

Management and Operation of the Electrical Grid

- Load Management is the process of balancing the supply of electricity on the network with the electrical load by adjusting or controlling the load rather than the power station.
 - This can be achieved by direct intervention of the utility in real time, by the use of frequency sensitive relays triggering circuit breakers (ripple control), by time clocks, or by using special tariffs to influence consumer behavior.
 - Load management allows utilities to reduce demand for electricity during peak usage times, which can, in turn, reduce costs by eliminating the need for peaking power plants.
 - Load management can also help reduce harmful emission, since peaking plants or backup generators are often dirtier and less efficient than base load power plants

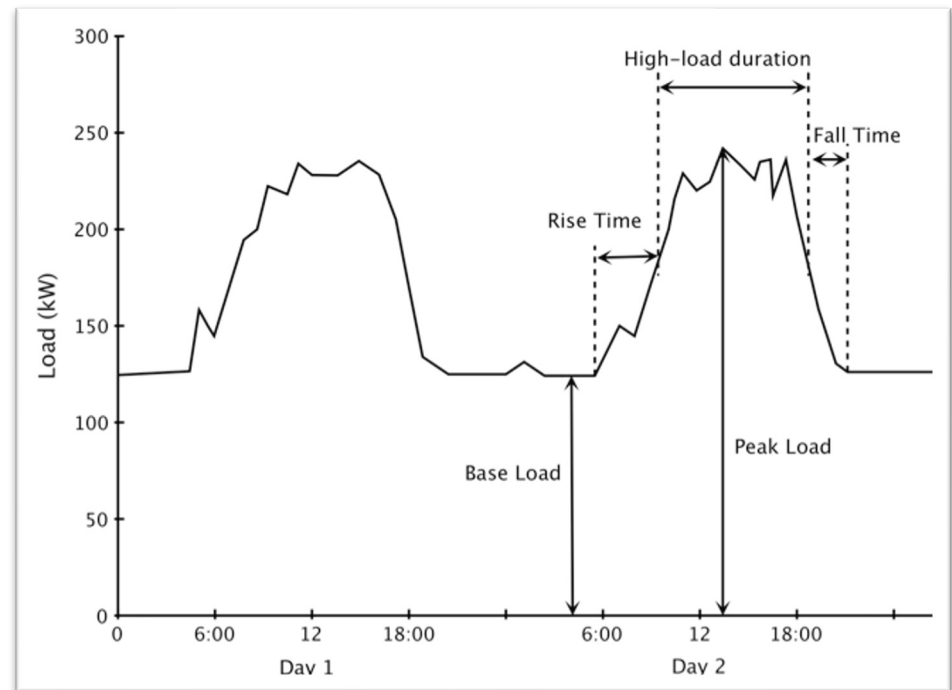
Management and Operation of the Electrical Grid

- Role of Utility in Grid Management and Operation
 - Responsible for the safe, reliable, and efficient electric transmission system including generation of electricity and natural gas
 - Purchase reliable power from a mix of convention and renewable generating sources
 - Manage substations and switching points in the electric system, connecting transmission systems to distribution
 - Responsible for the individual connections from the transmission lines to customers
- The Role California ISO (CAISO) in Grid Management and Operation
 - As the impartial grid operator; it is like the air traffic controller for the state's electricity flow:
 - Operates the high voltage grid for most of the state
 - Ensures power can flow as intended without congestion or overload
 - Keeps supply in balance with demand on a second by second basis
 - Coordinates the planning process for proposed grid expansions

