

*Exceptional service in the national interest*



# Estimating the Electrical Energy Consumption of a Building

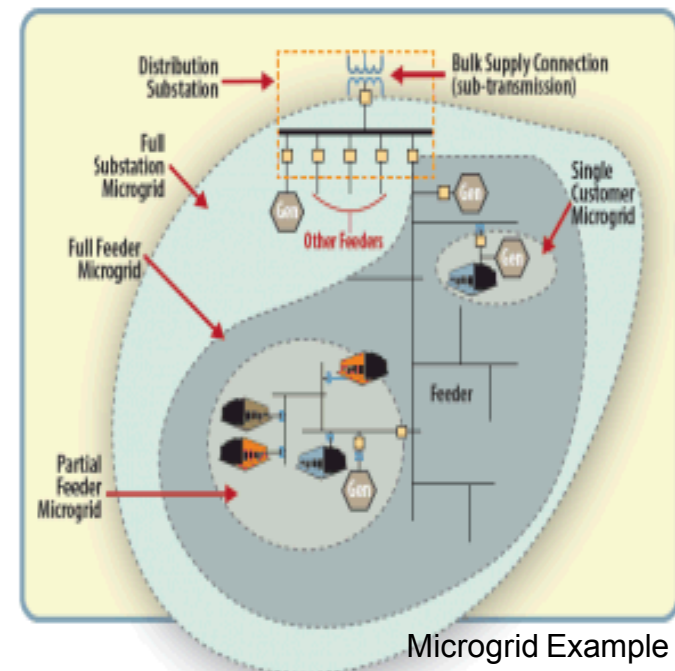
Vinson Jones (6114)

Mentor: Ben Schenkman



# Microgrid

- Microgrid < Power Grid
- Grid-Connected vs Islanded Mode
- During islanded mode the microgrid:
  - DER's
  - Responsible for own power.

