Mechanical Controls

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KEMA - Xenergy

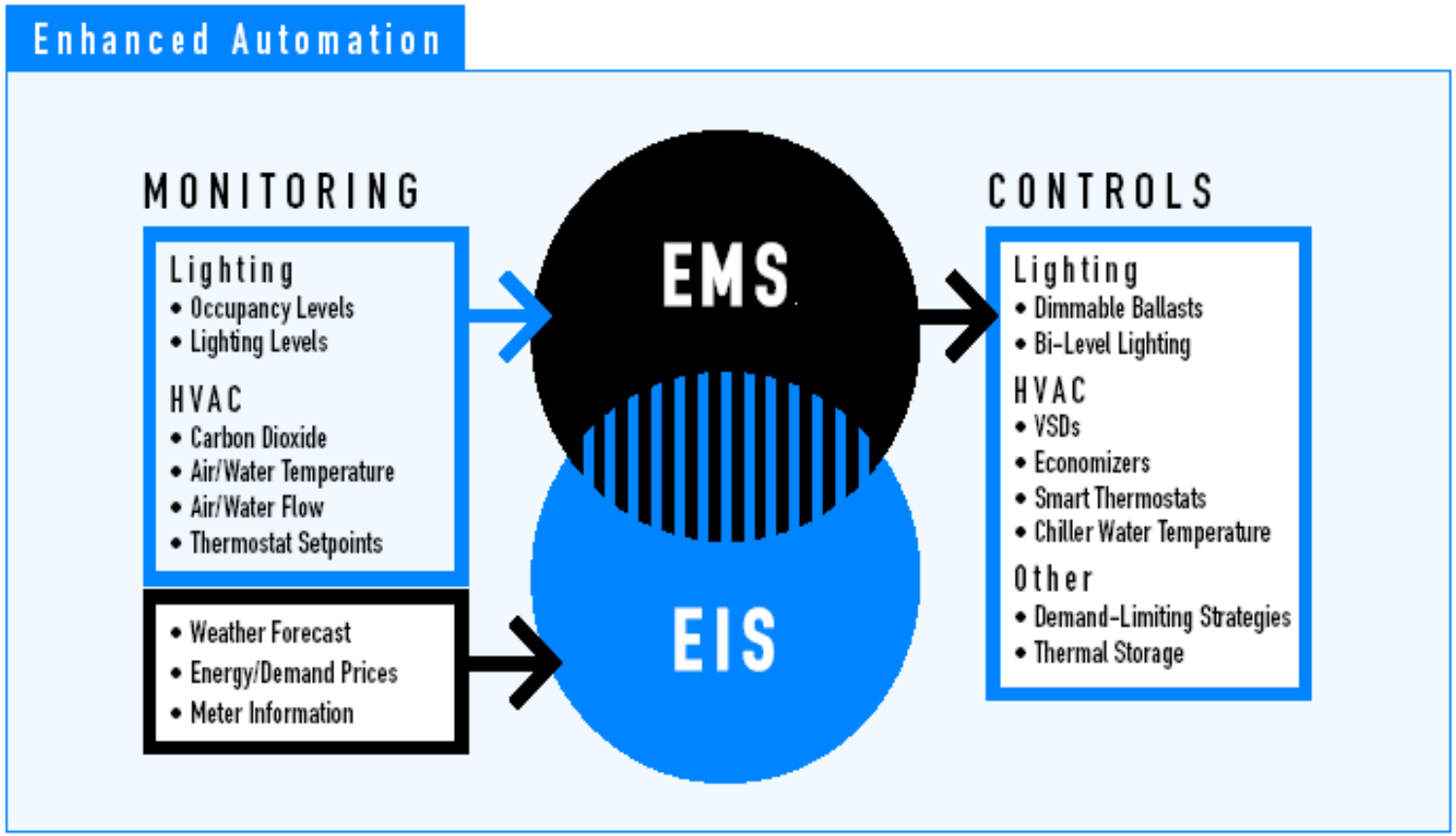
Enhanced Automation Initiative

www.EAInitiative.com

Energy Saving Strategies

- Enhanced Automation
- Conservation incentives
- Precooling
- Demand Control Ventilation
- Retro-Commissioning
- Case studies

What is Enhanced Automation?



Enhanced Automation Strategies

- For existing building automation systems
- Add additional sensors and actuators
- Update programming
- Dynamic control
- Building tunes itself – CO2 and occupancy sensors

Conservation Incentives

- KEMA – Enhanced Automation Initiative (EAI)
- Controls upgrades
- Quantum – Building Tune Up (BTU)
- Retro-commissioning
- SCE – Standard Performance Contract (SPC)
- Everything else

Enhanced Automation Initiative

- Free on-site EMS assessments
- Third party estimates of energy savings
- Vendor stipend for proposals
- Incentives for EMS improvements
- Technical assistance throughout process

Building Tune Up

- Building operations assessment
- Documentation of systems and procedures
- Rebates for corrective measures
- Improved comfort
- ENERGY STAR Building certification

A Case Study of Precooling with Zone Temperature Reset in a Commercial Office Building

Peng Xu, Philip Haves, James Braun, MaryAnn Piette

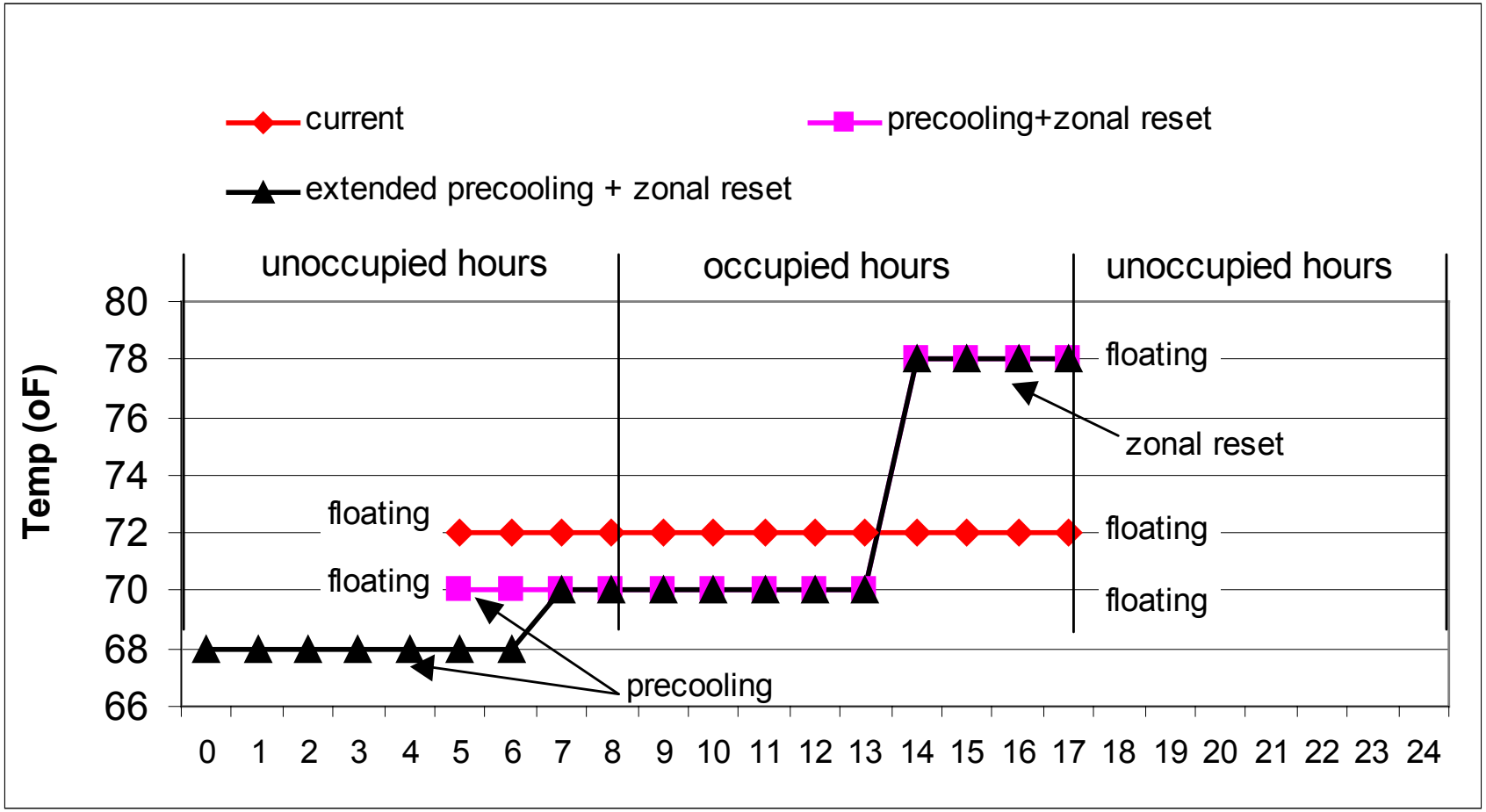
January 23, 2004

Sponsored by the California Energy Commission and the California Institute for Energy Efficiency