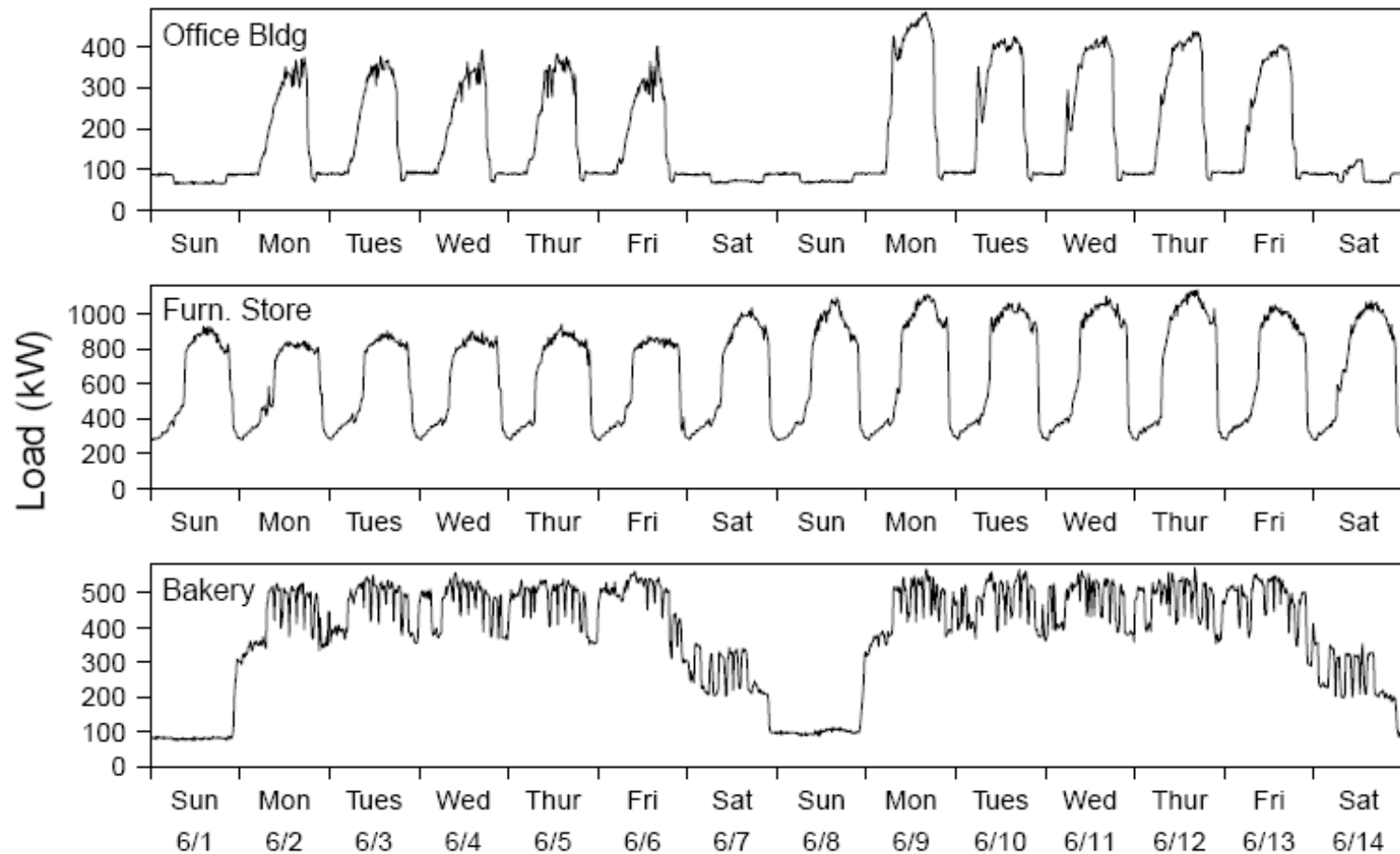
B. Load factor and billing data analysis for Demand Response and Load Shifting

Parameters for Evaluating Load Shapes

- Near-Base Load (kW): 2.5th percentile of daily load.
- Near-Peak Load (kW): 97.5th percentile of daily load.
- High-Load Duration (Hours): Duration for which load is closer to near-peak load than to near-base load.
- Rise Time (Hours): Duration for load to go from near-base load to the start of the high-load period.
- Fall Time (Hours): Duration for the load to go from the end of the high-load period to the near-base load.



