A Day in the Life of a Smart Building

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Johnson Controls

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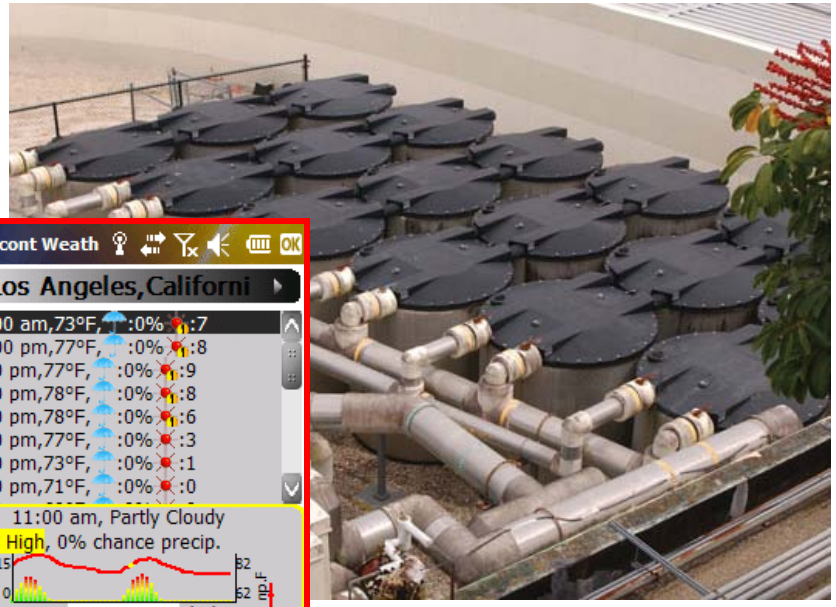
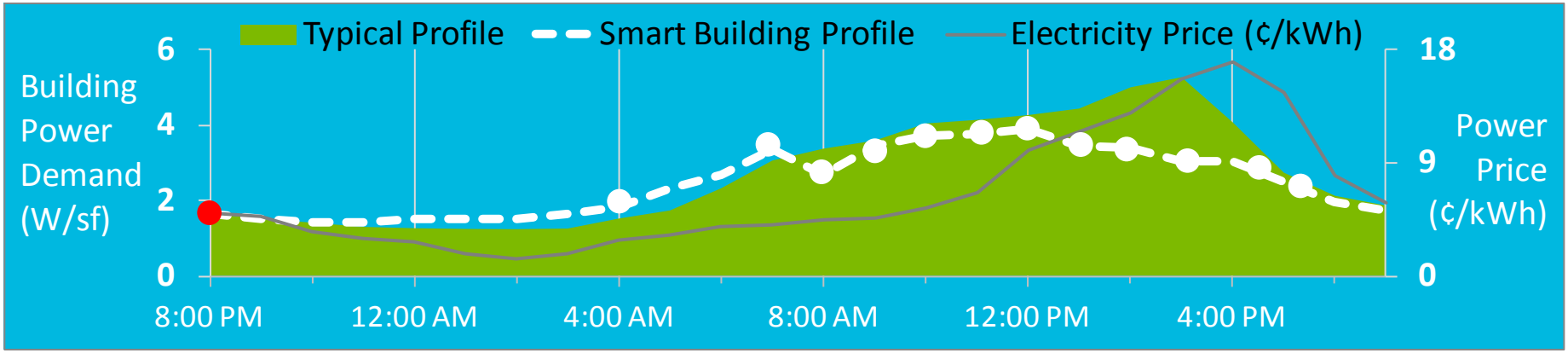
8:00 pm

Smart planning for tomorrow

- System accesses tomorrow's weather forecast
- Real time price forecasts are received from the electric utility
- System schedules night time ice storage generation





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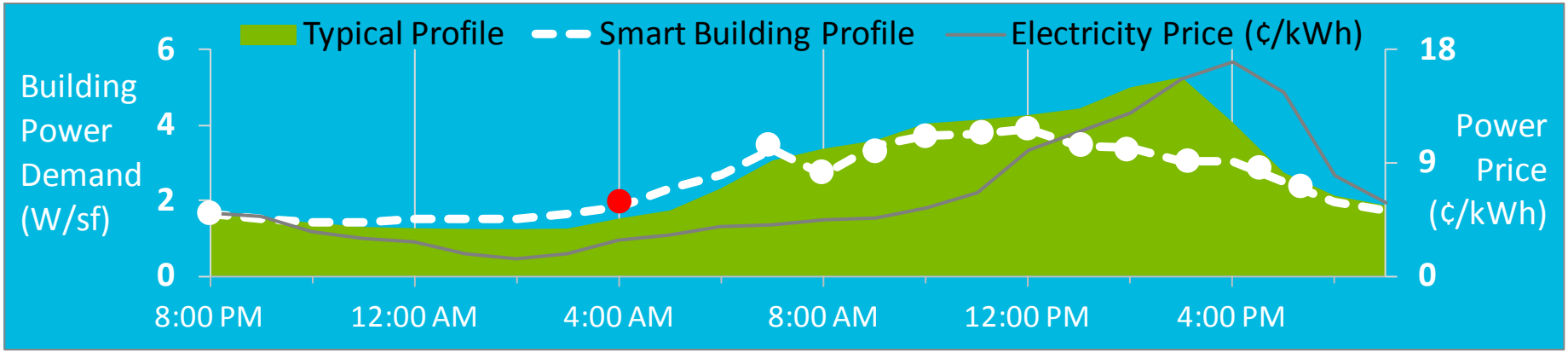
4:00 am

