Microgrids-as-a-Service

A New Approach to Solve Resiliency, Efficiency and Sustainability Challenges

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Energy Megatrends – Creating New Energy Landscape




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

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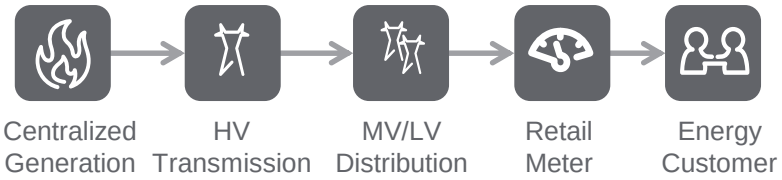
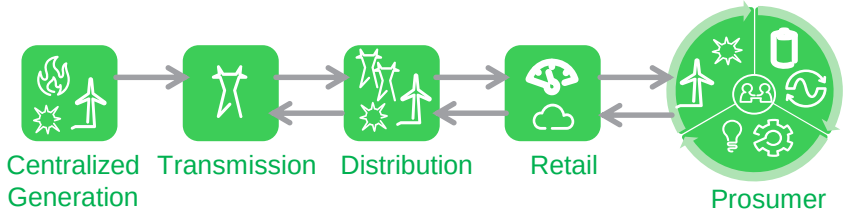
Energy Megatrends – Creating the New Energy Landscape

Decarbonization | **Digitization** | **Decentralization** | **+ More Energy**

Historical Energy Value Chain



The New Energy Landscape



- 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

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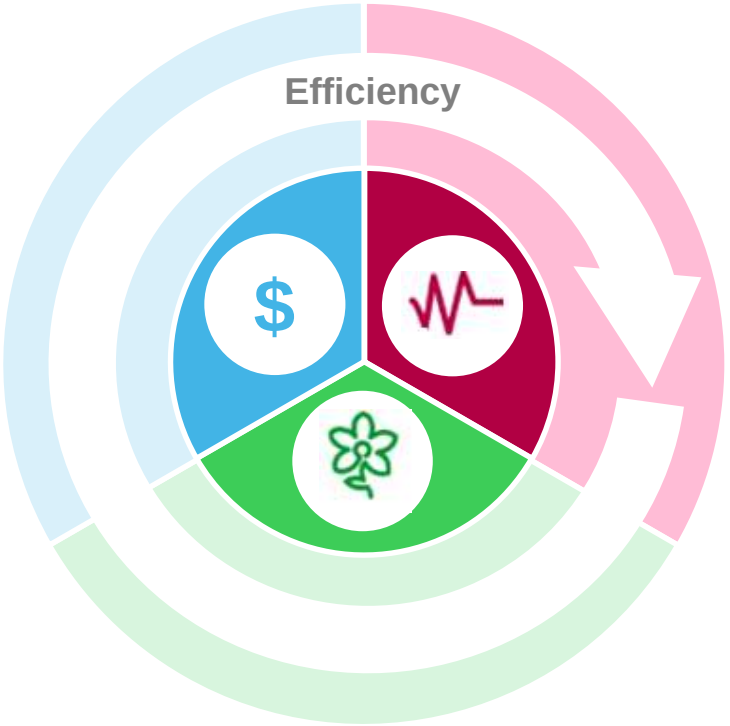
What New Energy “Prosumers” are looking for