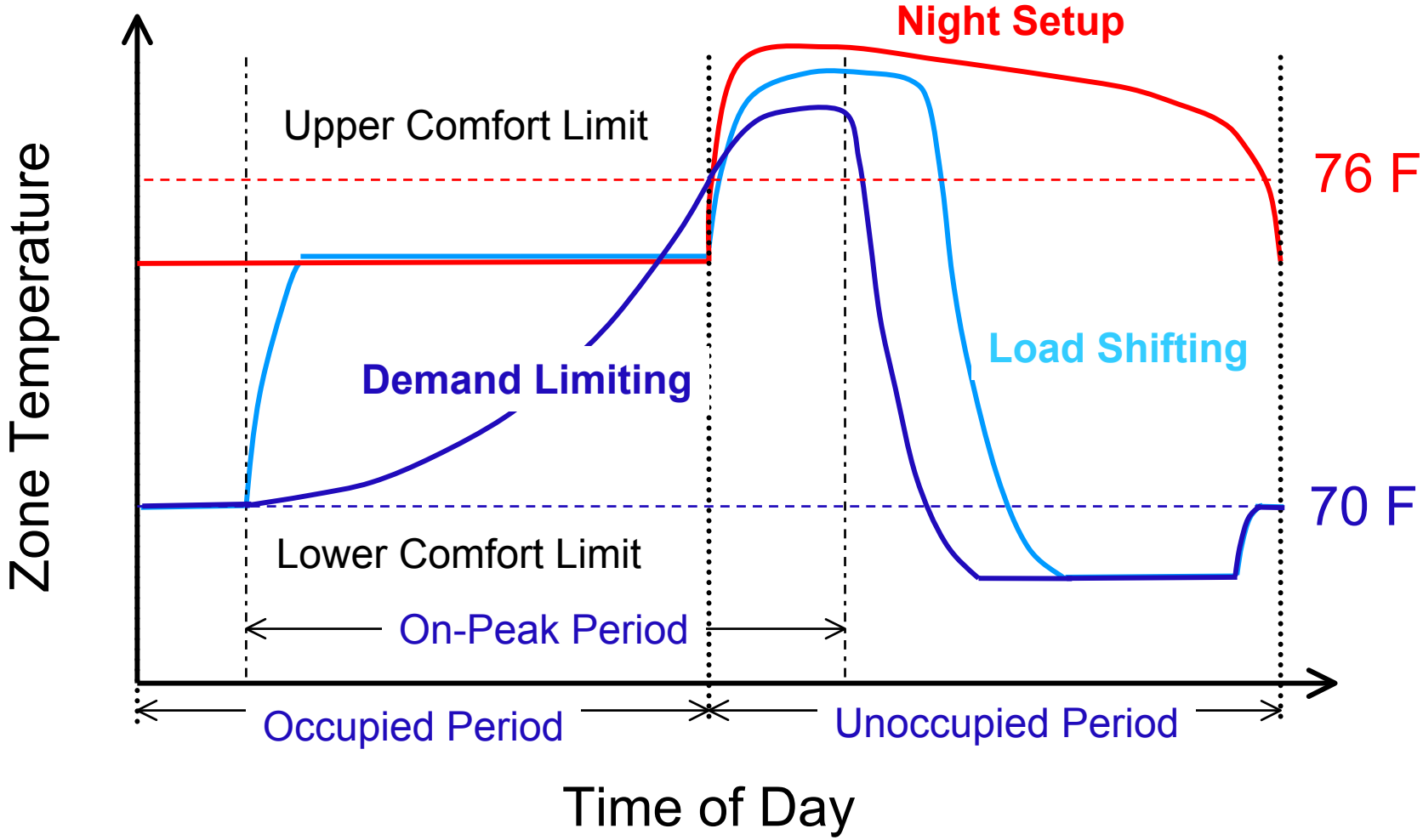
Executive Summary

- Precooling and zone temperature reset can shift up to 100% of cooling power from on- to off-peak in a moderate-weight commercial buildings
- Electricity peak demand reduced by as much as 2.3 W/ft^2
- Potential for cost savings when combined with Critical Peak Pricing