Chiller fault detected

- On-board diagnostics determines a chiller valve has failed
- System calculates costs associated with this fault based on real time price forecasts
- System auto-generates a work order and notifies facility manager by smart phone



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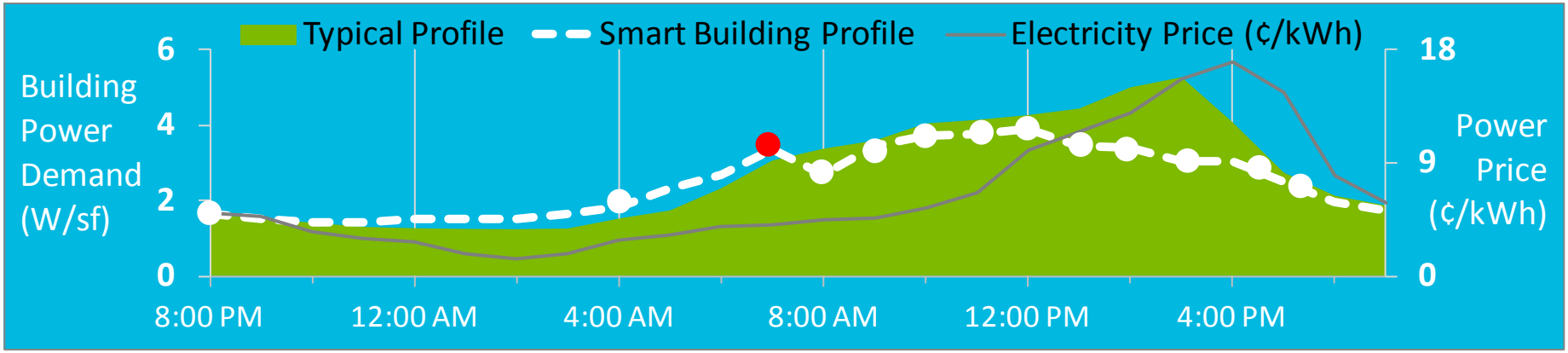
7:00 am

Chiller repaired

- Service technician arrives after being dispatched automatically
- Technician quickly fixes problem knowing the source and the new parts required
- Repair allows system to generate enough ice prior to spike in prices anticipated later in the afternoon



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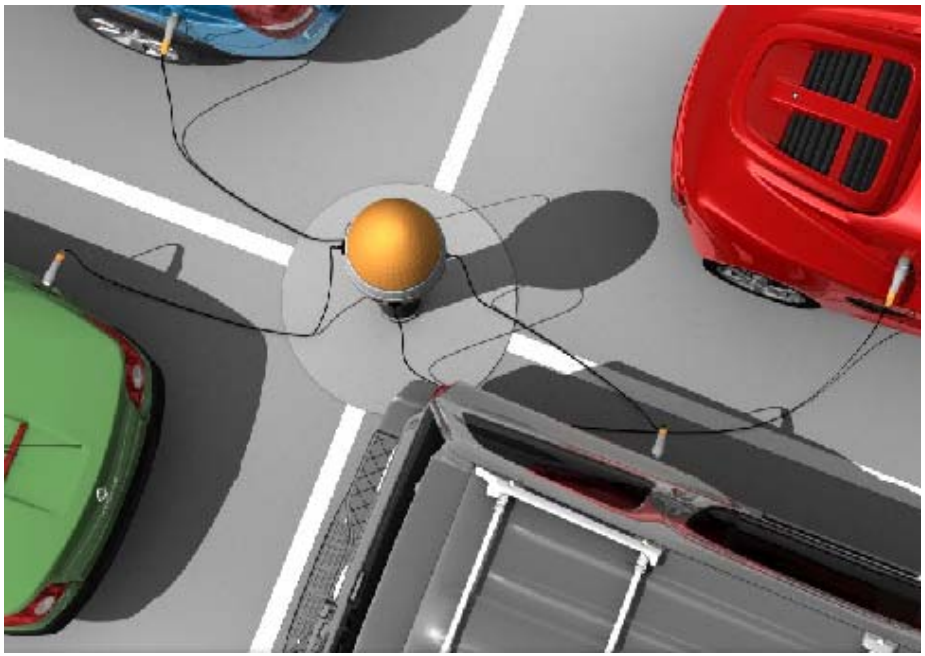
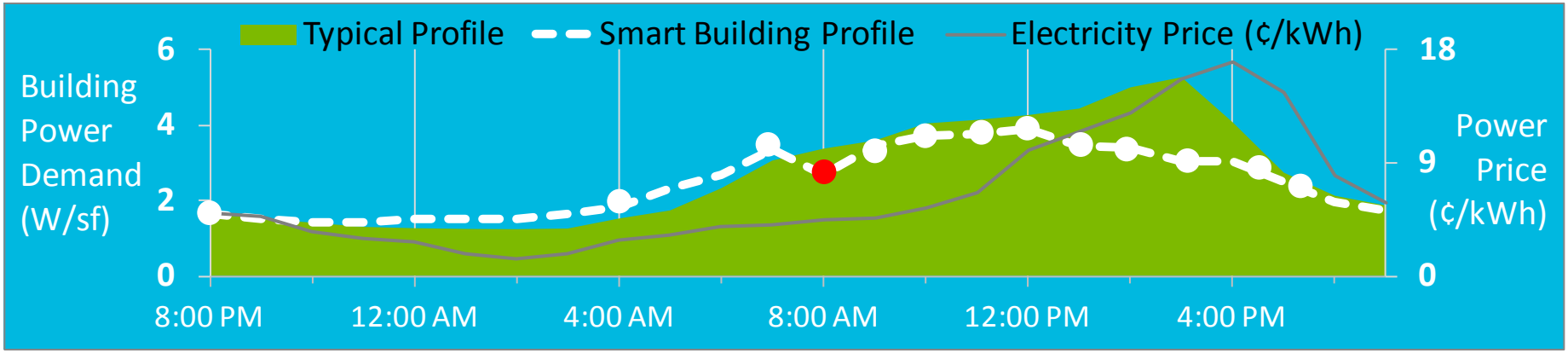
8:00 am

