

TerraSwarm



Smart Grid as the Swarm

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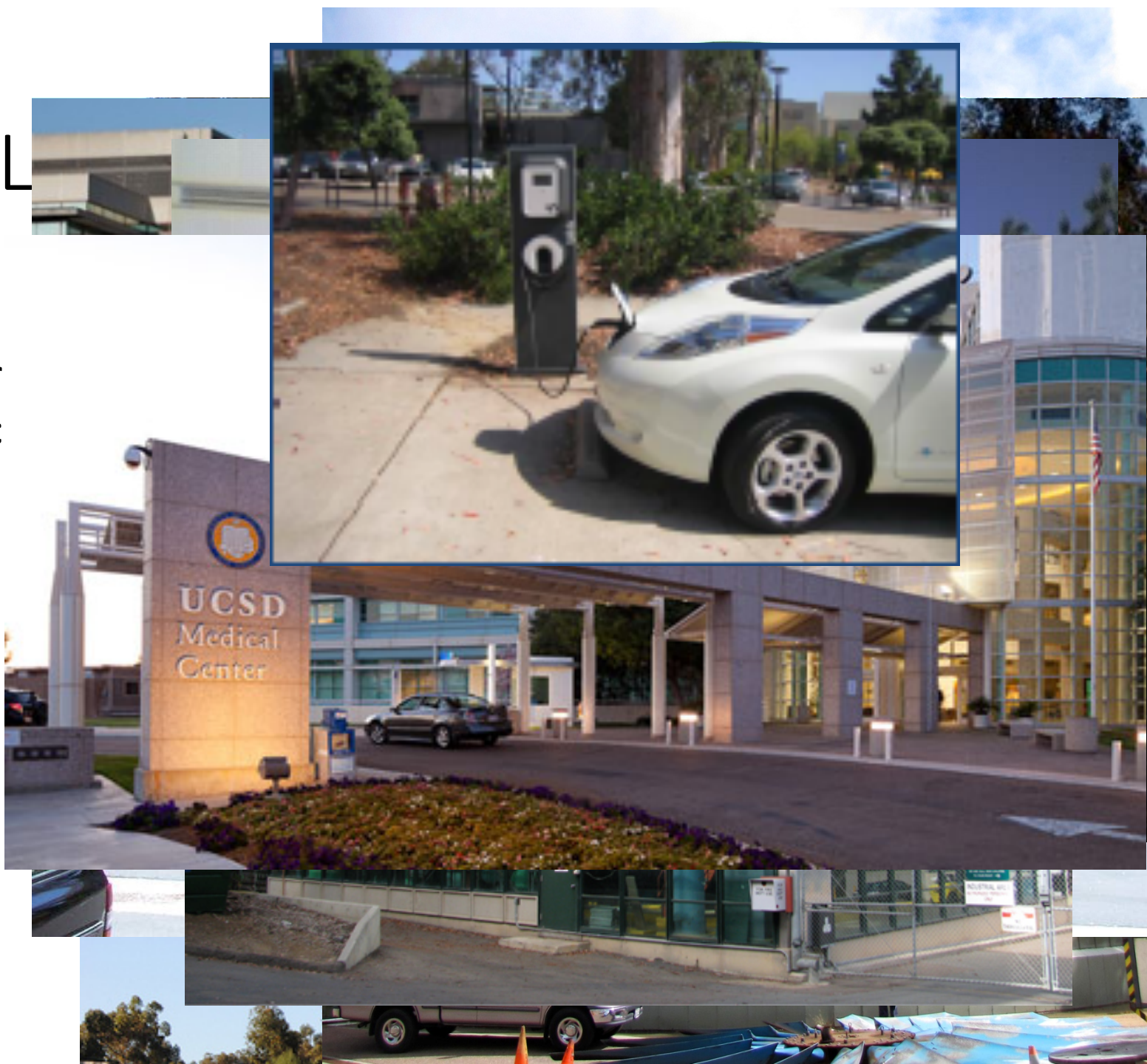


