Schneider Electric Microgrid Solutions

Microgrids-at-Scale… based on Smartly-Connected Distributed Energy Resources

Andy Haun, Chief Technology Officer - Microgrids Business

http://microgrids.schneider-electric.us/

Schneider Electric, the Global Specialist in Energy Management and Automation

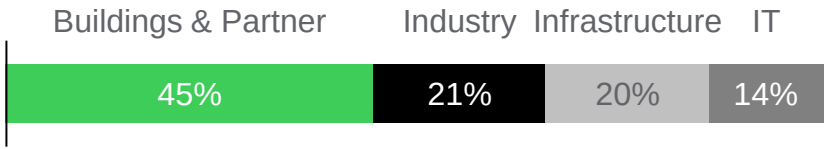
€26.6 billion
FY 2015 revenues

~5%
of FY revenues devoted to R&D

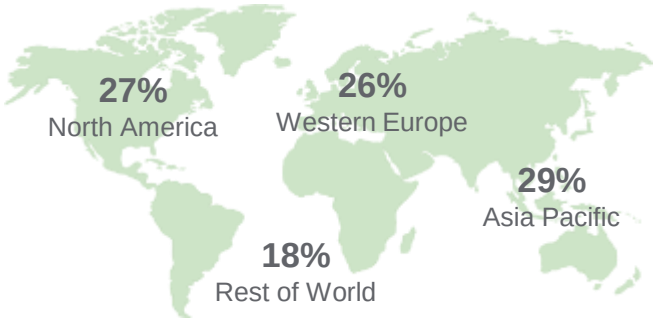
160,000+
people in 100+ countries

Four integrated and synergetic businesses

FY 2015 revenues



Balanced geographies – FY 2015 revenues

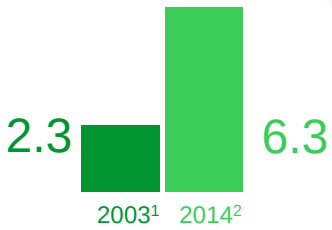


Schneider Electric Global Business in Over **100 Countries**

North America

33,700 Employees[3]

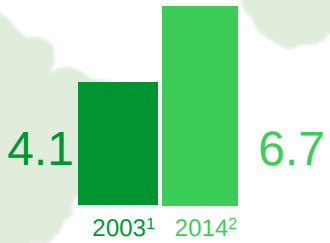
38 Factories



Western Europe

47,600 Employees[3]