Employee plugs in vehicle at work

- Electric or plug-in hybrid vehicles recharge when real time price of electricity is low
- Smart charging supports voltage regulation for the local utility
- Purchase or sale of power to building is automatically factored into payroll system





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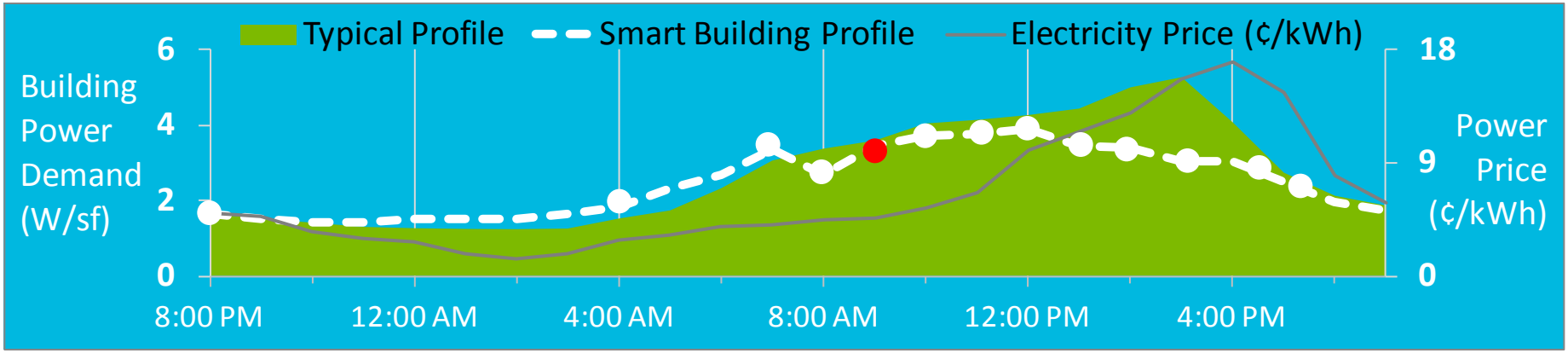
9:00 am

Meeting space is ready to go

- The building management system prepares the conference room for a meeting with 15 people
- Occupancy and CO_2 sensors provide an override in the case less or more people attend the meeting