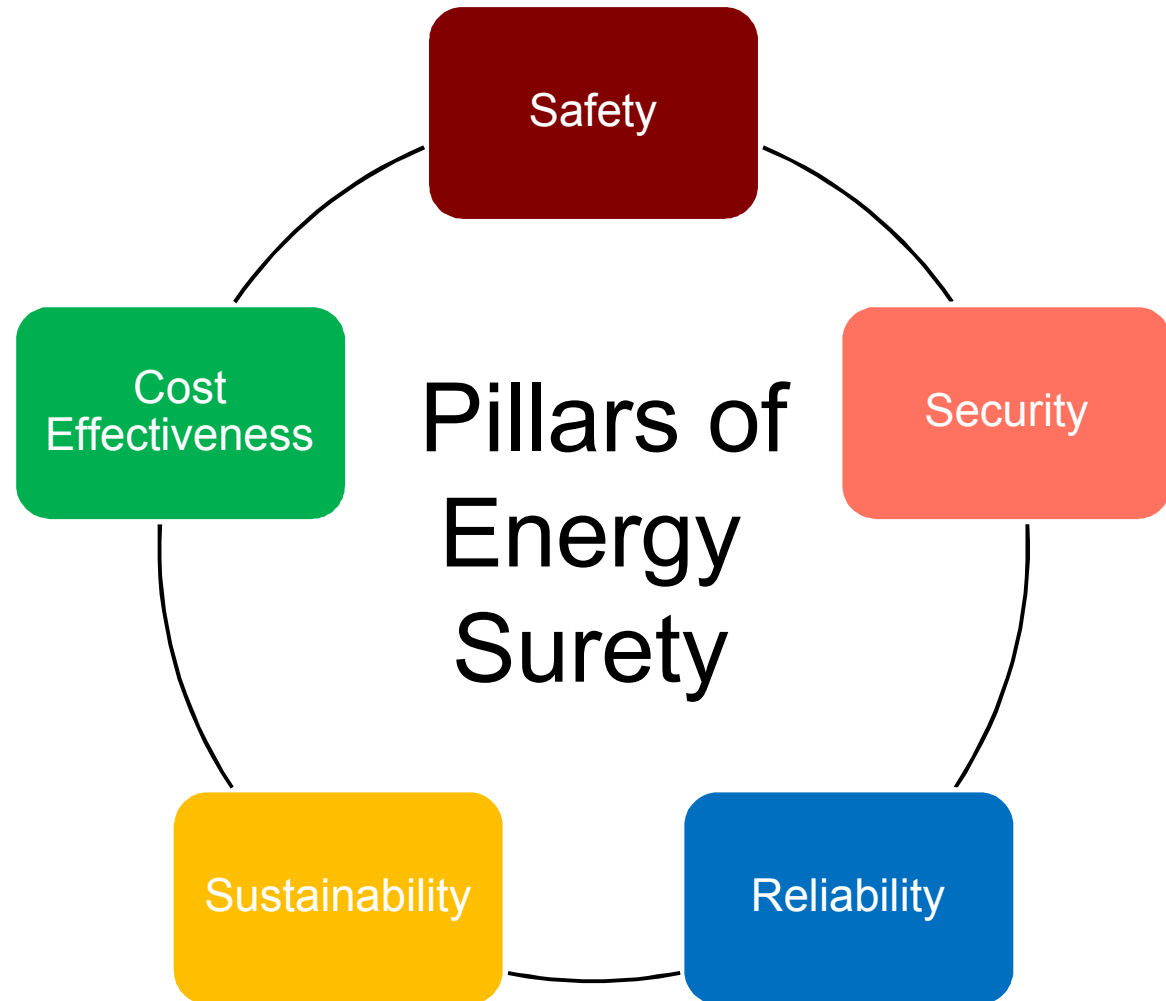


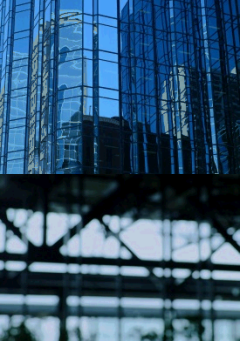
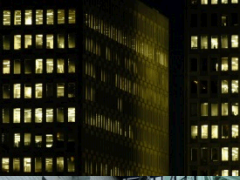
# Outline

- Purpose:
  - Load (kW/kVAR) curve for entire year.
  - Hunting for data.
- Data:
  - Openei.org
  - EnergyPlus Software

## Types of Buildings:

- Small/Medium/Large Office
- Quick/Full Service Restaurant
- Hospital
- Large/Small Hotel
- Midrise Apartment Building
- Outpatient Facilities
- Primary/Secondary schools
- Stand-alone/Strip Mall
- Retail
- Supermarket
- Warehouse





# Safety

- Without accurate estimation of energy consumption:
  - Generation can't keep up
  - Loss of power.
  - Unsafe conditions

# Reliability

- Knowing the type of load:
  - Can determine any load curve shifting

# Security

- Need to know the consumption of critical loads.



# Sustainability

- High penetration of renewables requires energy storage.



OR





# Cost Effectiveness

- Matching load and generation keeps the system efficient
- The more expensive sources aren't overused.

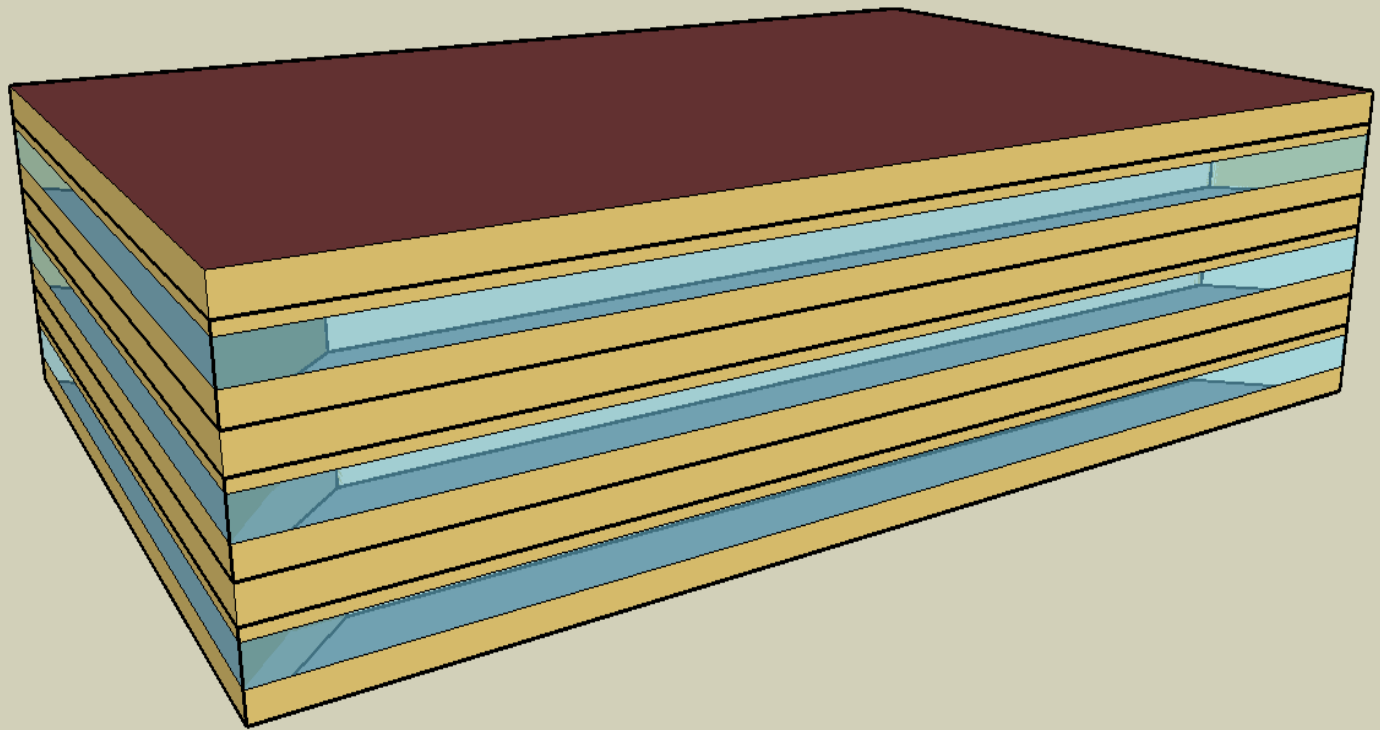


# Methods

- The hourly data found will be used to determine the affects of:
  - Climate, Location, Square Footage, HVAC ratings, building activity
- The current method:
  - The simulation curve is corrected square footage/HVAC differences.