Cost

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

Resilience

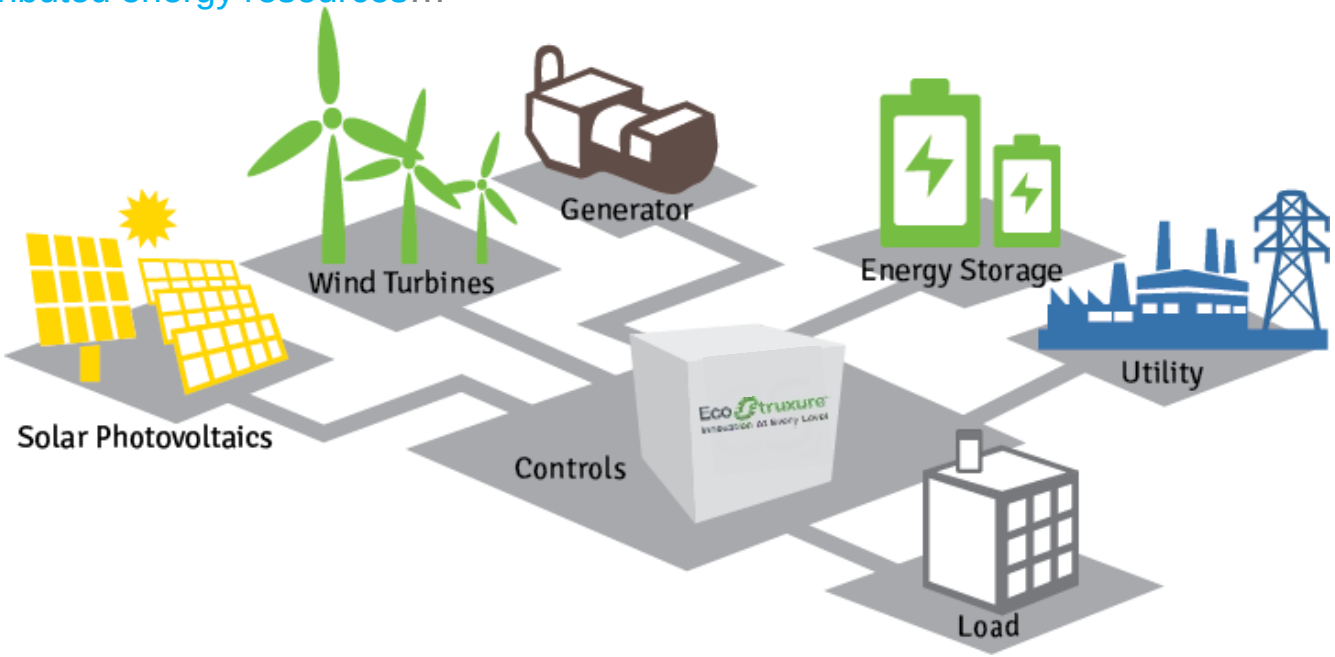
- Serve loads during times of grid instability
- Oasis for employees / customers – shelter in place
- Protect power sensitive / critical assets from poor power quality

Sustainability

- Reduce carbon footprint
- Improve brand image
- Attract / Service carbon sensitive customers

What is a Microgrid?

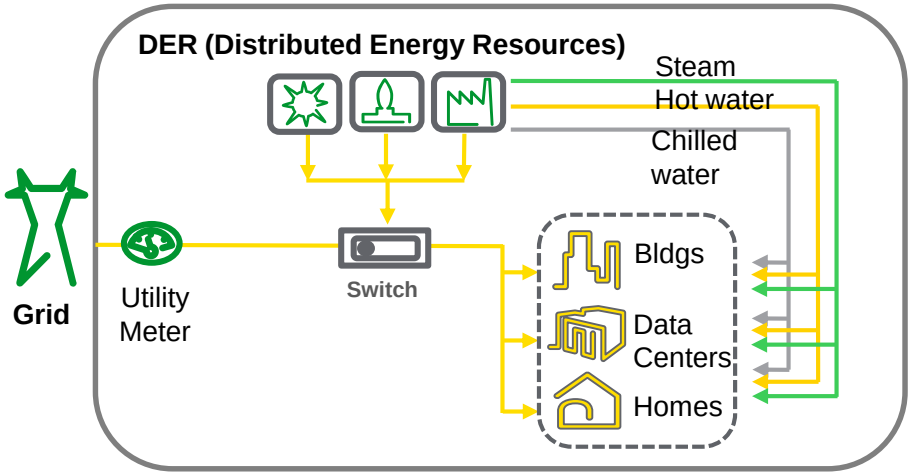
An integrated energy system consisting of interconnected loads and distributed energy resources…



…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”