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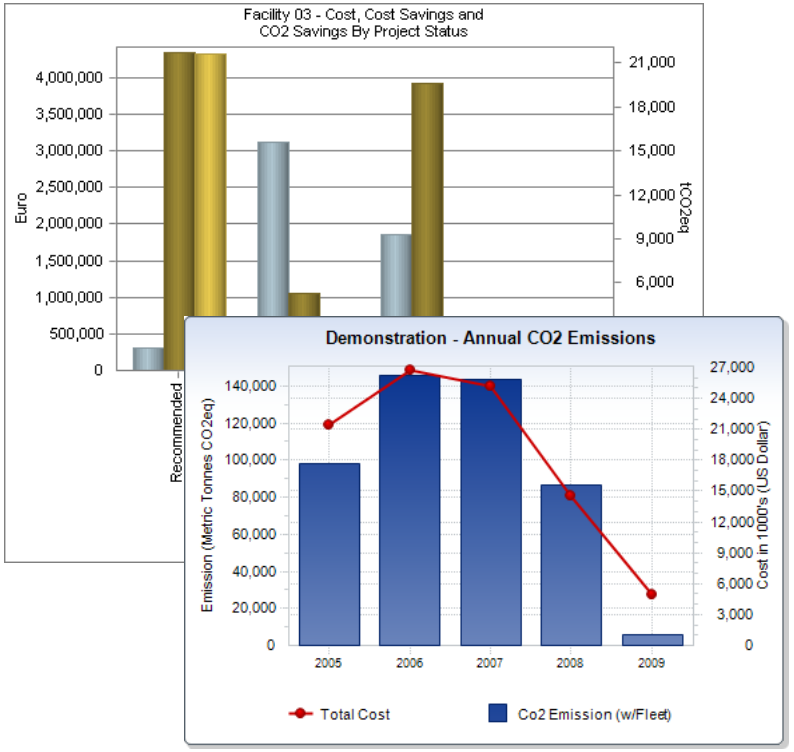
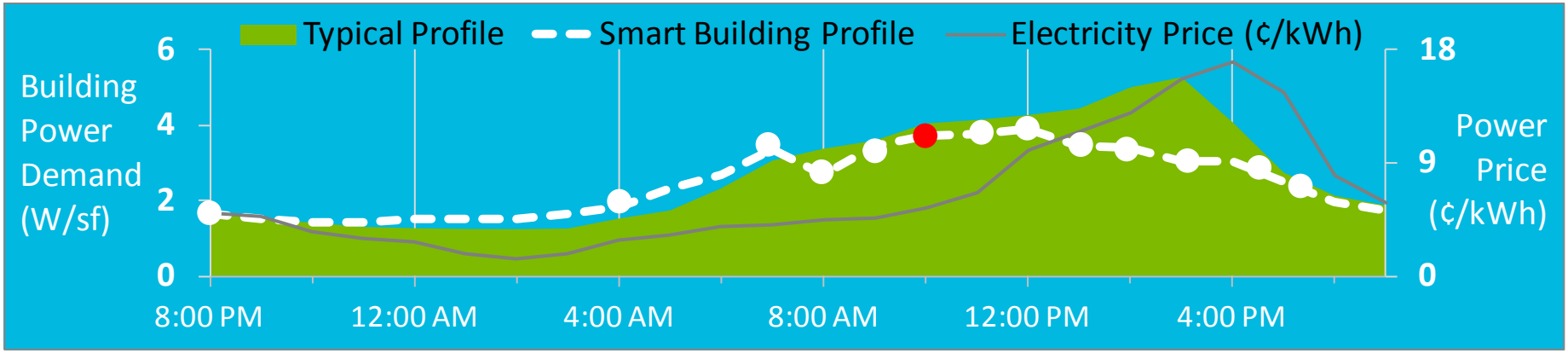
10:00 am

CFO calls for carbon reporting data

- A market analyst asks the CFO about the business' carbon management strategies
- Enterprise dashboard provides access to carbon emissions data for the most recent quarter and annual carbon reductions





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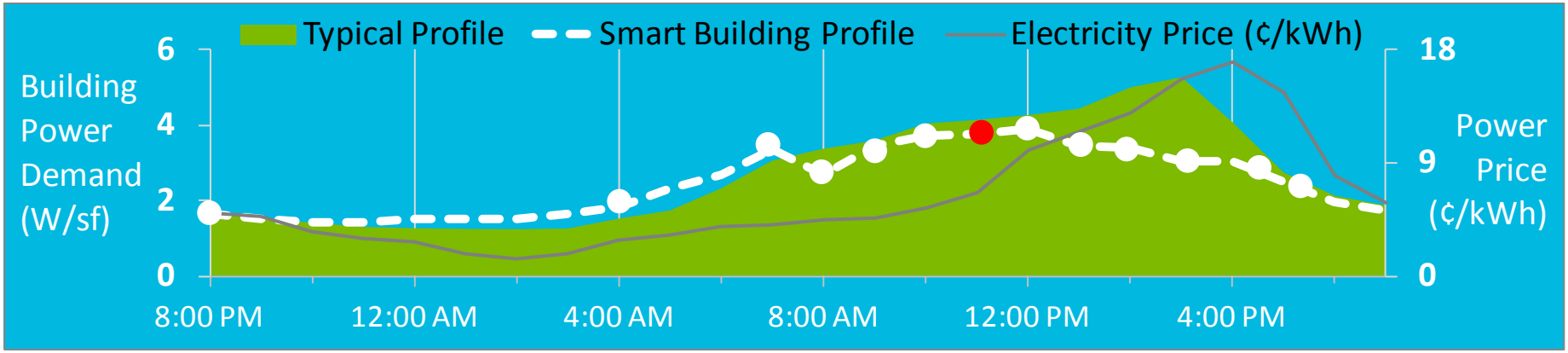
11:00 am

Utility power price triggers automatic demand reduction for tenant

- The price for electricity from 12pm-2pm exceeds the threshold pre-defined by the tenant
- The following actions to reduce power demand are taken:
  - reset space temps by 2°F
  - slowly dim lighting 20% in occupant spaces
- Actions and impact reported back to utility