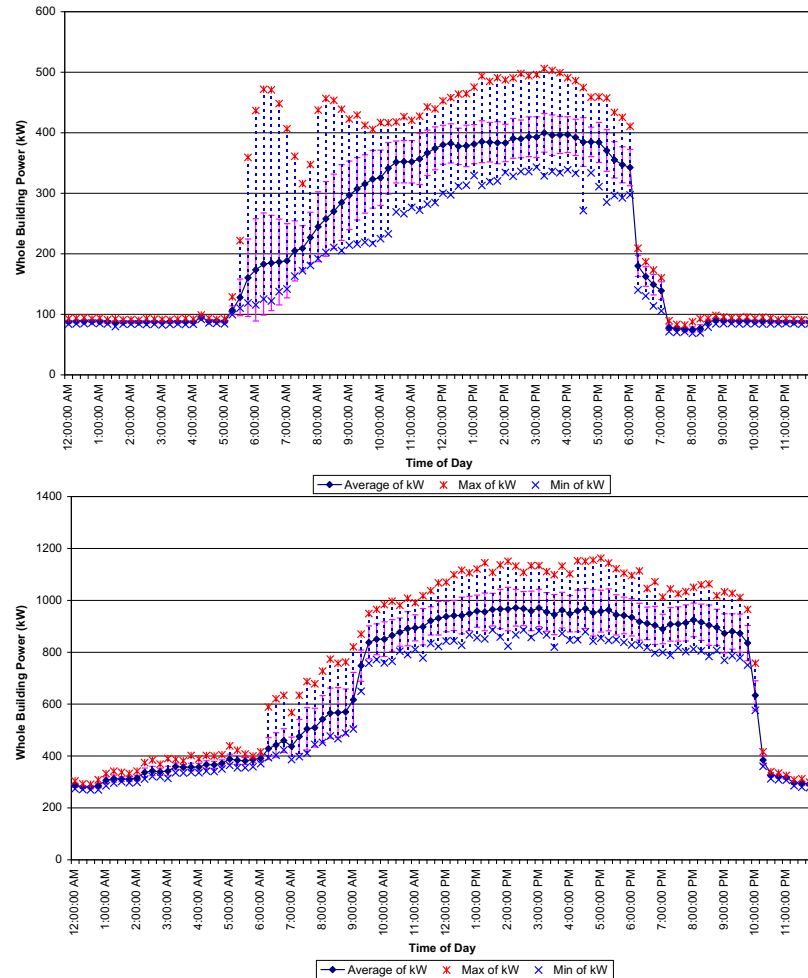
Visual Observations



Load Statistical Summary (LSS)

LSS a plot of average, minimum and maximum points for a given range of dates.

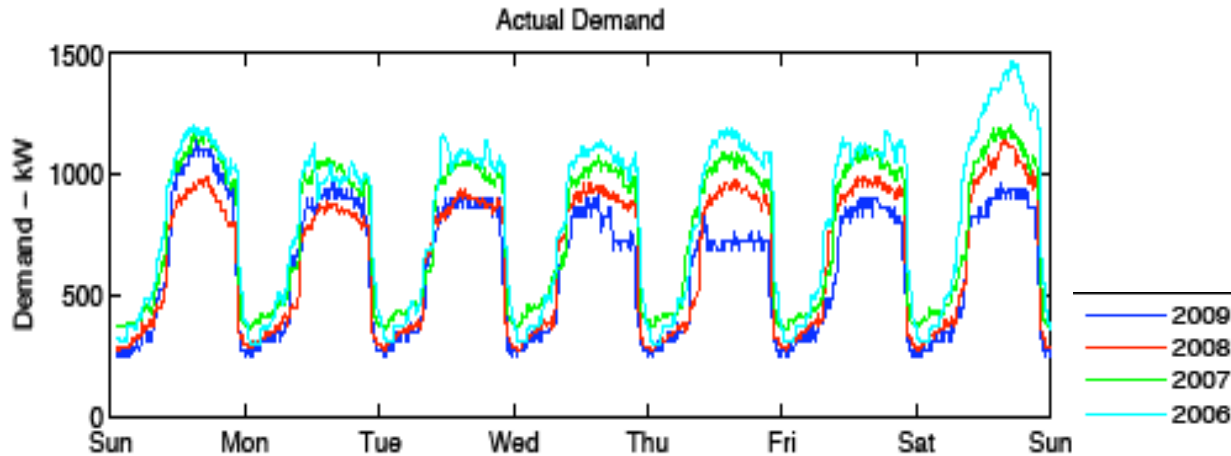
- Refined to display Near-base load and near-high load (2.5 and 97.5 percentile values) (Price 2010)