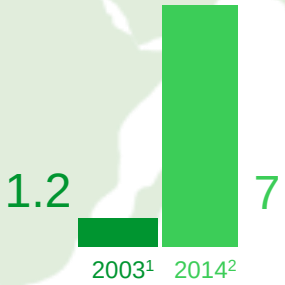
92 Factories



Asia Pacific

61,500 Employees[3]
Including JV

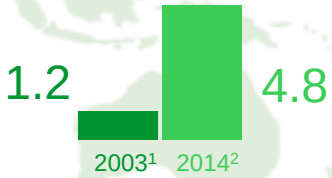
77 Factories
Including JV



Rest of the World

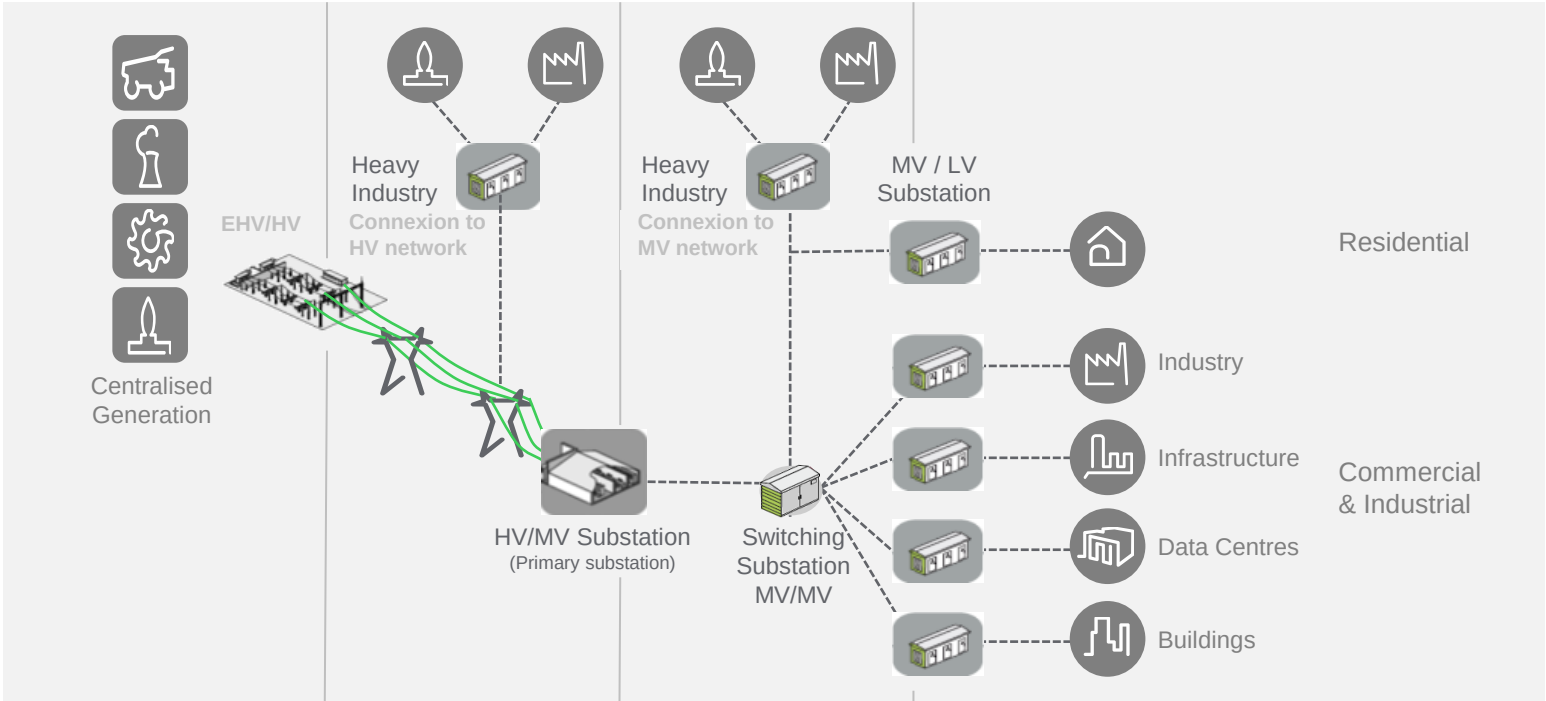
34,100 Employees[3]

38 Factories



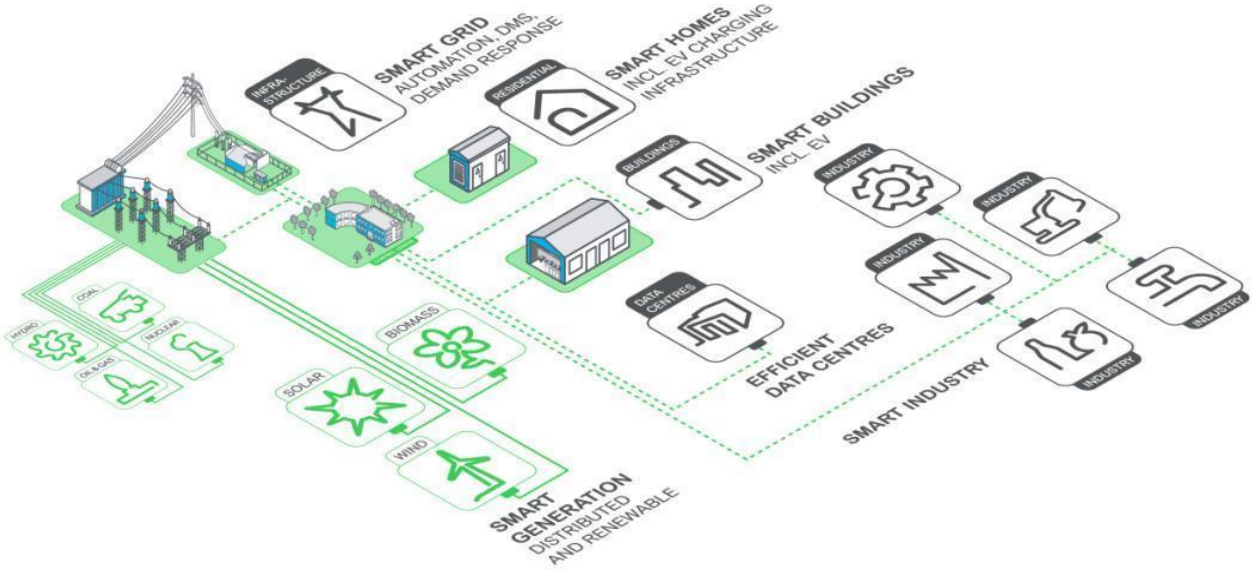
1: Published figures in billion € restated to reflect country-market view;
2: Billion € pro-forma basis including LTM Sep 2014 revenue for Invensys
3: Including Invensys, excluding Delixi and Fuji