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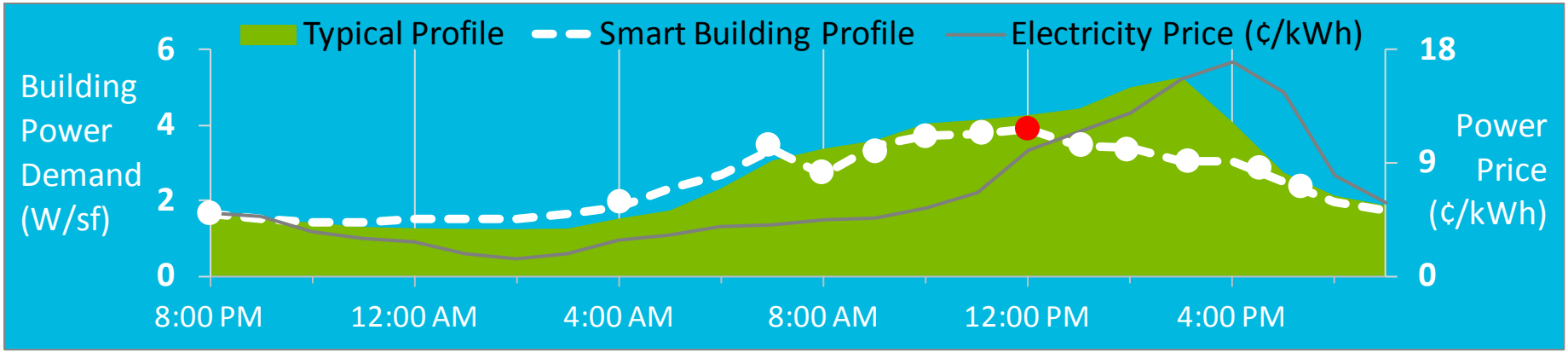
12:00 pm

Power price triggers automated demand reduction for building owner

- The building management system also takes action in common areas:
  - dispatch ice storage cooling
  - increase chilled water set point
  - dim lighting in common areas by 20%

- Actions and impact are reported back to utility



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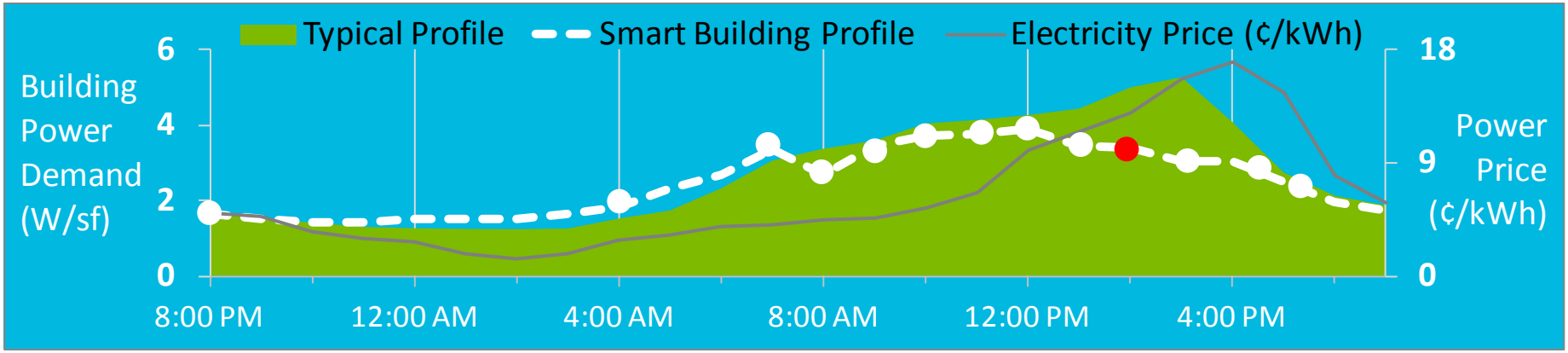
2:00 pm

Automated demand reductions leverage IT system integration

- System alerts employees via email or text message to unplug their laptops and run on battery power from 2-4pm
- PC power management software agent automatically reduces desktop power consumption
- Computing load is reduced for non-production servers and non-critical tasks are deferred



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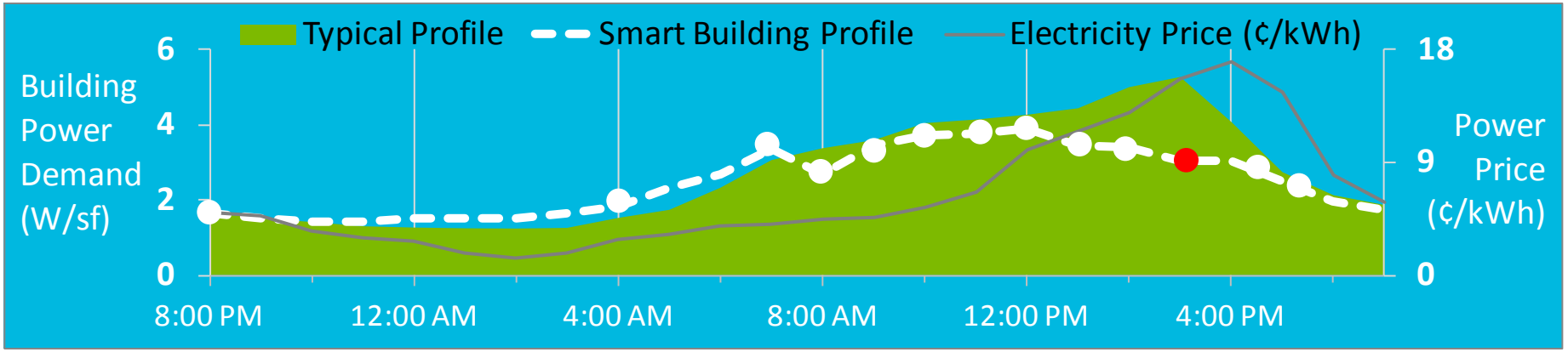
3:00 pm