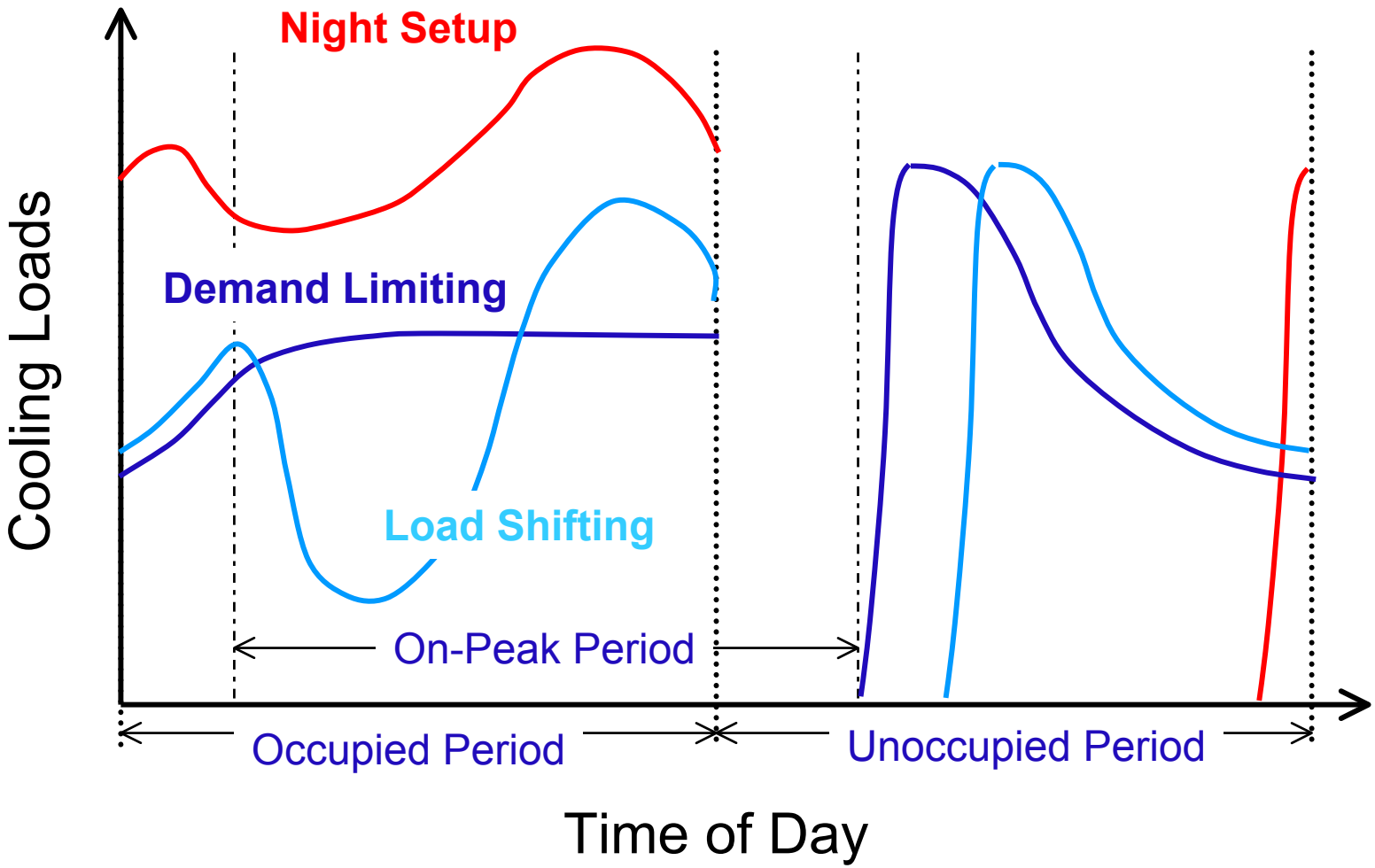
Precooling & Zonal Reset Strategies



Types of Strategies

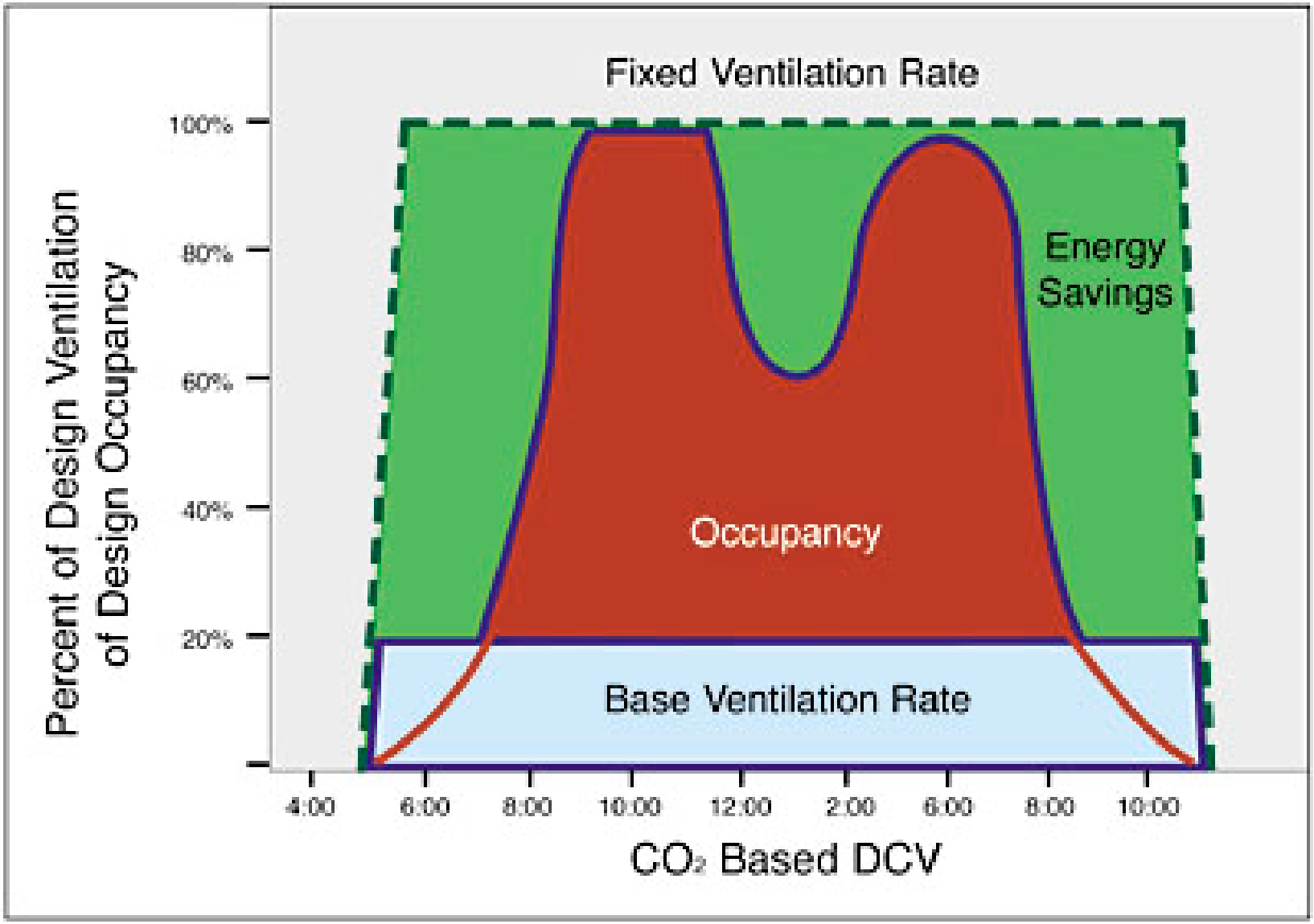


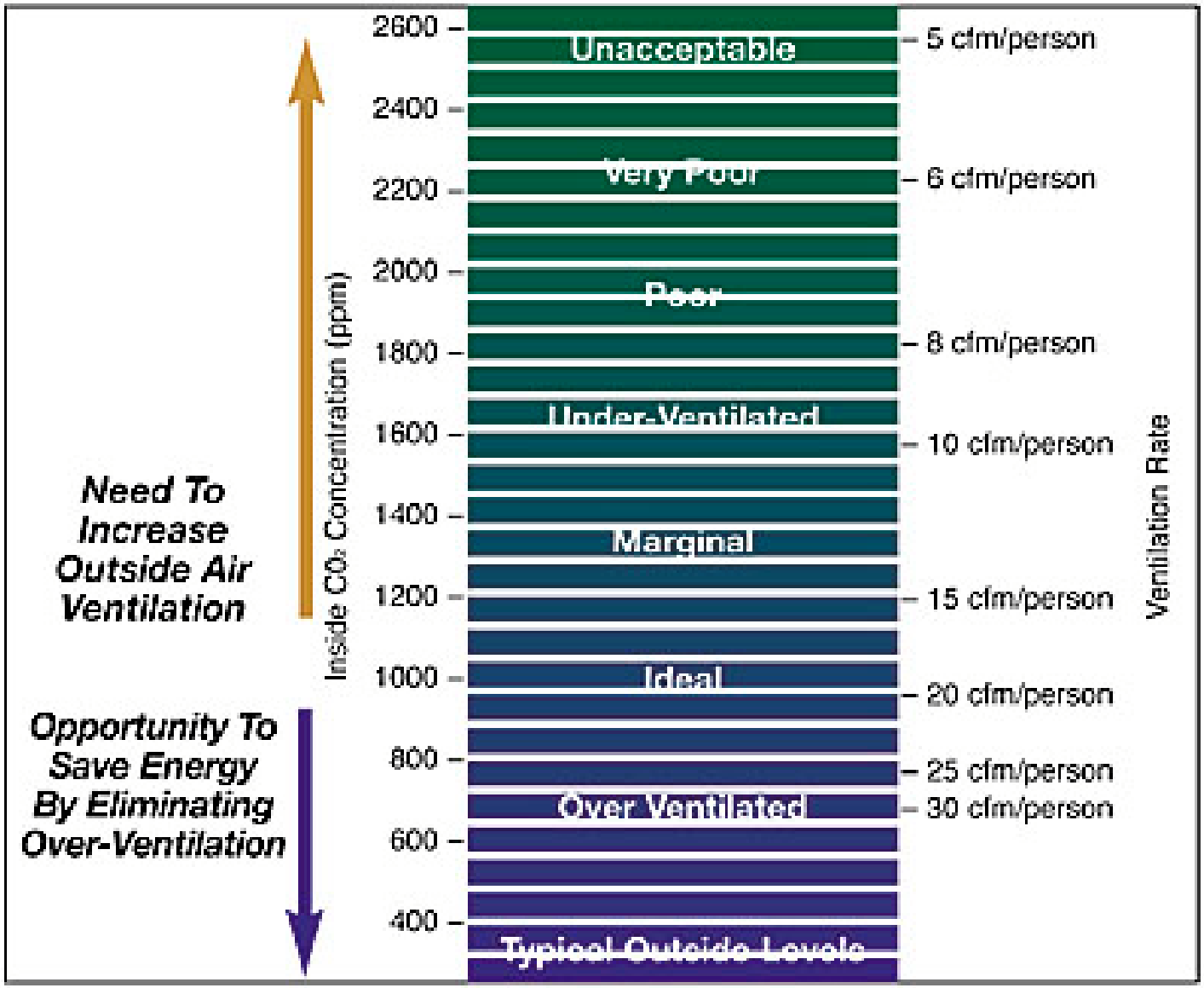
Load Effects

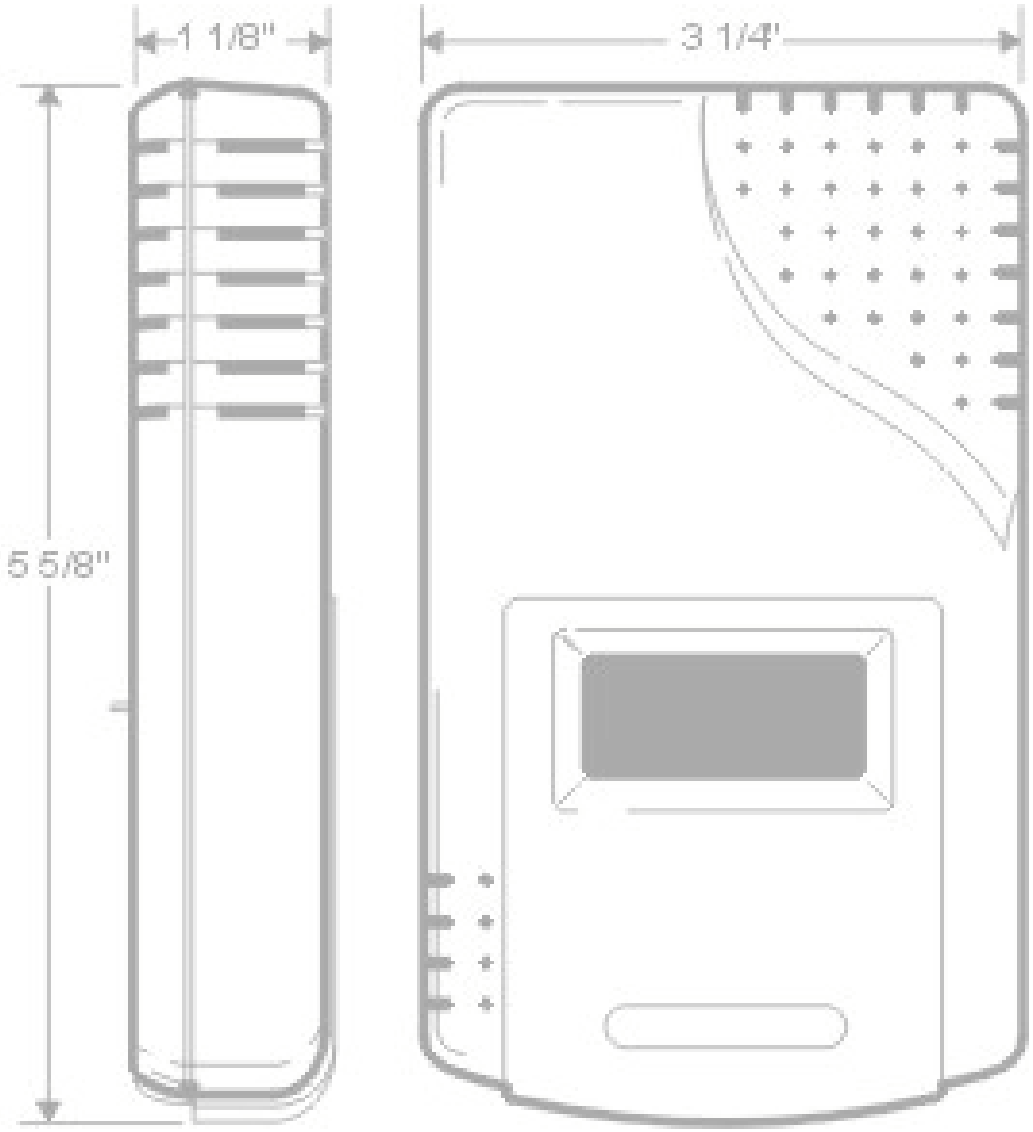


Demand Control Ventilation

- Case study:
- Mail order candy packing and shipping
- Air designed for 1400 – 400 on most days
- Night school
- Air for 480 – usually only 60 students
- Gymnasium designed for 2,000 – usually 10 students
- Table from Engineered Systems Magazine


Fixed Ventilation Rate
Energy Savings
Occupancy
Base Ventilation Rate
Percent of Design Ventilation of Design Occupancy
100%
80%
60%
40%
20%
4:00
6:00
8:00
10:00
12:00
2:00
6:00
8:00
10:00
CO2 Based DCV


Need To Increase Outside Air Ventilation
Opportunity To Save Energy By Eliminating Over-Ventilation
Inside CO_2 Concentration (ppm)
2600
2400
2200
2000
1800
1600
1400
1200
1000
800
600
400
Unacceptable
Very Poor
Poor
Under-Ventilated
Marginal
Ideal
Over Ventilated
Typical Outside Levels
5 cfm/person
6 cfm/person
8 cfm/person
10 cfm/person
15 cfm/person
20 cfm/person
25 cfm/person
30 cfm/person
Ventilation Rate


1 1/8"
3 1/4'
5 5/8"

Retro-Commissioning

- Building Tune Up
- Detailed look at all control components
- Missing programming