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



The new World of Energy: Electricity is…

Distributed & Connected

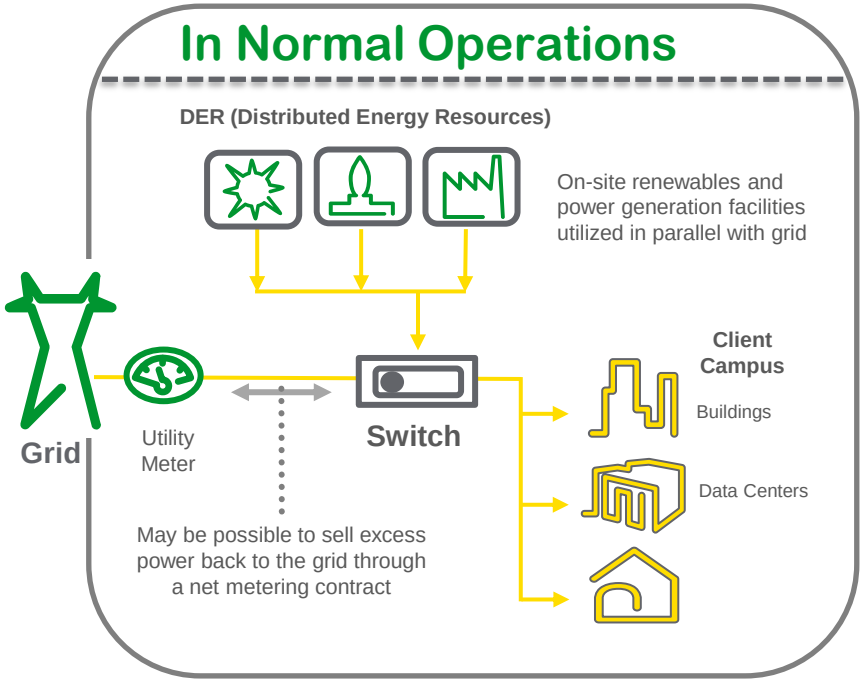


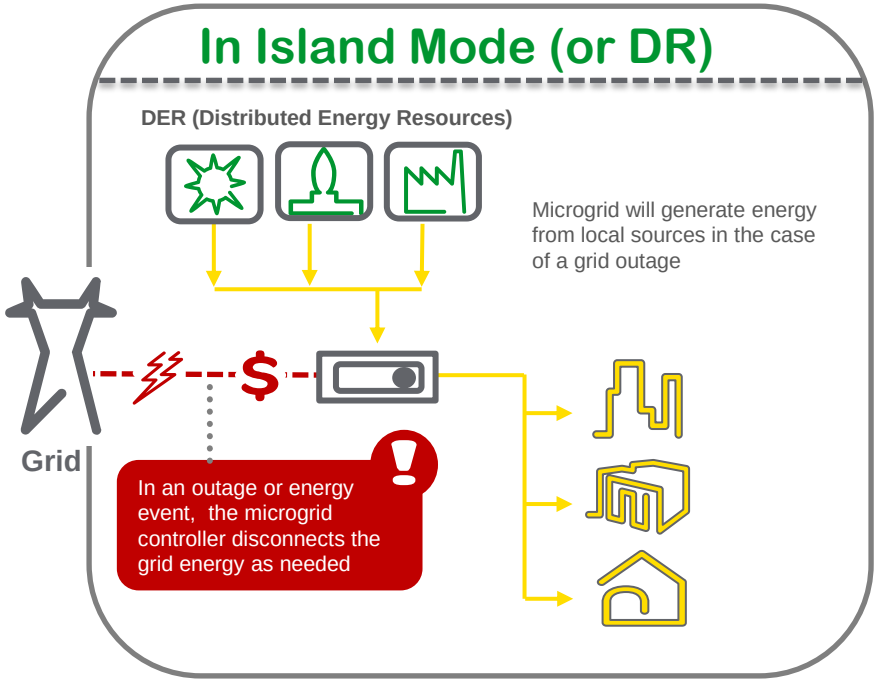
Smart Grid + **Distributed Generation** + **Efficient Demand**

CONNECTED FROM PLANT TO PLUG

What is a Microgrid?