Cloud cover causes solar photovoltaic generation to drop

- Building receives a demand limiting signal from utility during the 2pm -5pm period.
- When cloud cover causes solar production to drop, system uses on-site electric storage to meet demand reduction goal
- Combination of distributed generation, electric and thermal storage and vehicle charging is used to control the load profile



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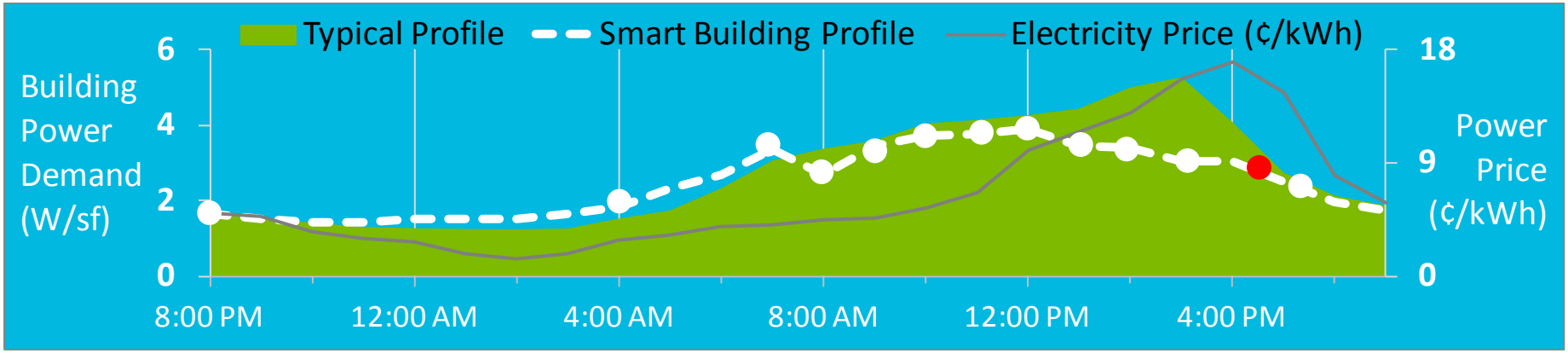
5:30 pm

Leaving the office

- As employee badges out, the system automatically turns off the lights and puts the computer into stand-by
- When he arrives to parking deck, his plug-in electric vehicle has been charged just enough for him to get home



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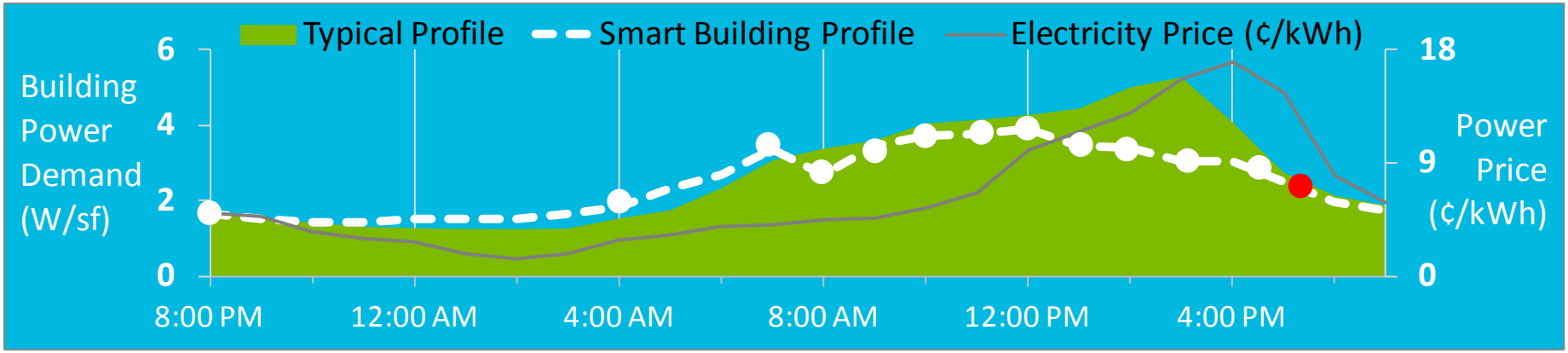
6:30 pm

End of the workday

- System controls lighting and HVAC to follow the janitorial staff throughout the building
- Video surveillance system counts occupants remaining after hours and adjusts temperature setpoints and lighting