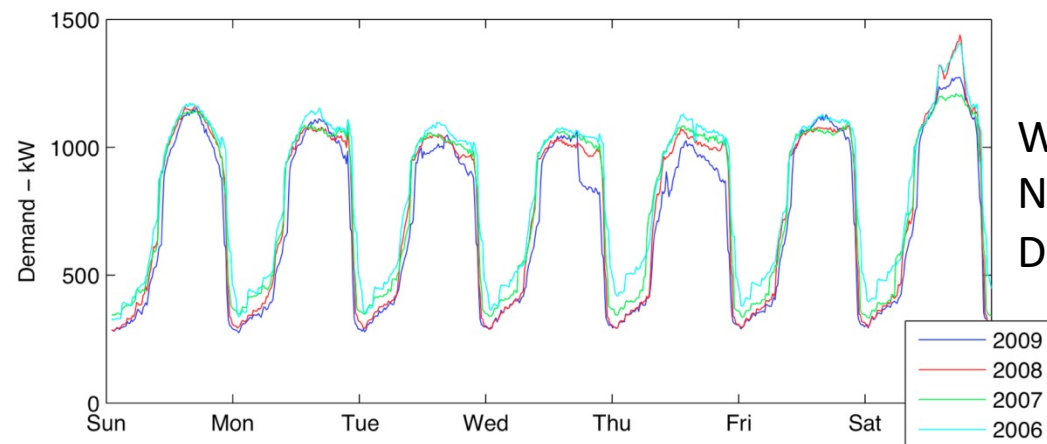
Load Variability

- Variability of each interval data within a given period is calculated using variance.
- If the loads are highly variable ($V > 15\%$), the programs that settle using a baseline may not be appropriate for the customer.

Weather Sensitivity



Rank Order
Correlation is used to
determine weather
sensitivity



Weather
Normalized
Demand

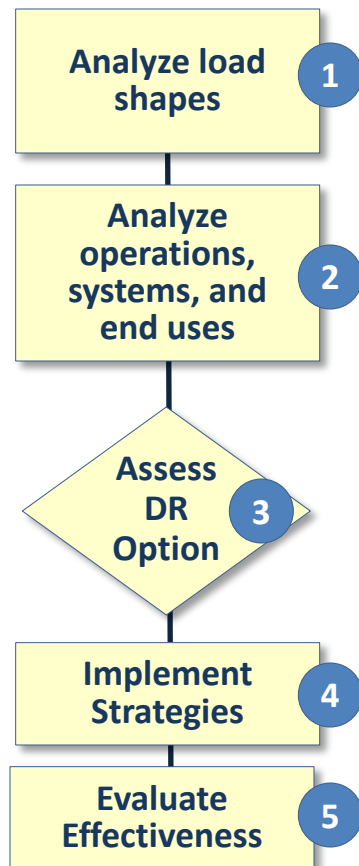
Weather Sensitivity

- Rank Order Correlation (ROC) is used to calculate weather sensitivity of buildings

$$r_s = 1 - \frac{6(\sum D^2)}{N(N^2 - 1)}$$

- Weather normalization is used anytime we need to compare building performance of weather sensitive buildings.
- Less DR opportunity in mild weather and long DR duration

DR Process



Historical data used for various purposes:

1. Visual analysis
2. Develop Load Statistical Summary
3. Evaluate Load Variability and Weather Sensitivity
4. End-use contribution to peak load.

Collect information on end uses, systems, controls and operations

What kind of DR program works for the facility? Mapping load shapes onto rates and programs

Semi- or fully-automated

Calculate shed - is it acceptable? Variable?