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





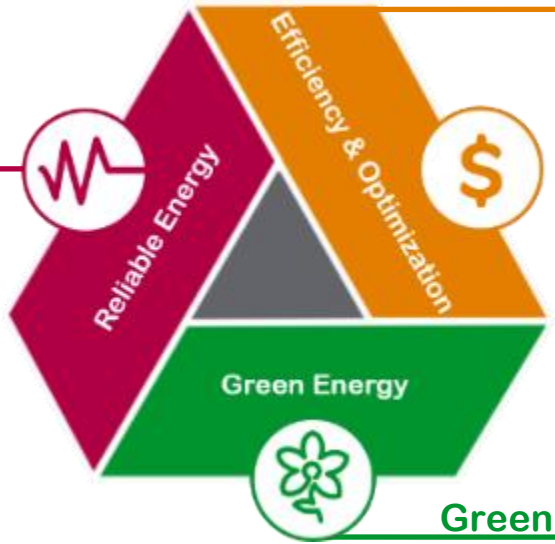
… as a single entity, can be controlled and operated in parallel with the grid or in an intentional *islanded* mode.

Microgrid Value Proposition

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

Reliable Energy

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



Efficiency & Optimization

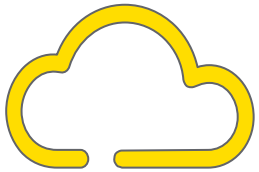
- Minimize energy costs
- Harness combined heat and power
- Maximize incentives
- Monetize energy flexibility with the grid

Green Energy

- Incorporate low cost solar & low emission DER
- Implement net-zero projects
- Reduce green house gases

Highlight - Microgrid Components

Microgrid Control & Event Management



Cloud

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

StruxureWare™ Demand-Side Operation

Client Constraints

Weather forecast (DTN)