- Failed sensors
- Failed actuators

Large office building

- 160,000 SF suburban city hall
- Open office plan, stats 20 feet apart
- Overlapping setpoints
- Maintenance contractor fought against
- Went for 6 months
- 28% savings when they did

Laboratory

- High tech building - bills way high
- Building control computer all programmed
- On a cold day, called for 37 degree chilled water
- But whole building ran off one bad stat
- Clean room ran 10 air changes per minute
- But only occupied a few hours a day
- 20% savings

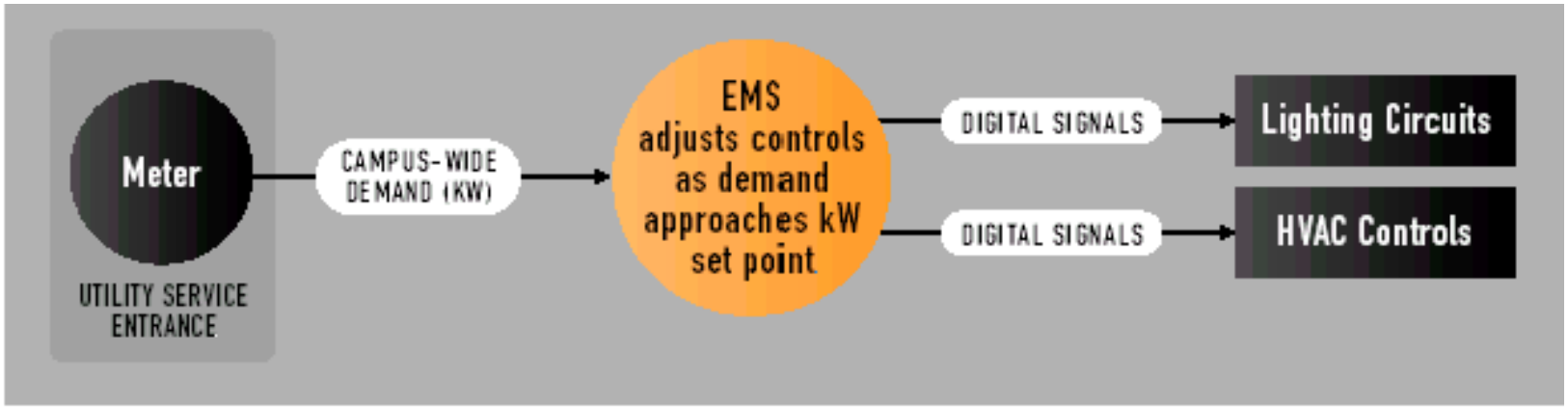
Appendix A: Successful Examples

EA Case Studies

Building Type	Technology	Project Cost	Annual Savings
Municipal Buildings	Chiller control via EMS/EIS	$280K	$70K
Office Campus	Lighting, pumps and fan control via EMS and CO_2 sensors	$285K	N/A
Office High Rise	Dimmable ballast and HVAC control via EMS and internet	$358K	$114K
College Campus	HVAC on/off and set-point control via EMS/EIS	$282K	$30K
Retail Chain	EMS control of HVAC and lighting via pager-based EIS	$320K	$140K
Hotel	Standard EMS control of HVAC	$48K	$64K

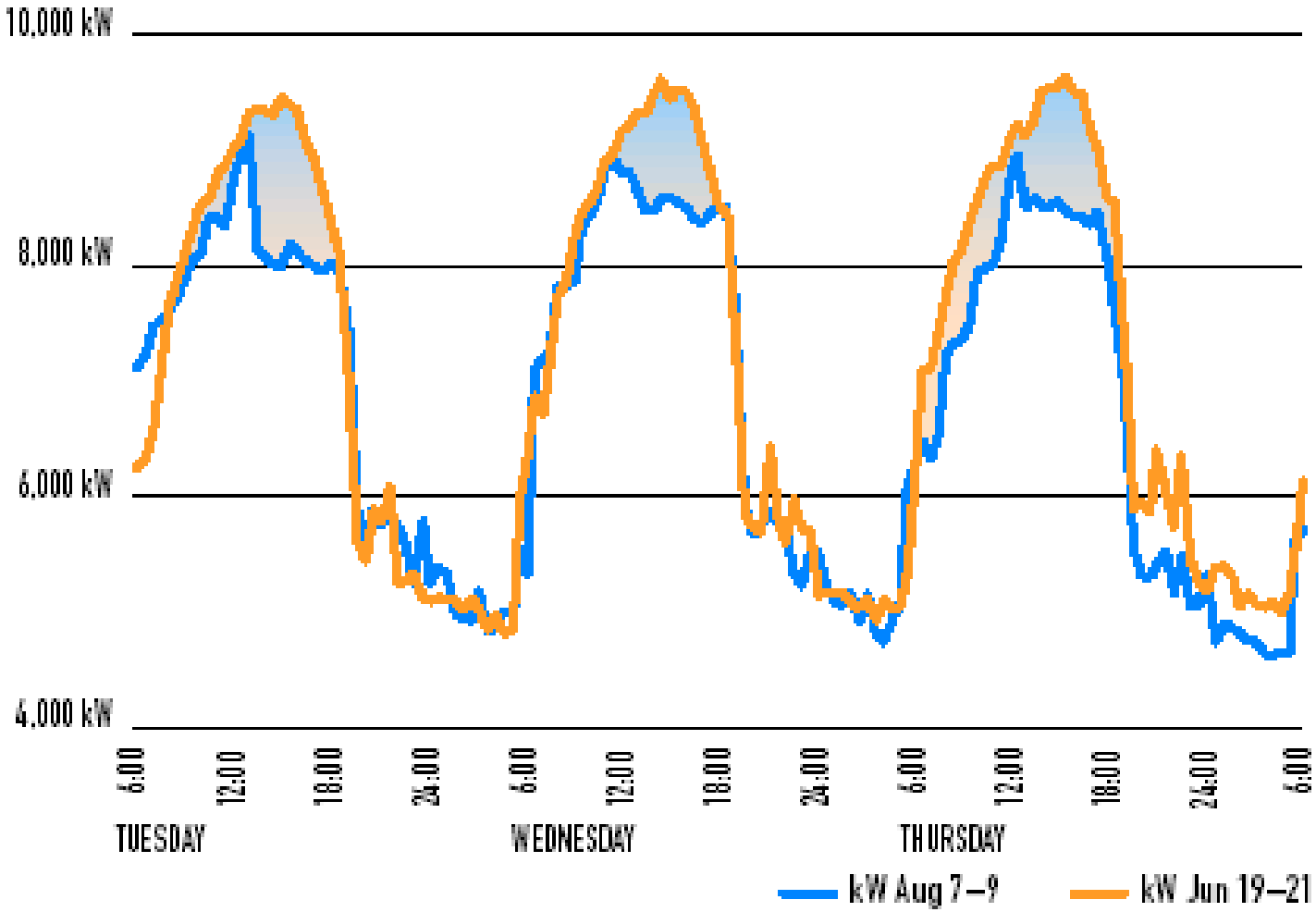
All cases studies also installed capability to receive 15-minute interval utility data via an EIS on a real-time or next-day basis.