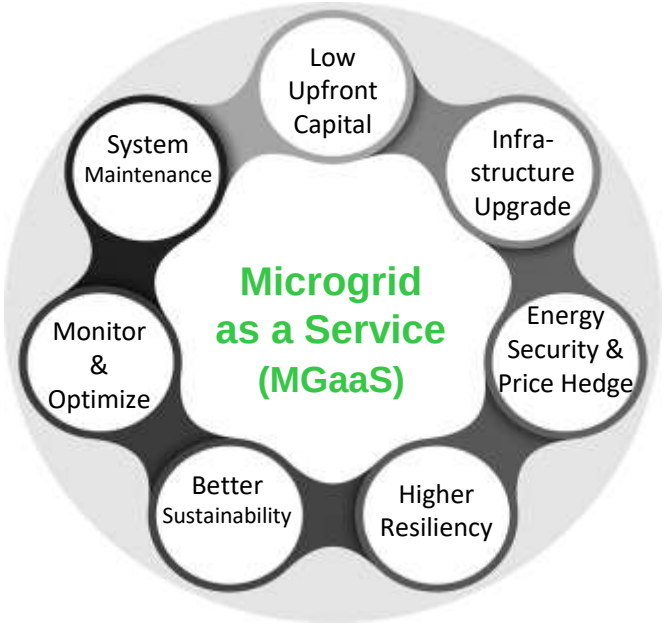
CAPEX (or EPC) Business Model

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

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 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.

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Microgrid-as-a-Service Case Study
SE NAM Boston One Campus

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**

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Prosumers have varying degrees of supply and demand flexibility

The more flexibility the better the optimization

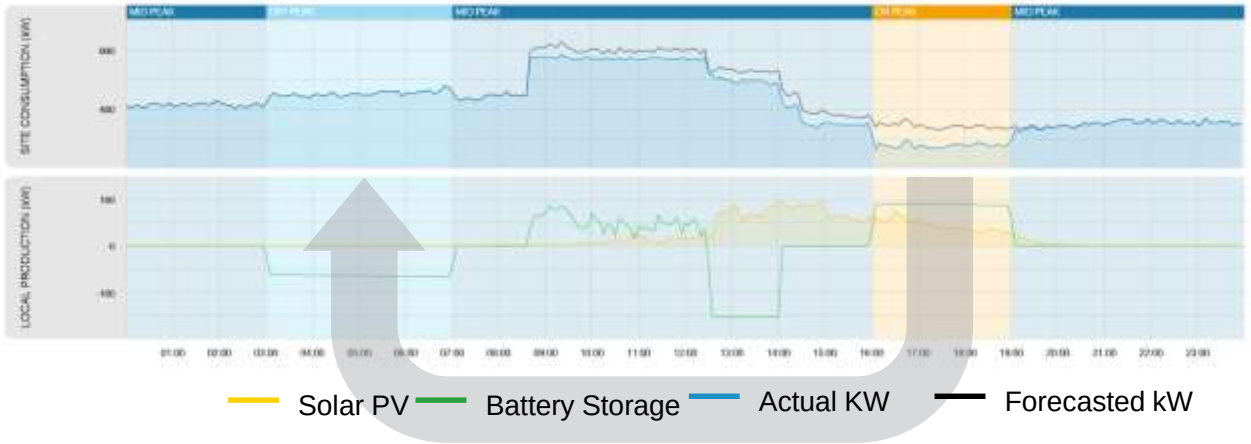
Lights and Motors
Grid and Solar

Lights and EV Charging
Grid, Solar and Storage

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



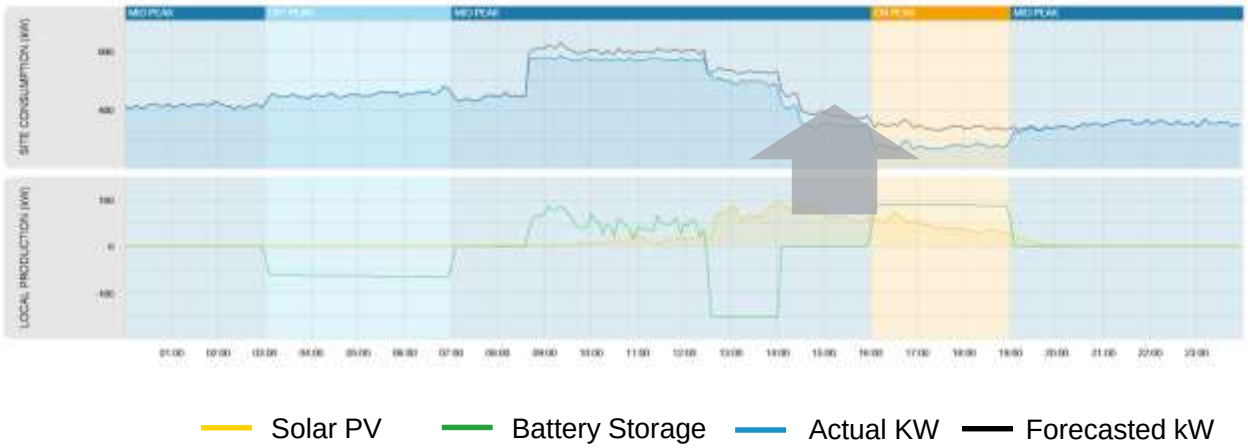
Source: Oncor – May 27, 2015

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.