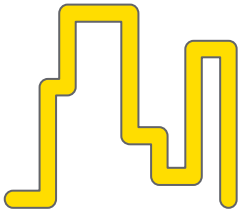
Energy market pricing

Demand response requests

DER Box

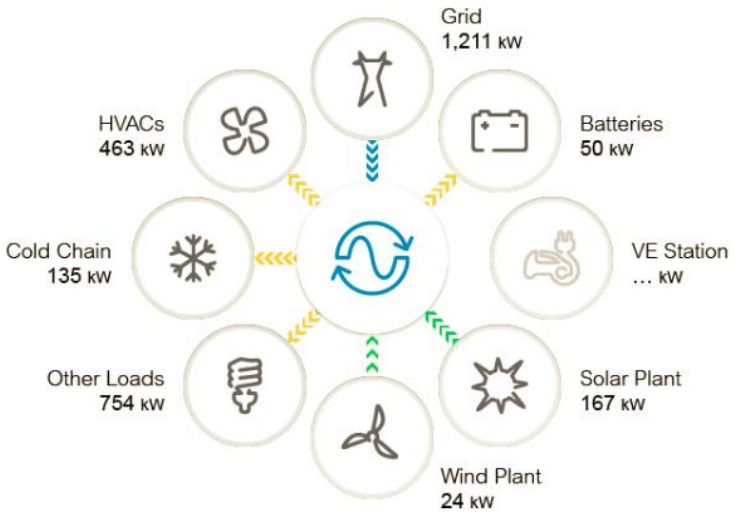
Microgrid Controller

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

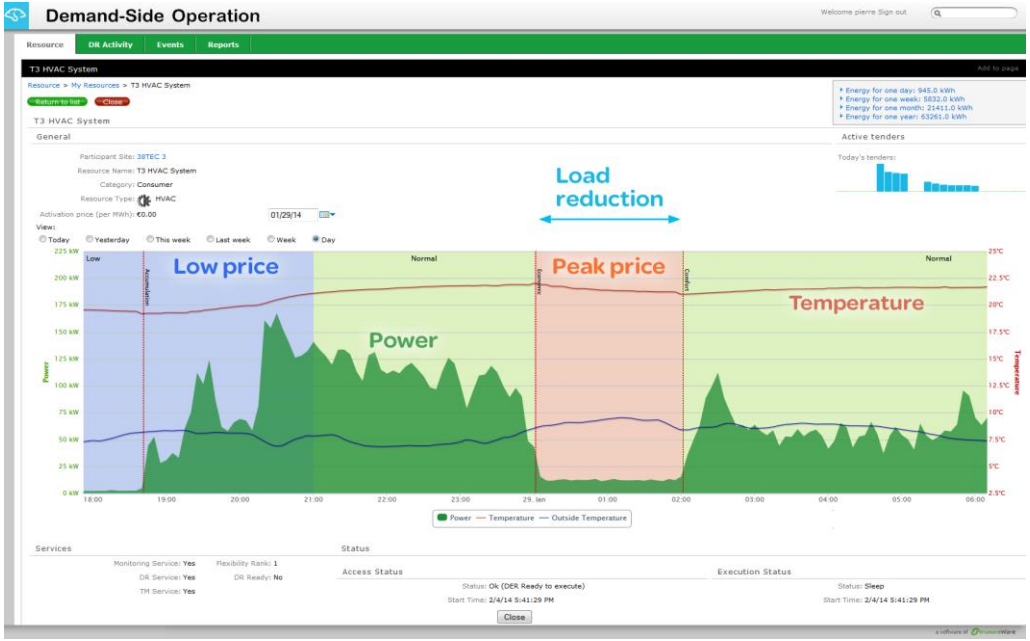


Client site

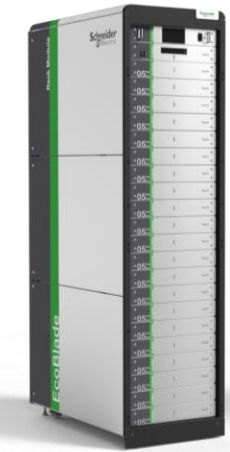
StruxureWare™ Demand-Side Operation



Advanced algorithms help make fast decisions about cost-saving opportunities



http://www2.schneider-electric.com/sites/corporate/en/products-services/smart-grid-solutions/prosumer-microgrid-solutions/commercial-industrial.page



Battery Energy Storage - The EcoBlade™

Residential	Commerical & Industrial	Utility / Independent Power Producer

Life Is On Schneider Electric

A few interesting microgrid examples

Oncor Microgrid

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***

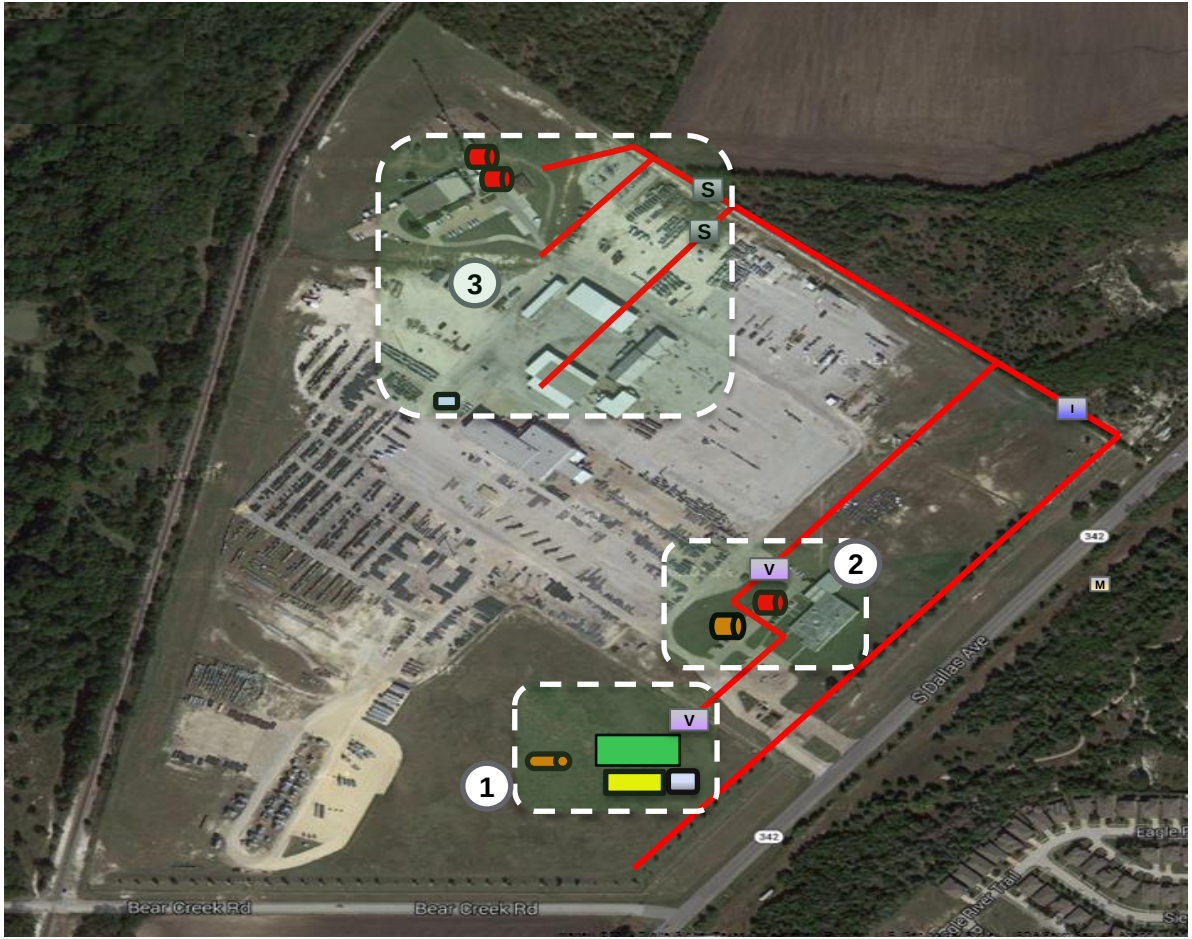
The most advanced microgrid in the US, located near Dallas, Texas