Office Campus



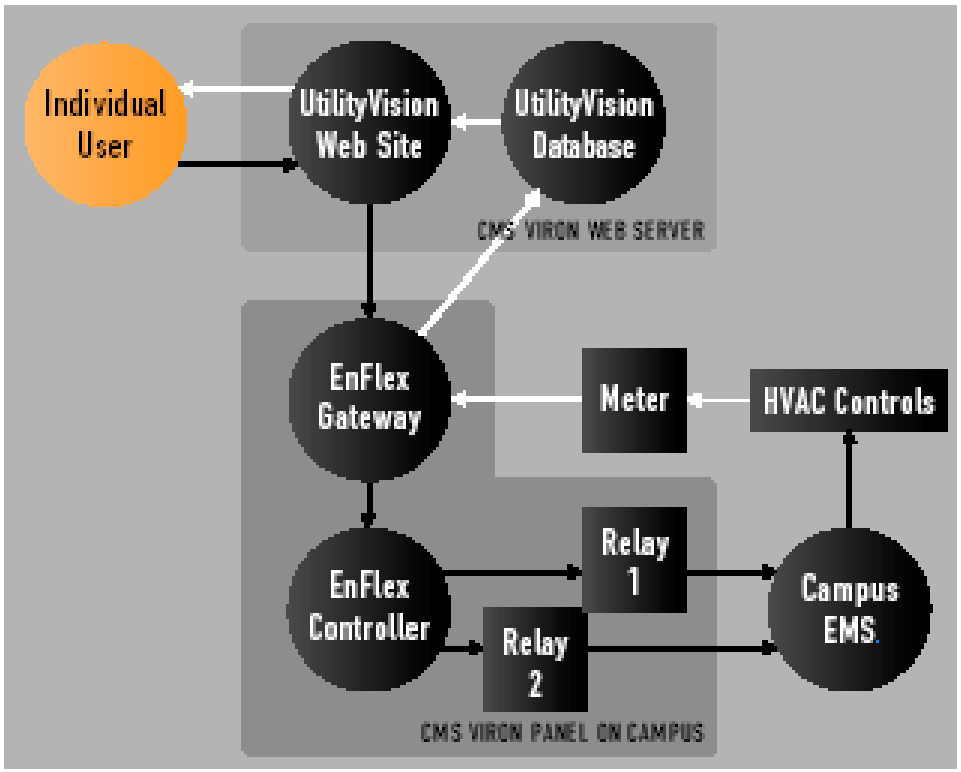
- Project Summary
  - Connected lighting and HVAC to EMS via LAN
  - New EIS collects 15-min interval data
  - Installed CO_2 sensors
- Primary Benefits
  - Cut peak load by 12%
  - Automated load shedding
  - Increased occupant comfort
  - Targeted HVAC control
  - Real-time access to meter data

Office Campus Savings



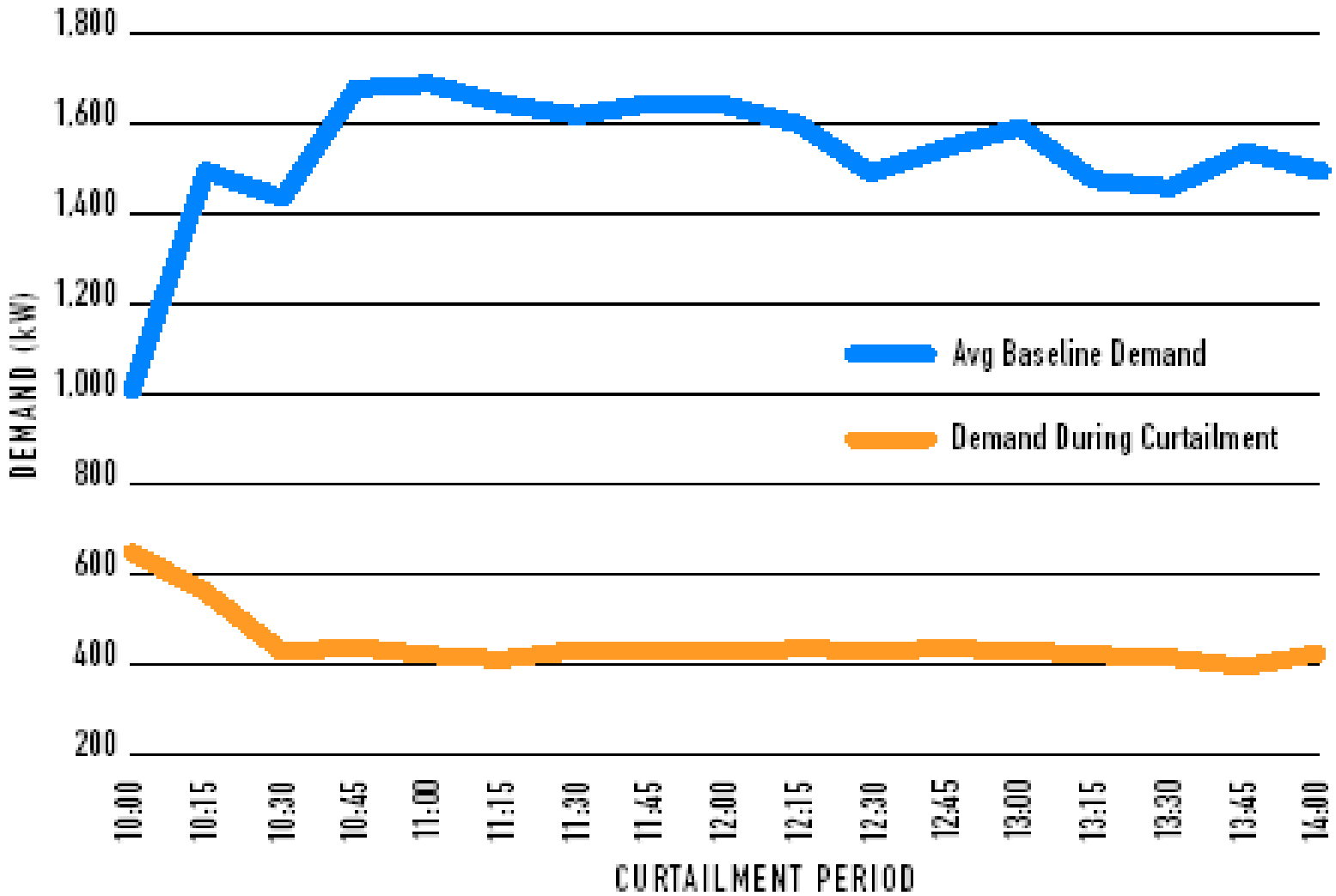
College Campus

- Project Summary
  - Established Web interface to HVAC controls and utility meters
  - Ability to raise set-point or shut down HVAC systems