# Methods

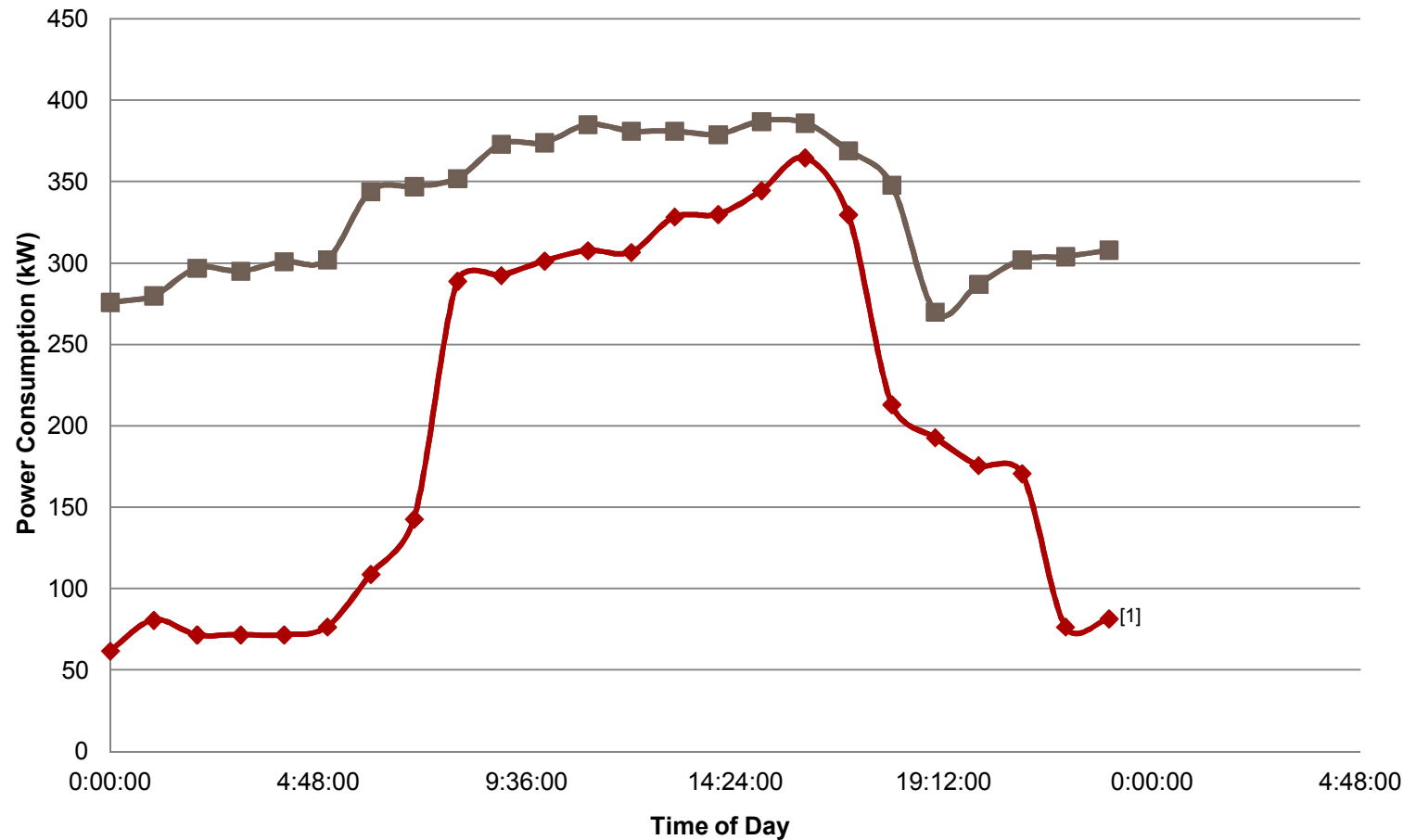
- Considering correction of base load
  - $A_{\text{peak}} = B_{\text{peak}}$  does not mean  $A_{\text{base}} = B_{\text{base}}$
- Time-Invariant input, Time-variant output
- Hierarchical Linear Models



EnergyPlus Reference Building for Medium Office

# Results to Date

## Load Curve: Actual vs. Simulation



# Future Work

- Organization of data.
- Dealing with other inputs other than square footage:
  - Location/Climate
- Determine how applicable to real commercial buildings
- Residential, Industrial

# Data Sources

- [1] United States Department of Energy. "Main Page." *Energy Information, Data, and Other Resources*. OpenEI, 13 Nov. 2012. Web. 15 July 2013.