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

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 – 65kW

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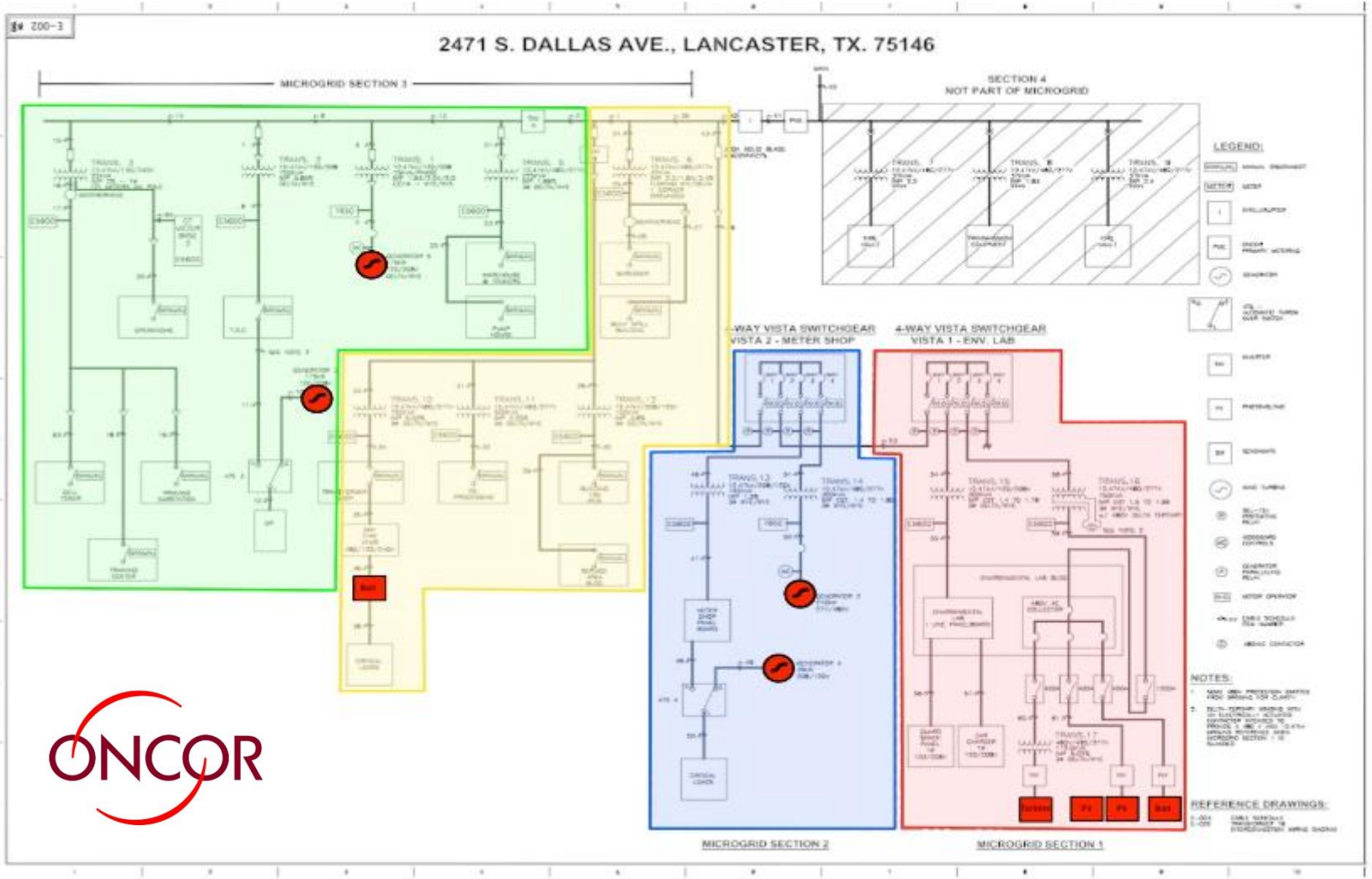