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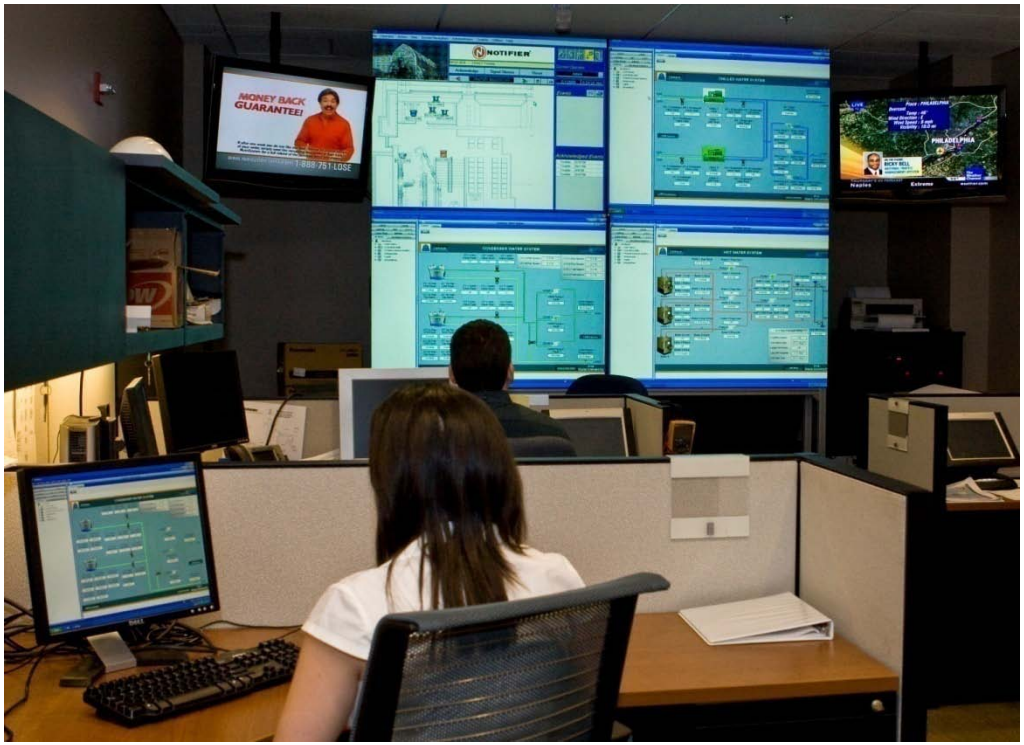
Case Study: Ave Maria University

- Opened to students and faculty in 2007
- Convergence of 23 technology systems on one IP backbone
  - Building management
  - Security management
  - IT Systems
  - Fire/life safety
  - HVAC Equipment
  - Audio/visual Systems
- CMMS integration with BMS for automated work order generation and management



Saved $1.5M in infrastructure costs

Saved $600K/year in energy costs

Saved $350K/year in staffing costs

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Case Study: Georgia Institute of Technology

- Georgia Tech buys electricity on dynamic hourly price from Georgia Power
- Each hour, building management system reads prices for for next 48 hours from utility's web service feed
- Facilities director sets price threshold for automated load shedding mode

Savings during initial summer 2006 single building pilot

Week	Number of RTP Events	Amp-Hours Saved	Energy Saved (kWh)	Cost Savings ($)
July 16–21*	5	524	3772	438
Aug. 8–12	4	185	1335	155
Aug. 13–19	2	27	195	22
Aug. 20–26	1	60	431	50
Aug. 27–Sep. 2	3	150	1080	126
Total	15	946	6813	790

Observing a ~1MW peak load reduction, 7% of demand for participating buildings

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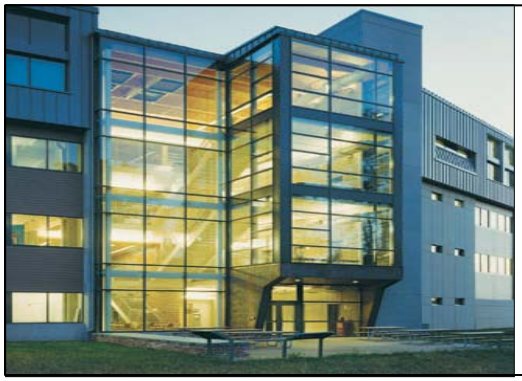
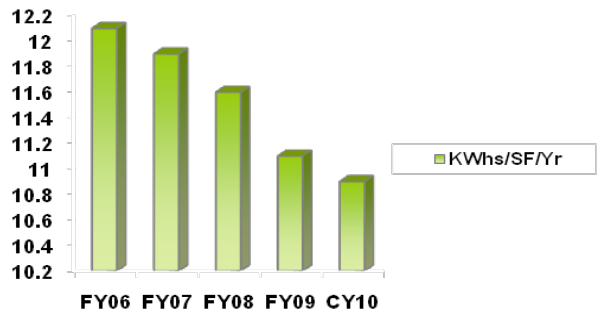
Case Study: State of Missouri