Demand Limit Management – Peak Shaving

Minimize / avoid fees by shaving peak demand



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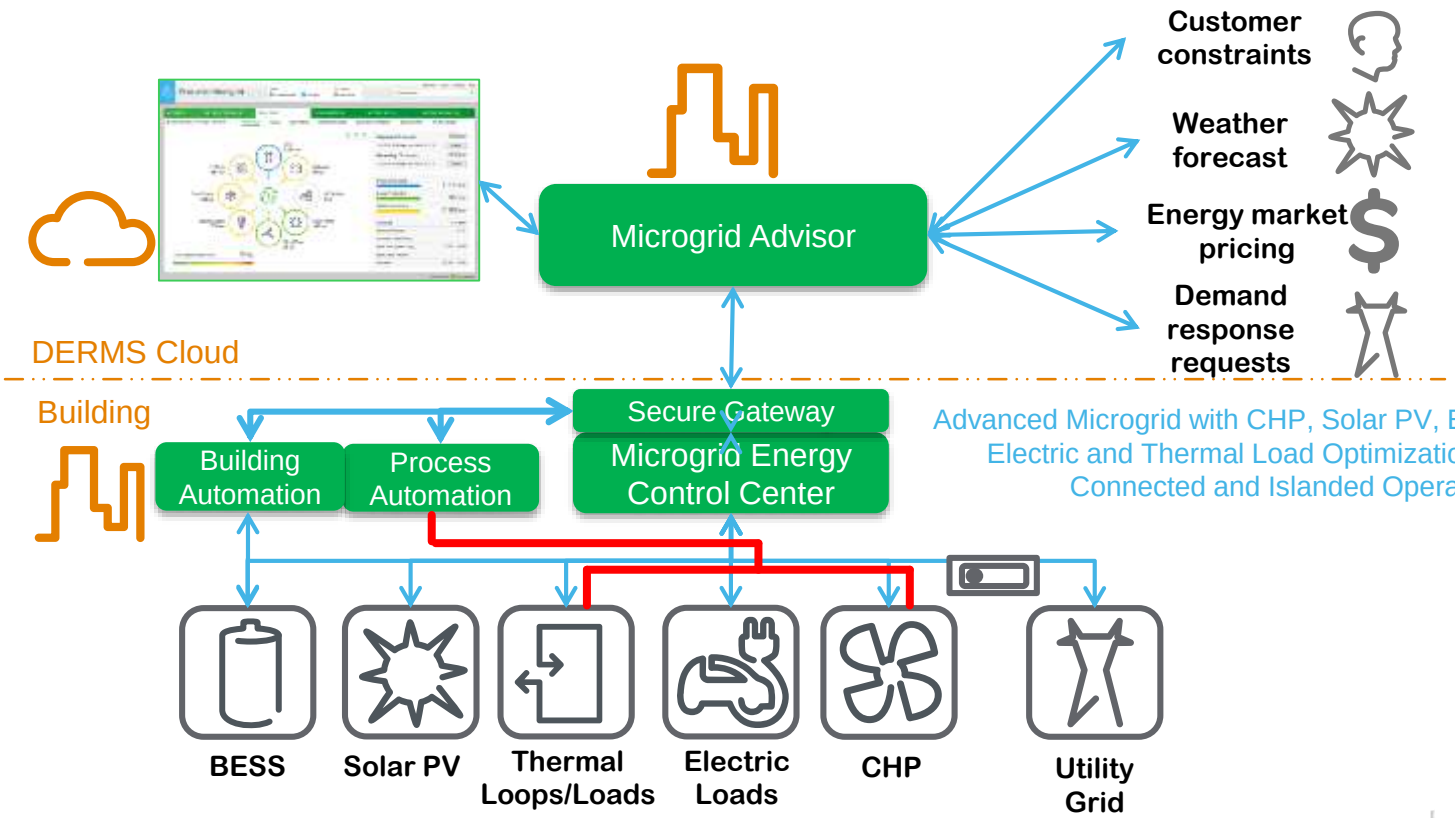
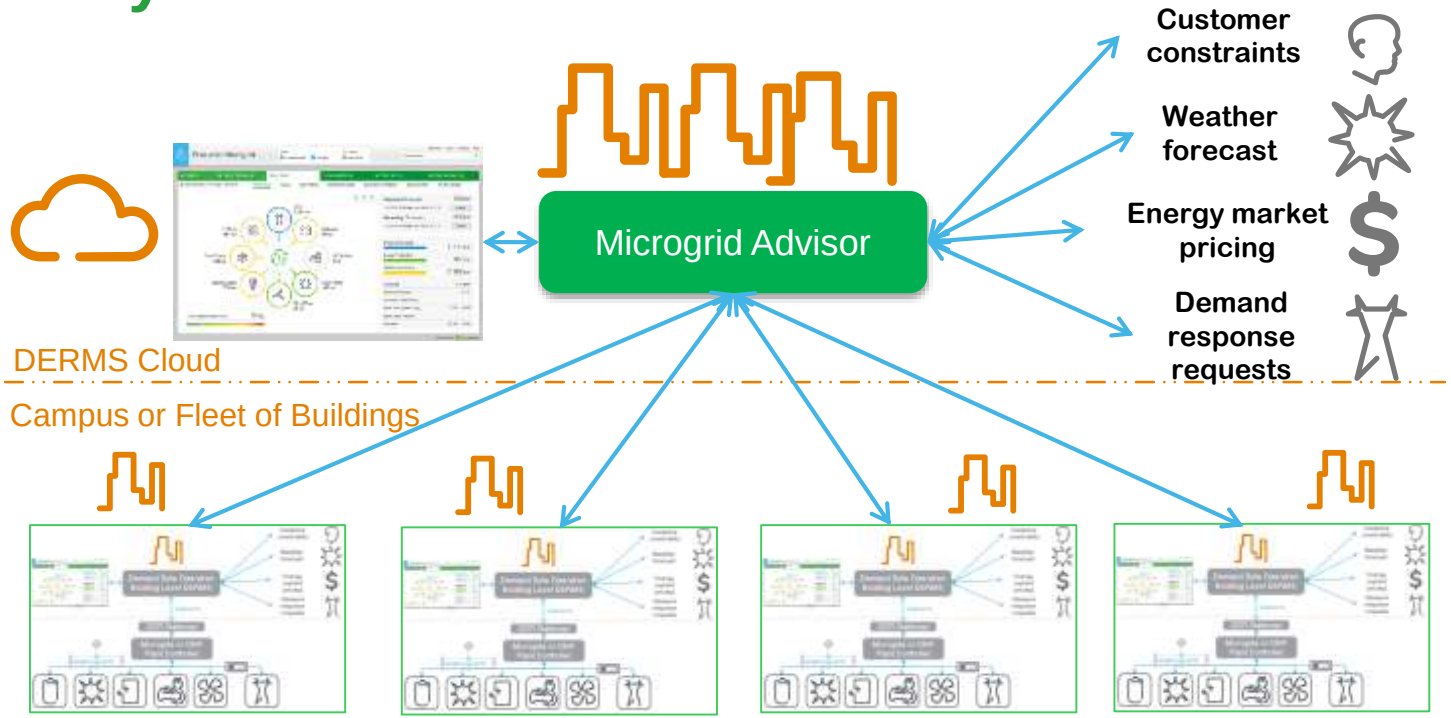
- *Example 1:* Dispatch energy storage to supply some load to avoid a peak
- *Example 2:* Shed loads (HVAC, EV Chargers, etc.) to avoid setting a peak
- *Example 3:* Sequence the start of large loads to avoid coincident peak demand