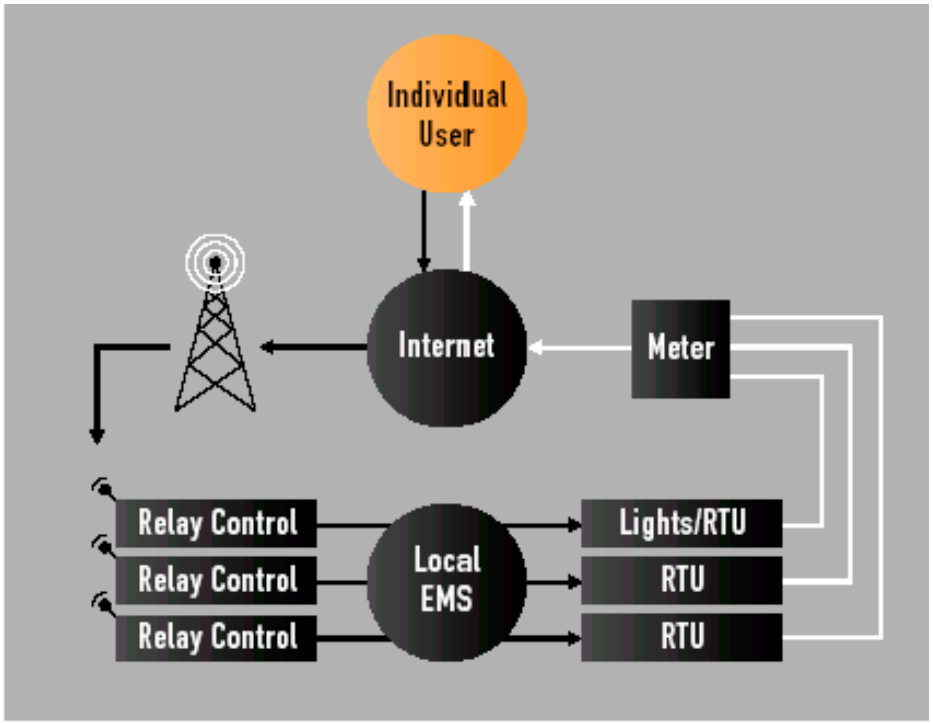
- Primary Benefits
  - Reduced peak demand from 4.4 MW to 1.7 MW
  - Ability to respond to dynamic energy prices
  - Real-time access to usage data

College Campus Savings



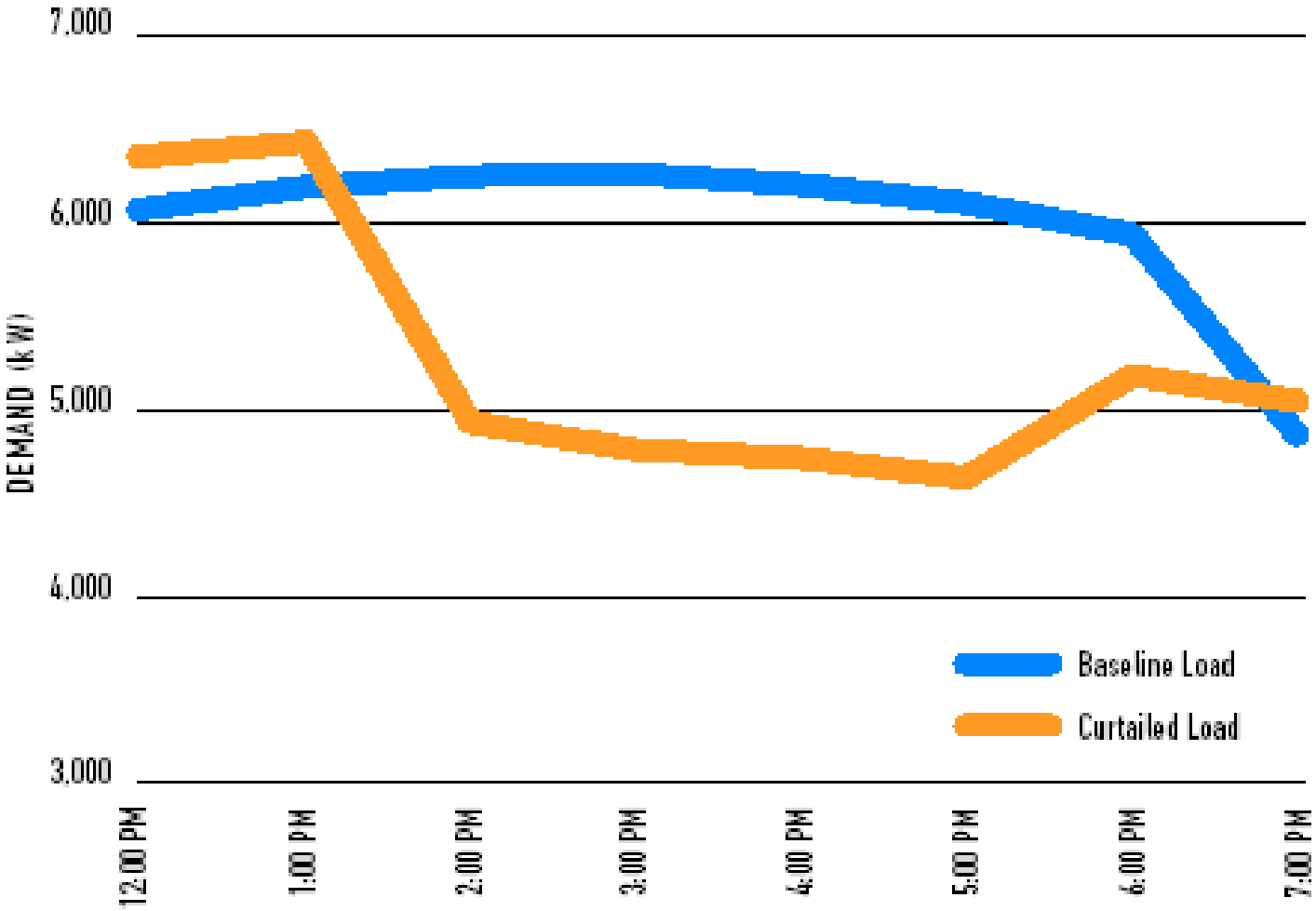
Retail Chain

- Project Summary
  - Pager-based signals to 119 stores to curtail lighting and HVAC loads
  - Centralized control via Internet
  - Ability to view interval utility data via Internet

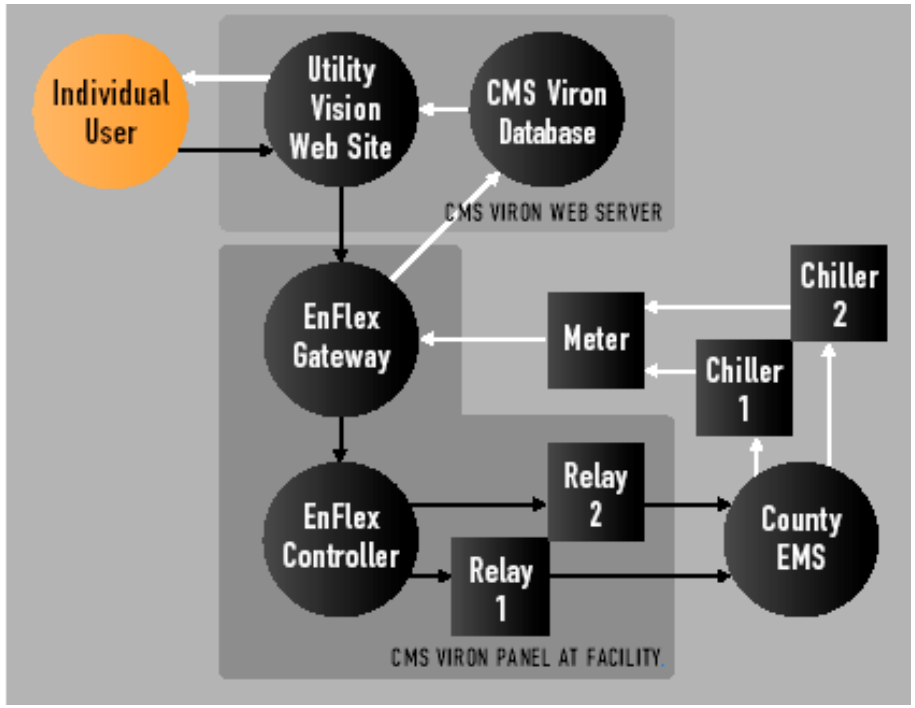


- Primary Benefits
  - Saved $140,000 in energy costs
  - Ability to reduce demand by 2.8 MW
  - Low transaction costs
  - Near real-time access to usage data