2471 S. DALLAS AVE., LANCASTER, TX. 75146
MICROGRID SECTION 3
SECTION 4
NOT PART OF MICROGRID
LEGEND:
4-WAY VISTA SWITCHGEAR
VISTA 2 - METER SHOP
4-WAY VISTA SWITCHGEAR
VISTA 1 - ENV. LAB
NOTES:
REFERENCE DRAWINGS:
MICROGRID SECTION 2
MICROGRID SECTION 1
ONCOR

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

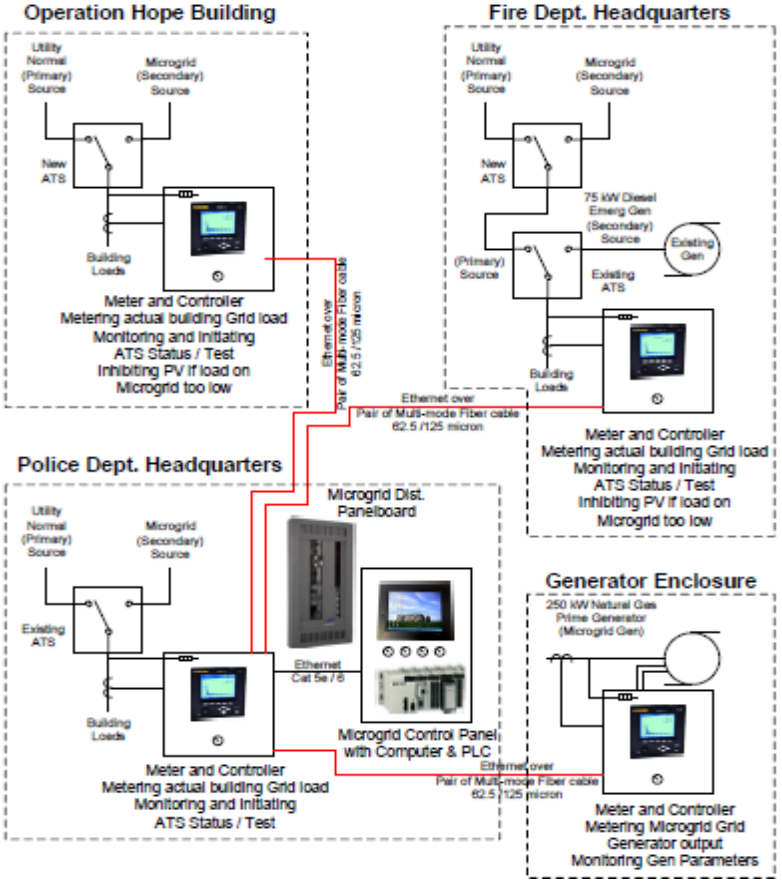
Reliable Energy

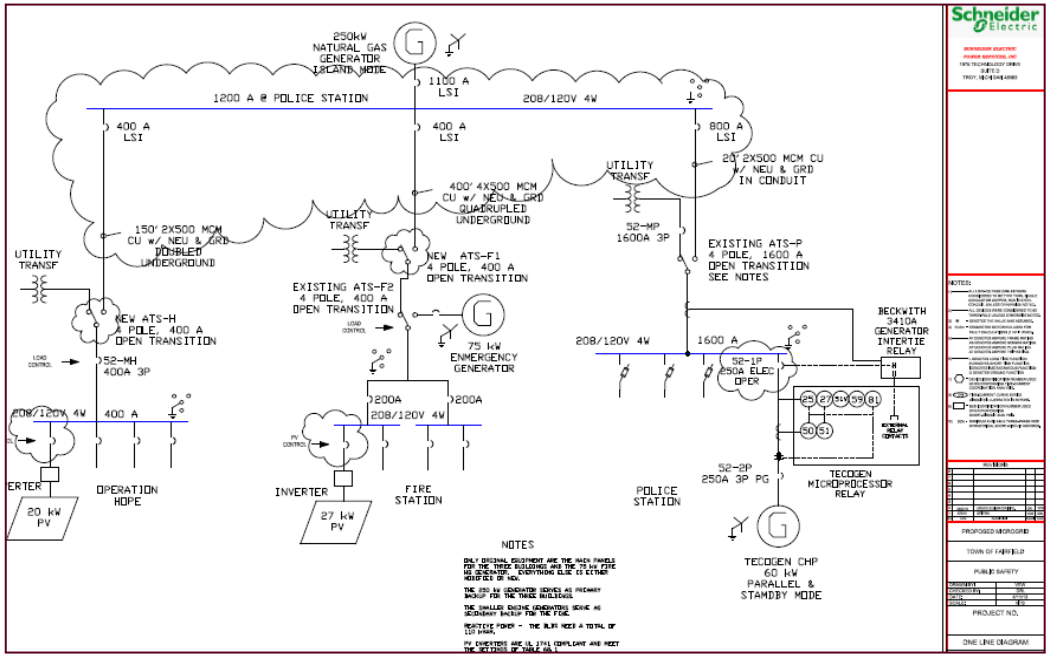
- Ensure 365/24/7 operations of critical infrastructure, including police and fire HQ, emergency comm center, cell phone tower service, and homeless shelter.