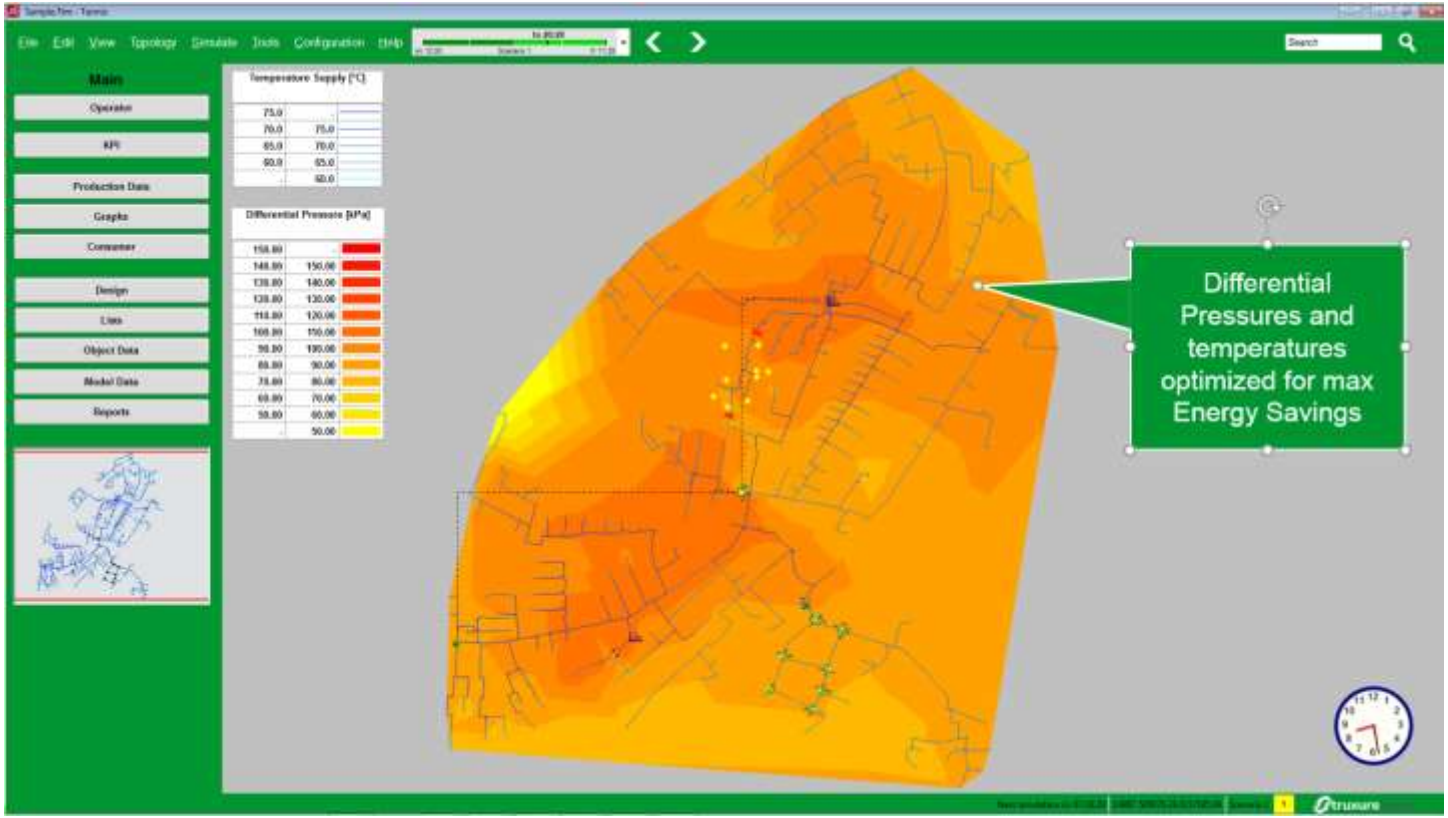
Microgrid Architecture – Building or Facility



Microgrid Architecture – City, Complex, Campus or Facility Fleet



Termis Software: CHP/District Heating and Cooling Optimization



Microgrid Energy Control Center

DERs

Wind

Genset(s) & CHP

Solar PV

Solar PV

Battery Energy Storage

Utility

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

Configuration	125kW/250kWh	250kW/500kWh	500kW/1MWh	1MW/2MWh
Power Cabinets	1	1	1	2
Battery Cabinets	2	3	6	11
Power Cabinet Est. Weight - kg	400	500	700	1400
Battery Cabinet Est. Weight - kg	2990	5850	11700	21450
BESS Est. Weight - kg	3390	6350	12400	22850
Est. SQ. FT	37.5 (3 x 2.5'x 5')	50 (4 x 2.5' x 5')	87.5 (7 x 2.5' x 5')	162.5 (13 x 2.5' x 5')

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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