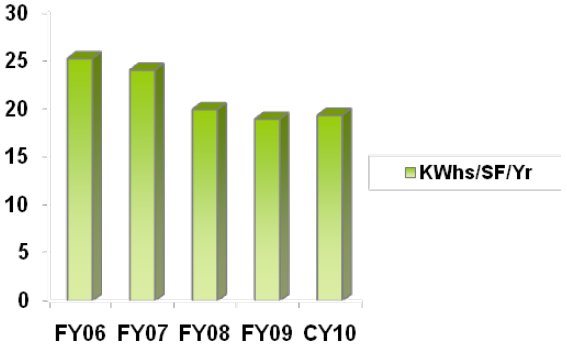


- FY06 12.1 KWhs/SF
- FY08 11.6 KWhs/SF
- CY10 10.9 KWhs/SF

9.0 % Reduction

- FY06 26.7 KWhs/SF
- FY08 21.7 KWhs/SF
- CY10 19.2 KWhs/SF

28.0 % Reduction



- FY06 25.2 KWhs/SF
- FY08 21.0 KWhs/SF
- CY10 19.3 KWhs/SF

23.4 % Reduction

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Case Study: IDeAS Net Zero Energy Building

- Integrated Design Associates - San Jose, CA
- Commercial Office Building Retrofit Project
- Geothermal heat pump with floor-based radiant heating and cooling and dedicated high efficiency outdoor air ventilation unit
- PV-integrated membrane roofing
- High efficiency windows and day lighting controls
- 40% better than 2005 California Title 24 energy requirements

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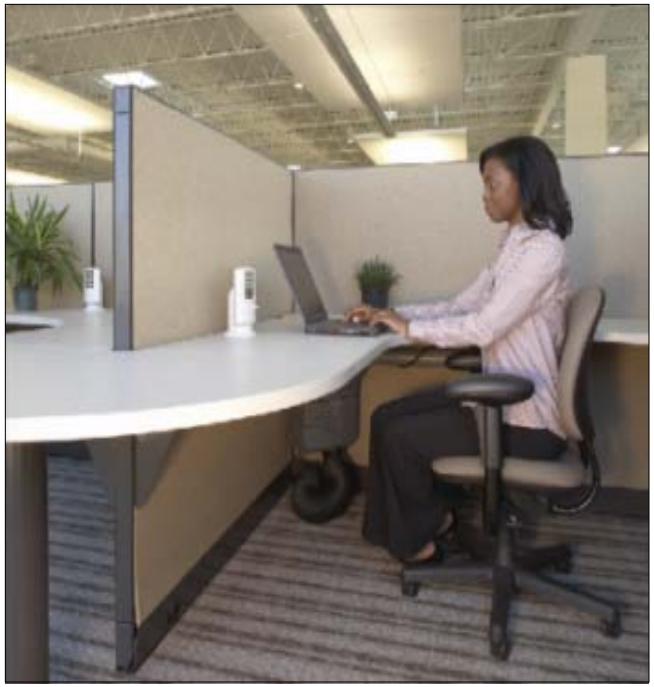
Case Study: Johnson Controls Corporate Headquarters



- Personal Environmental Modules provide individualized controls as well as integration with the Building Management System to optimize comfort, indoor environmental quality and energy efficiency.
- Real-time monitoring of building occupancy provides additional energy efficiency opportunities across the corporate campus.

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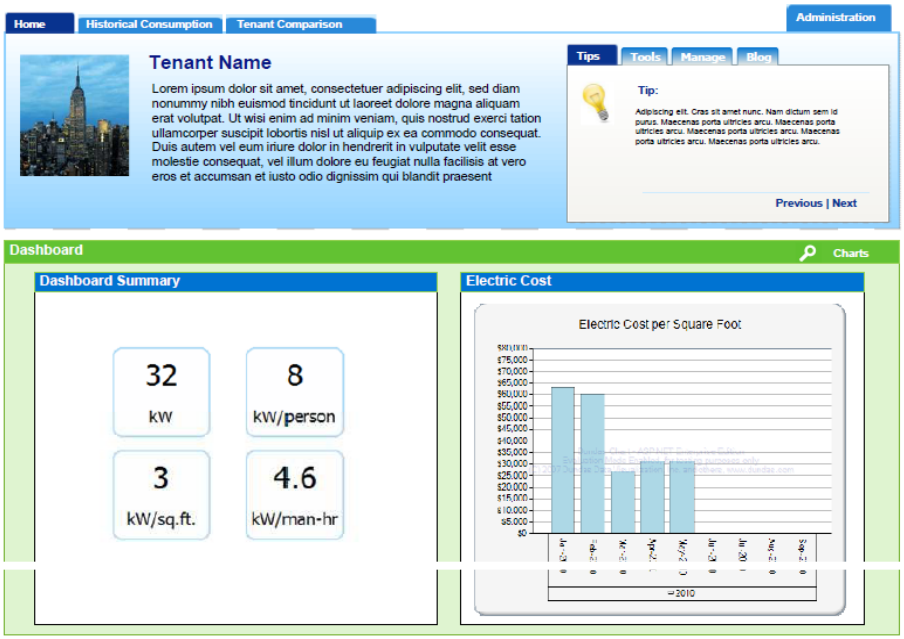
Case Study: Empire State Building



38% energy savings, guaranteed

Simple payback of 3.1 years

LEED Gold certification

Energy Star Top 25% of U.S. office buildings

33% reduction in cooling load

Savings of $4.4 million annually

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For more information about smart buildings and smart grid integration is available at:

www.InstituteBE.com

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