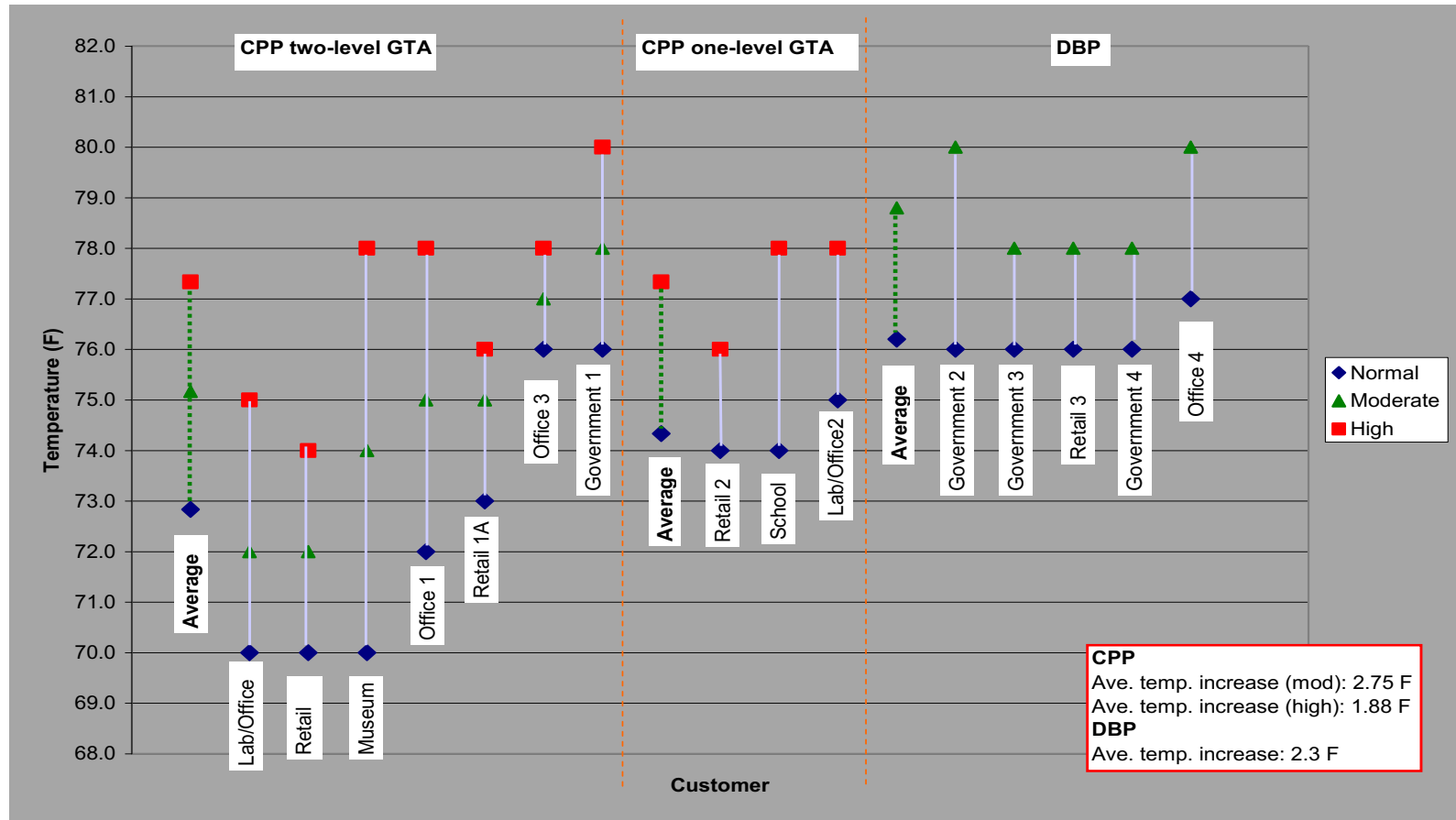
Understanding Building Operations

- Collect information on building systems, end uses and operations.
- Architectural, mechanical and electrical drawings?
- Is there any sub-metering? Trend logs?
- Any plans for energy efficiency or change in building operations?

DR Strategies

		HVAC											Lighting					Other
	Building use	Global temp. adjustment	Duct static pres. decrease	SAT Increase	Fan VFD limit	CHW temp. Increase	Fan qty. reduction	Pre-cooling	Cooling valve limit	Boiler lockout	Slow recovery	Extended shed period	Common area light dim	Office area light dim	Turn off light	Dimmable ballast	BI-level switching	Non-critical process shed
ACWD	Office, lab	X	X	X		X			X	X		X						
B of A	Office, data center		X	X	X	X			X									
Chabot	Museum	X						X										
2530 Arnold	Office	X									X							
50 Douglas	Office	X									X							
MDF	Detention facility	X																
Echelon	Hi-tech office	X	X	X			X						X	X	X	X		
Centerville	Junior Highschool	X						X										
Irvington	Highschool	X						X										
Gilead 300	Office			X														
Gilead 342	Office, Lab	X		X														
Gilead 357	Office, Lab	X		X														
IKEA EPaloAlto	Furniture retail	X																
IKEA Emeryville	Furniture retail	X																
IKEA WSacto	Furniture retail																	
Oracle Rocklin	Office	X	X															
Safeway Stockton	Supermarket																X	
Solectron	Office, Manufacture	X													X			
Svenhard's	Bakery																	X
Sybase	Hi-tech office														X			
Target Antioch	Retail	X					X											
Target Bakersfield	Retail	X					X											
Target Hayward	Retail	X					X						X				X	
Walmart Fresno	Retail	X															X	

Global Temperature Adjustment



BEST Center Curricula, Resources & Recordings

Academic Programs

Georgia Piedmont Technical College - Building Automation Systems

Milwaukee Area Technical College - Sustainable Facilities Operations

Laney College - Commercial HVAC Systems

City College San Francisco - Commercial Building Energy Analysis & Audits

Professional Development Materials, Presentations & Videos

National Institutes

Building Automation Systems Instructor Workshops

Webinars (e.g., BEST Talks)

Faculty Profile Videos

Reports & Case Studies

Marketing Resources

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