Retail Chain Savings



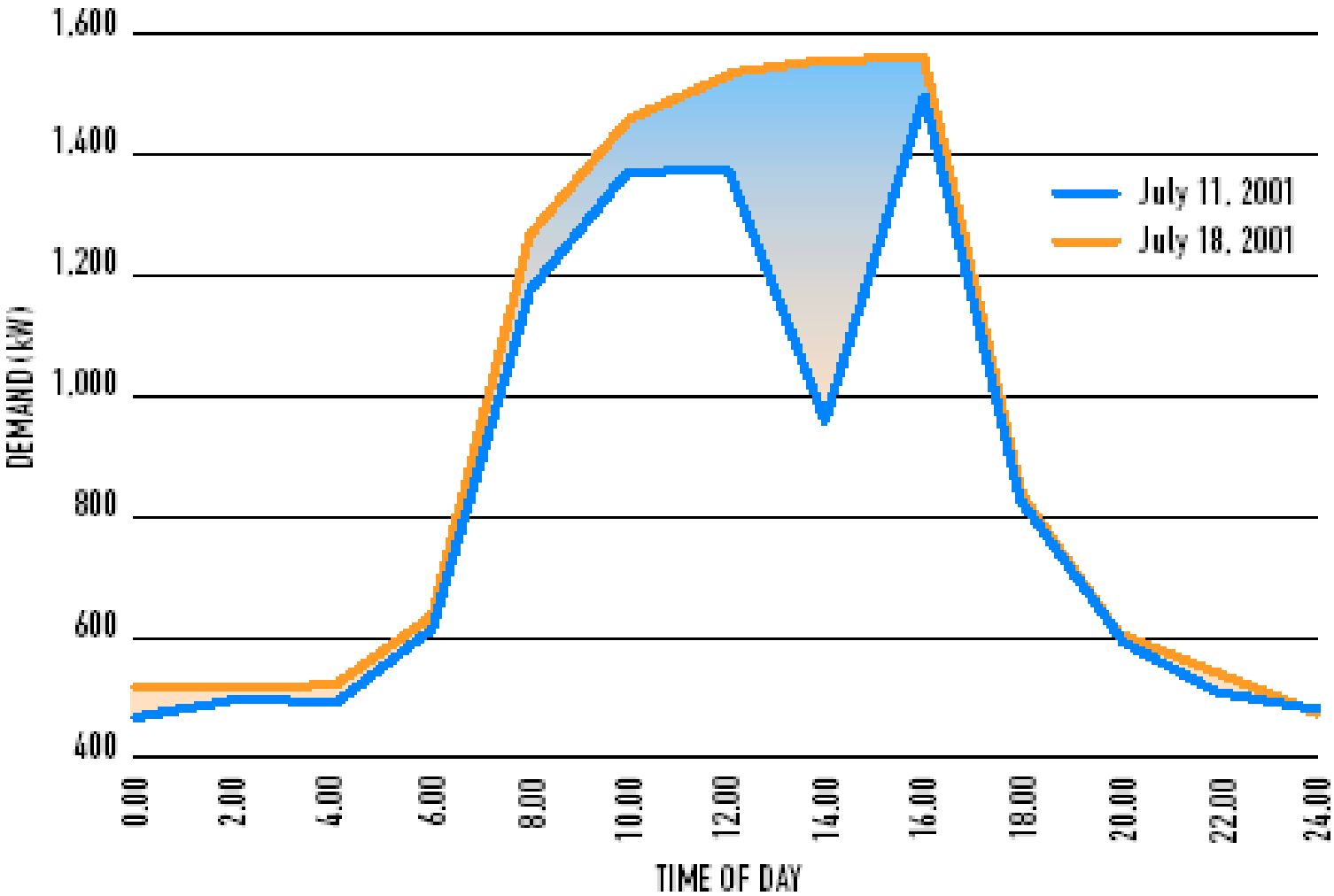
Public Institution



- Project Summary
  - Wireless chiller controls
  - Connected 5 buildings to central network
  - Installed EIS

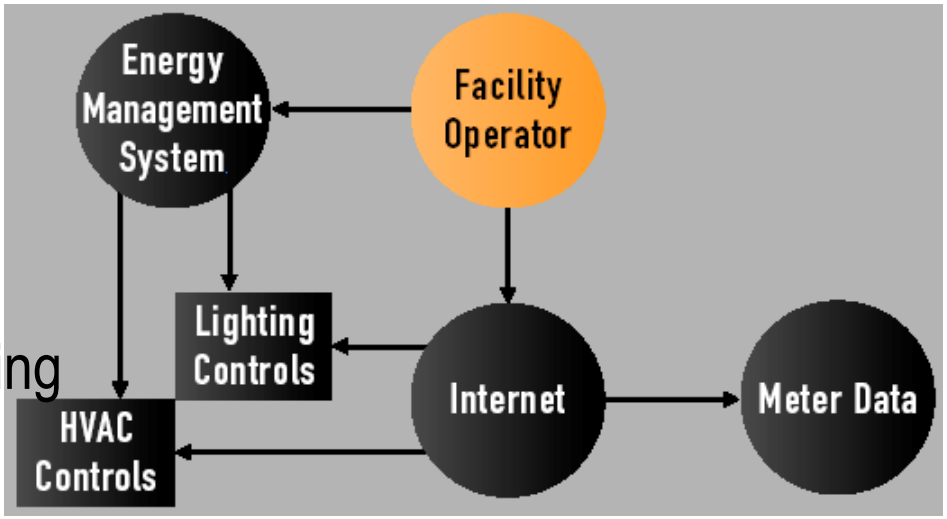
- Primary Benefits
  - Real-time data collection allowing for energy monitoring
  - More flexible curtailment options
  - Lower energy costs & less vulnerable to price spikes

Public Institution Savings



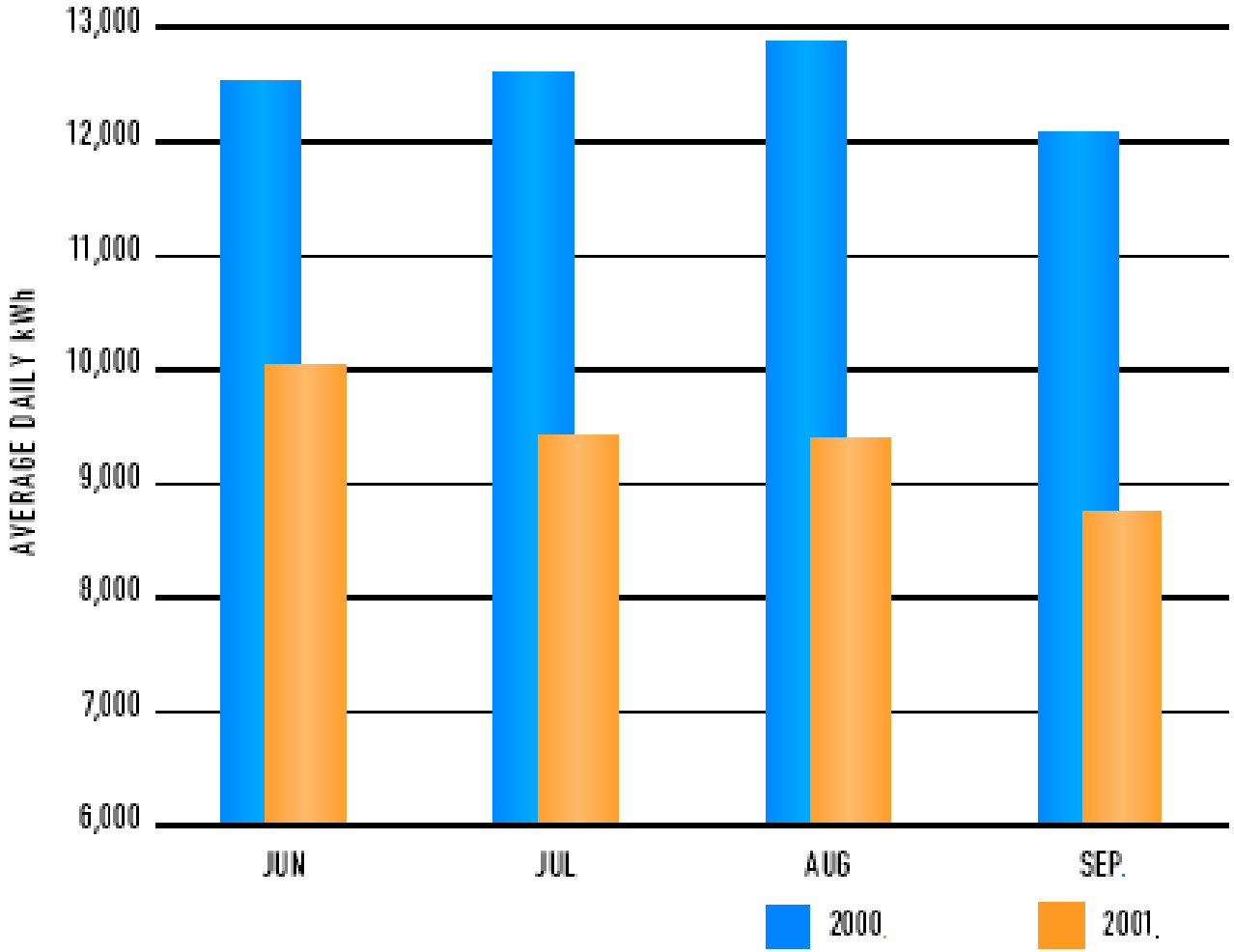
Office Building

- Project Summary
  - Lighting retrofit
  - Added wireless lighting & HVAC controls
  - Enhanced EIS



