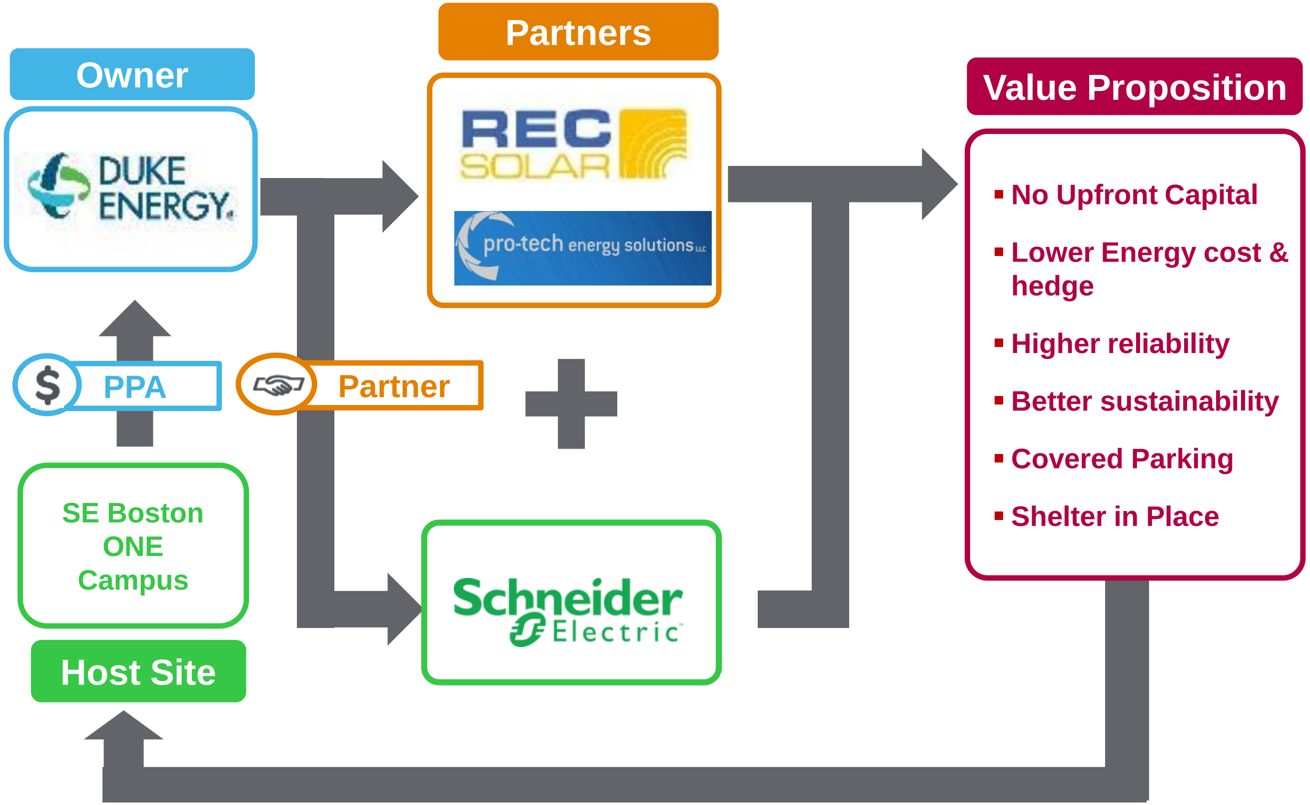
Energy as a Service – Boston ONE Campus



Benefits to Boston One Campus

- Base Rate from NGRID: 11.5c / kWh
- Green Rate from NGRID: 13.5c / kWh
- Cost of locally generated green energy from Duke: 8c / kWh. Savings of 30% from base rate and 40% from green rate
- Adding storage and facility upgrades to improve resilience raises our net rate from Duke to 9.5c / kWh. Net savings of 17% from base rate and 30% from greed rate

Case Study: Oncor

Location: Lancaster, TX (Dallas)
Completed: 2016

Overview
Oncor, a regulated electric utility, commissioned a demonstration microgrid to illustrate complex interactions between multiple distributed energy resources. The microgrid consist of (4) autonomous and dynamic zones of control, and the following DER:

- 120 kW PV Array
- 6 kW PV Array
- 200 kW Tesla Battery Energy Storage System
- 65 kW Capstone Microturbine
- (3) diesel backup generators
- (1) propane backup generator

SE Project Scope

- Design, build, and commission the microgrid controller, SCADA, power monitoring, and microgrid optimization software

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

American Family Insurance

Corporate HQ & Disaster Operations

Modes of Operation

- Power Quality and Fault Direction Detection w/ Proactive CTT Island Mode, and seamless transmission back to primary sources
- Automatic system reconfiguration after loss of service entrance or generator
- Automatic load-shed and condition-based load recovery and management after blackout
- Demand response / Curtailment modes including generator operation and load shedding
- Full manual options

- Located in Madison, WI
- (4) Service Entrances
- (4) Diesel Generators
- (20+) Automated Substations

Bear Creek Mountain Resort & Conference Center

- Located on more than 330 acres in Berks County, Pennsylvania.
- The resort has gone thru several expansions, adding a 65-room hotel, multiple additions to ski lifts, a new pump house, and 125 high-powered snow guns.
- There is a 5 MVA cap on incoming power from the Utility due to transmission constraint
- In warmer weather, the resort must run in “heavy snow-making mode” the resulting facility load can reach 7.2 MVA.

BEAR CREEK MOUNTAIN • RESORT

Solution Includes

- Load forecasting algorithm
- Menu driven load prioritization
- Automatic load and generator management

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Greenlys

- Smart grid functionality in Grenoble and Lyon, France, to benefit C&I and residential end users
    - Standardize and showcase a functional smart grid that integrates consumer, facilities renewable energy (solar, CHP, etc.), electric vehicles, and smart meters
    - Ultimately incorporates over 1,000 residential customers and 40 commercial building sites
    - 43 million Euros investment over 4 years (2012-2016)