Green Energy

- Installed PV system at Fire HQ
- Use natural gas fired CHP generators

Town of Fairfield Advanced Microgrid





US Department of Energy Solar Decathlon Microgrids

Schneider Electric is the proud sponsor of this innovative collegiate competition providing the site microgrid since 2009

2011 Project at a Glance

- Washington, DC (Irvine, Ca in 2013 & 2015)
- Designed, built, and interconnected the sites Net Zero Microgrid
- 19 Connected solar powered homes
- 187 kW peak load
- 87 kW peak export to utility
- 0.5% voltage regulation
- Built to IEC, NEC, and NFPA standards

Reliable Energy

- Ensure 365/24/7 operations of competition microgrid
- Managed the microgrid with 19 unique Solar PV generators

Green Energy

- 100% solar PV generation

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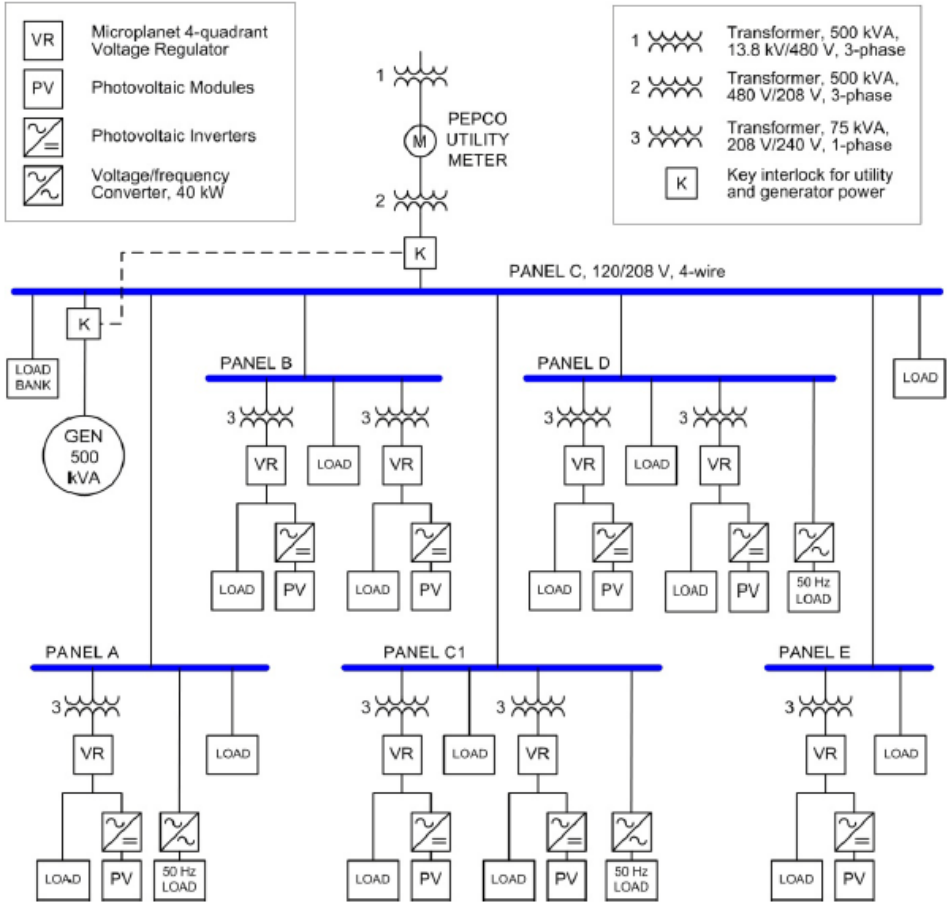
Solar Decathlon Microgrid 2011



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