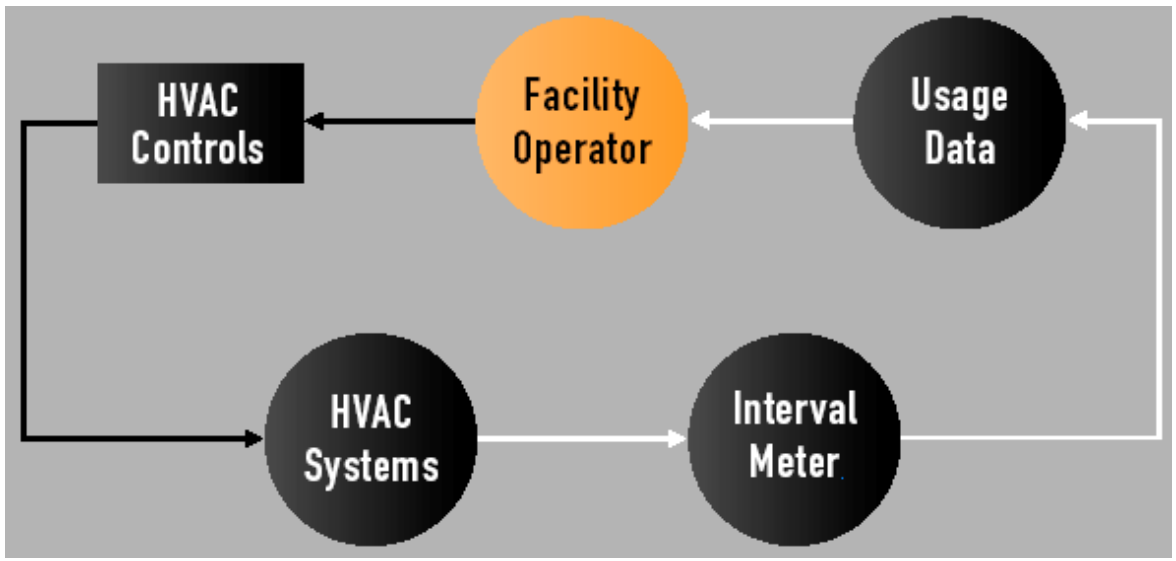
- Primary Benefits
  - Lowered energy costs
  - Access to energy & demand data
  - Flexible lighting system
  - Tenant energy billing

Office Building Savings

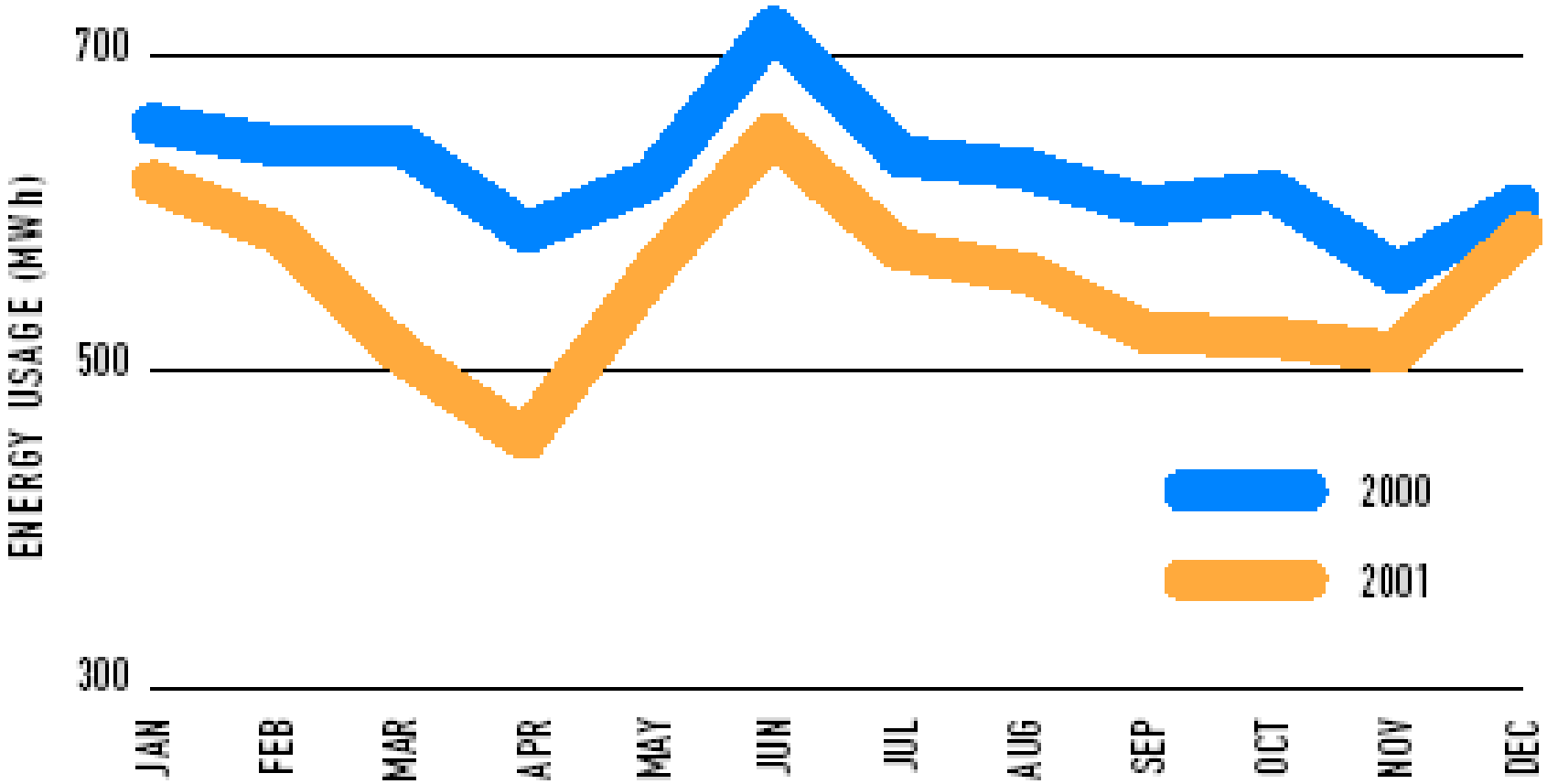


Hotel

- Project Summary
  - Installed DDC EMS
  - Installed EIS to immediately see effects of load-shedding efforts
- Primary Benefits
  - Access to real-time data
  - Cut over 800 MWh in 2001
  - Centralized remote control of HVAC



Hotel Savings



Appendix B:
Cost & Savings Estimates

HVAC Control Technologies and Strategies

Time and temperature control	On/off control Space temperature control Combined time and temperature control Other operating temperature and time control
Advanced time and temperature control	Shut-off with high limit Night ventilation Optimal start
Variable capacity control	Variable-air-volume (VAV) designs Variable-speed exhaust systems Variable-speed control of cooling towers Variable-speed drives for centrifugal refrigeration machines (including chillers) Variable-speed pumps for condenser water or chilled/hot water pumps
Demand-response ventilation	Carbon dioxide sensing systems Occupancy sensing systems Carbon monoxide sensing systems for garages
Peak load shifting strategy	Thermal energy storage
Chilled-water system control	Chilled-water temperature control Condensing temperature control Cooling tower/evaporative condenser fan control

EMS Cost Estimates

EMS System Complexity Levels and Costs

System Complexity Level	Control Components	Average Cost per Building Square Footage
Static	Packaged units and chiller start/stop control based on time and temperature; fan and possible lighting on/off control based on time; and/or water temperature control based on time and temperature	$ 1.75
	Static plus: Economizer controls; Chiller plant controls; variable-speed drive control; night temperature control; CO_2 ventilation strategies; and/or lighting control strategies	$ 3.00
Dynamic	Plus: optimal start/stop; demand limiting strategies; daylighting controls; thermal storage controls; and/or optimizing HVAC operations	$ 4.00

Questions?

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