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UCSD Campus – L

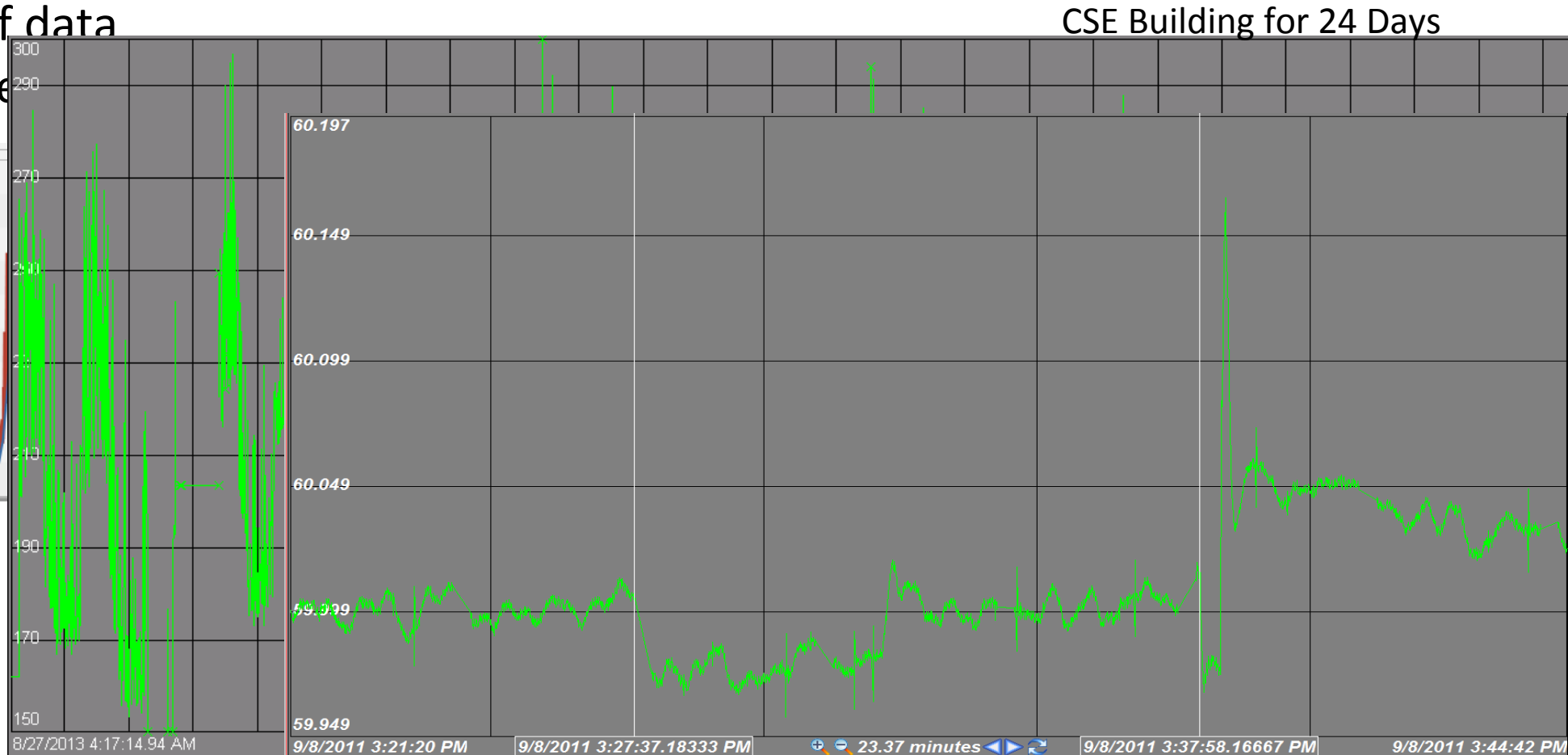
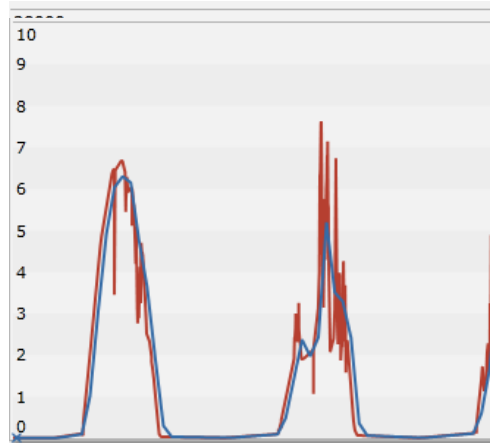
- Self Power Generation
 - Stable – Methane Power
 - Unstable – Photo Voltaic
 - Heat and Power Storage
- Different Types of Loads
 - Single Student Housing
 - Office Buildings
 - Medical Institute
 - Supercomputer Center
 - Electric Vehicles
 - EV Charging Stations





UCSD Parameter Database:

- More than 85000 Parameters
- Up to 2 years of data
- Phasor Measurement



Residential

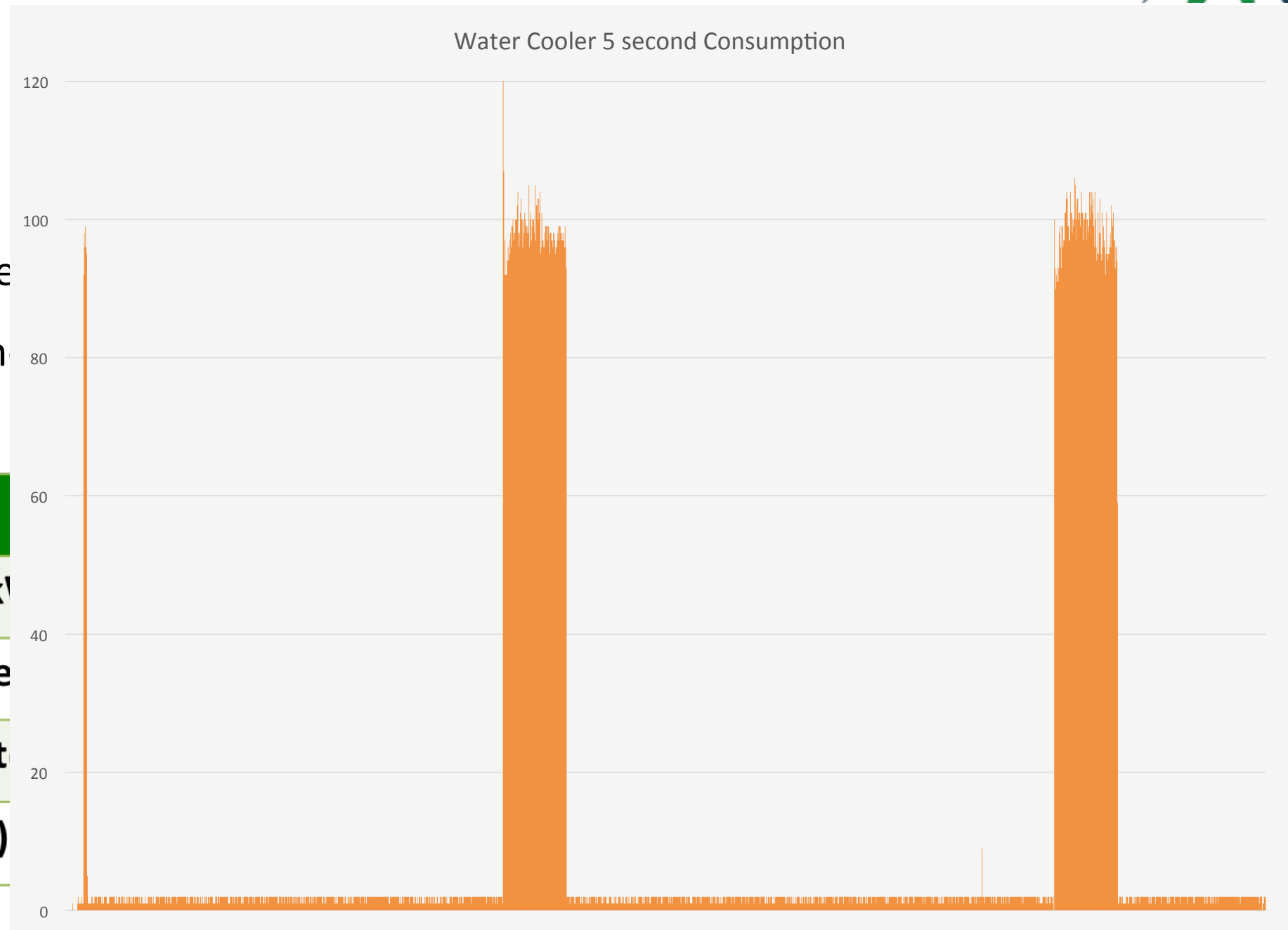
- Residential power
- Simulation: Home
- Instrumentation

Total Grid Energy (kWh)

Green Energy Efficiency

Green Energy Sold to Grid

Grid Energy Cost (\$)





Usage of Context Information

- Control HVAC, Lighting and Appliances
- Increase Energy Efficiency
- Preliminary Results:

HVAC Automation

Lighting Automation based on ambient temperature,

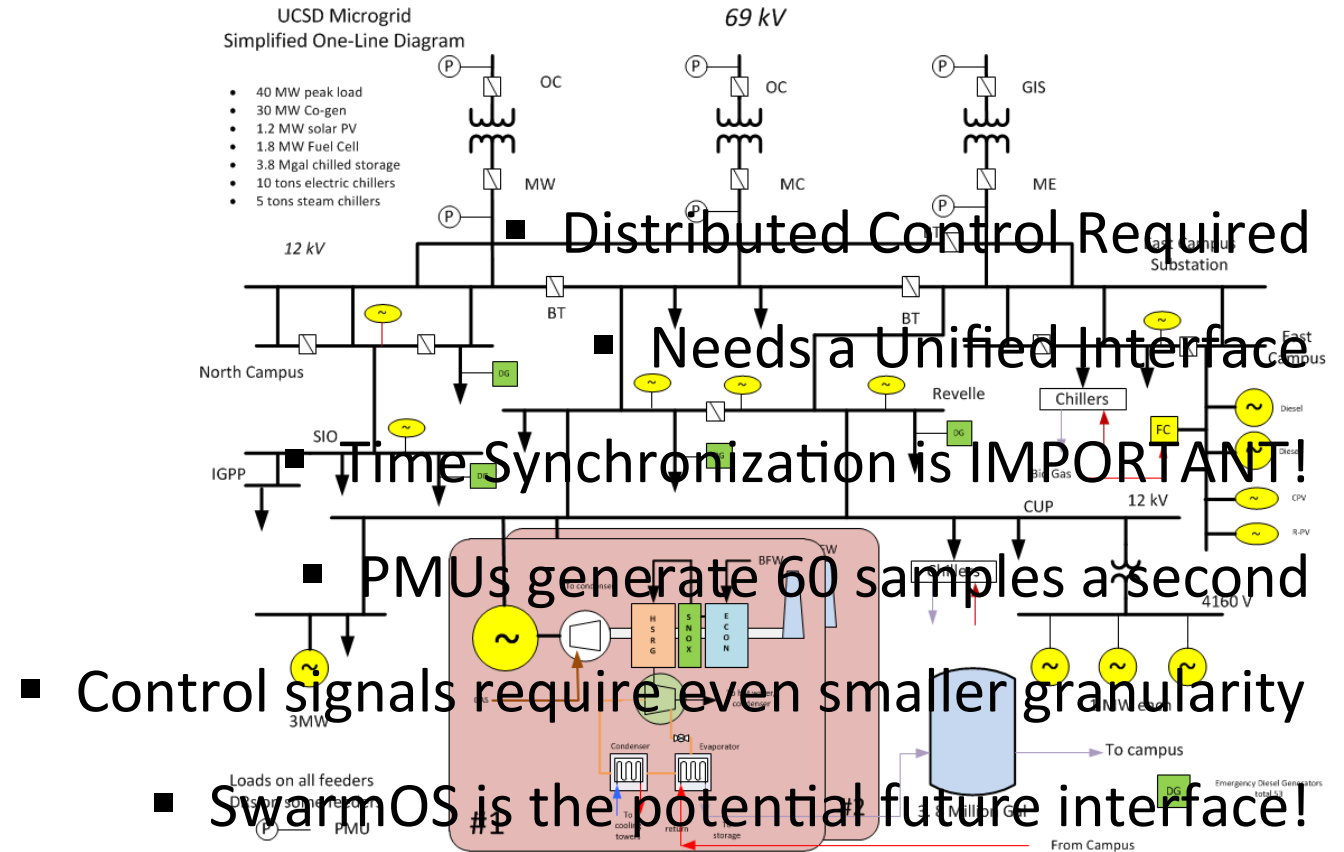
- Automated based on ambient light predefined thresholds, and user intensity and user presence occupancy

Total Energy Cost Savings up to 36%

	Energy (kWh)	Energy Price (\$/kWh)	Net Cost (\$)
Normal consumption	340.20	0.24	82.08
Context-aware consumption	270.43	0.19	52.12

UCSD Microgrid

- The Microgrid circuit is simulated and controlled in real-time
- But!, Commercial Software Used
- But2!, Central Controller





Simulation Environment using OpenDSS

- Open Source Power Flow Simulation
- Simple Interface – Time Synchronous Connection Possible
- Accepts External Simulations (UCSD's HomeSim)
- Accepts External Databases (**UCSD's** Database, **UCB's** OpenBMS, **CMU's** Sensor Andrew, ...)
- Playground for:
 - Distributed Control
 - Home Automation
 - System Stability Control
 - Energy Storage Control

