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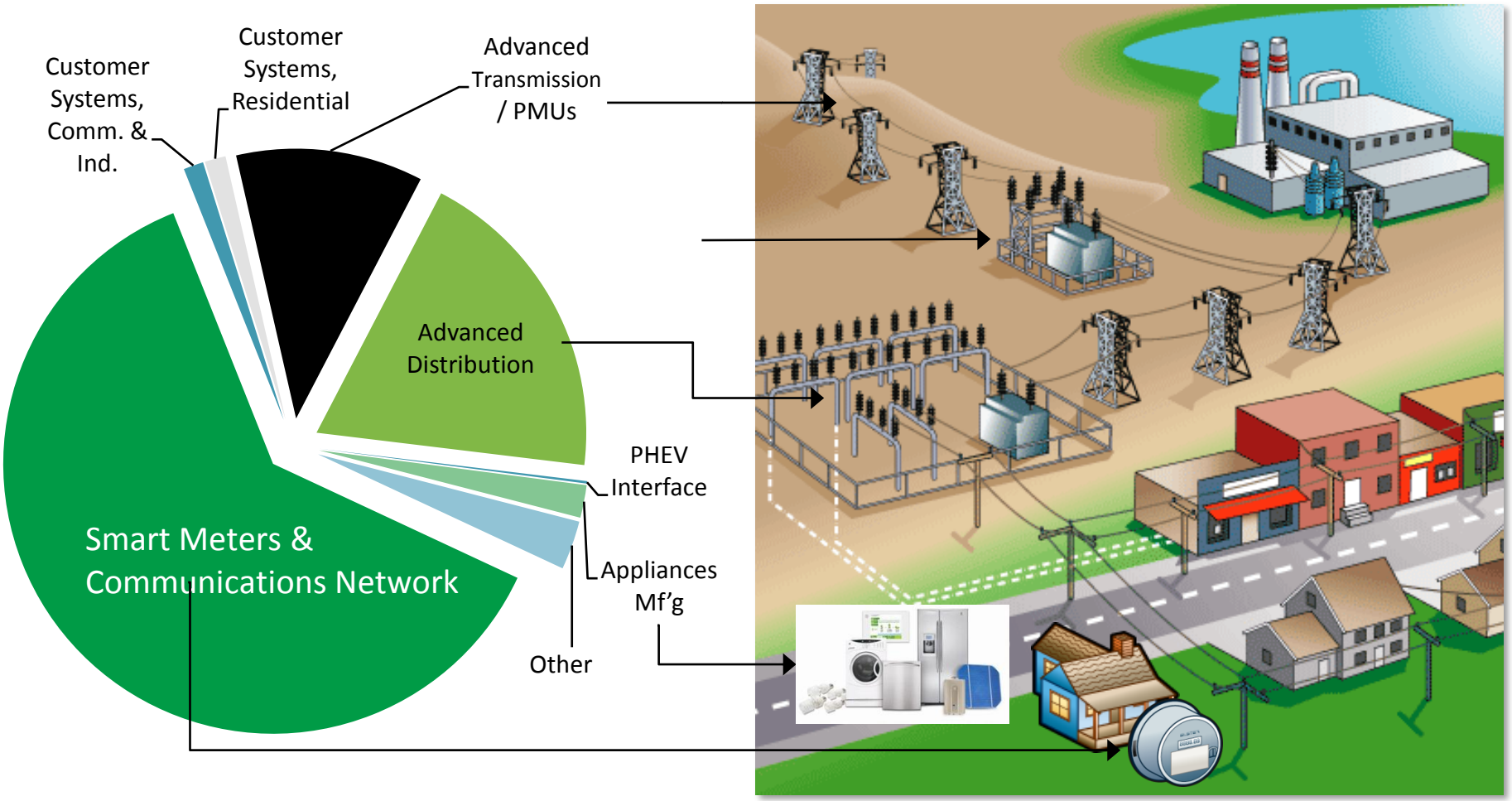
Demand Response in Commercial Buildings

Technology as an Enabler for Scaling Up

Johnson Controls

Technology makes the smart grid possible…

…and *buildings* are the next wave



Source: Johnson Controls analysis of **$3.4 billion** in SGIG awarded October 2009

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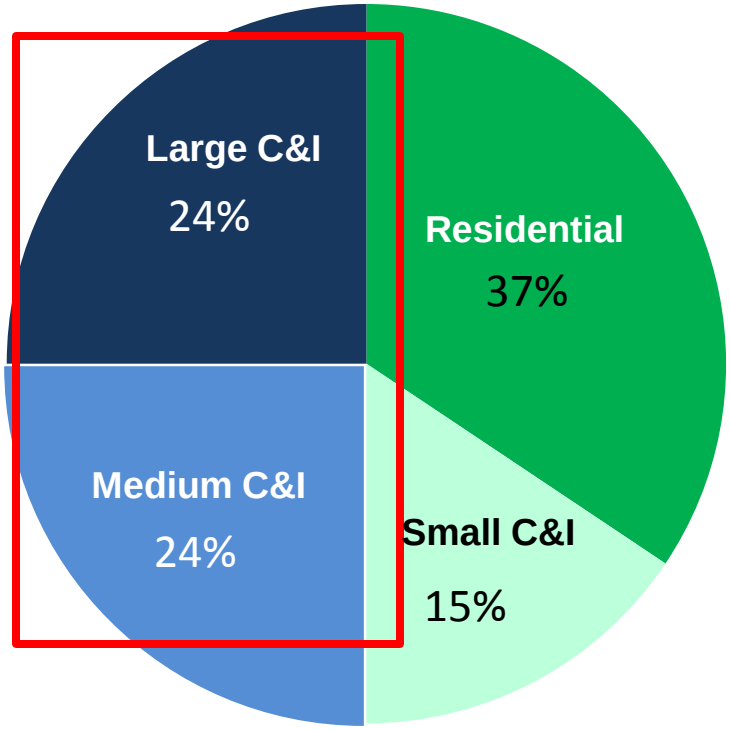
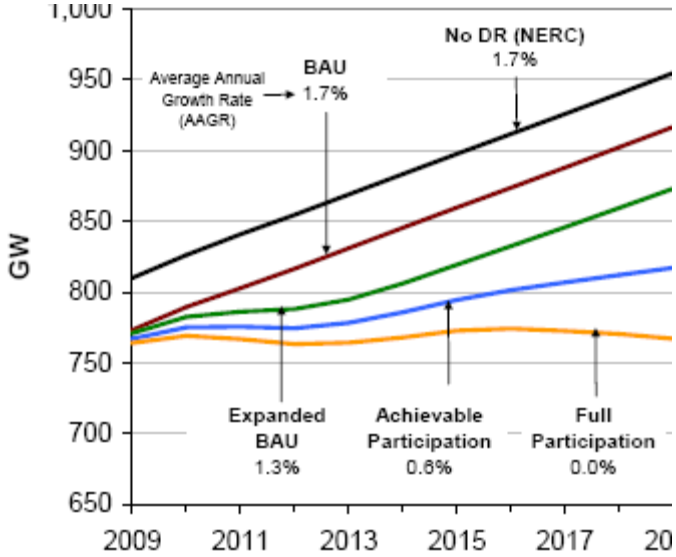
Commercial buildings – big load, large potential

U.S. Electricity Demand (GW)



Half of U.S. peak demand is medium to large facilities (>20 kW)

Potential Impact of DR (10-yr)



4%

20%

Source: North American Electric Reliability Corporation (2009) "2009 Summer Reliability Assessment"
FERC (2009) "A National Assessment of Demand Response Potential"

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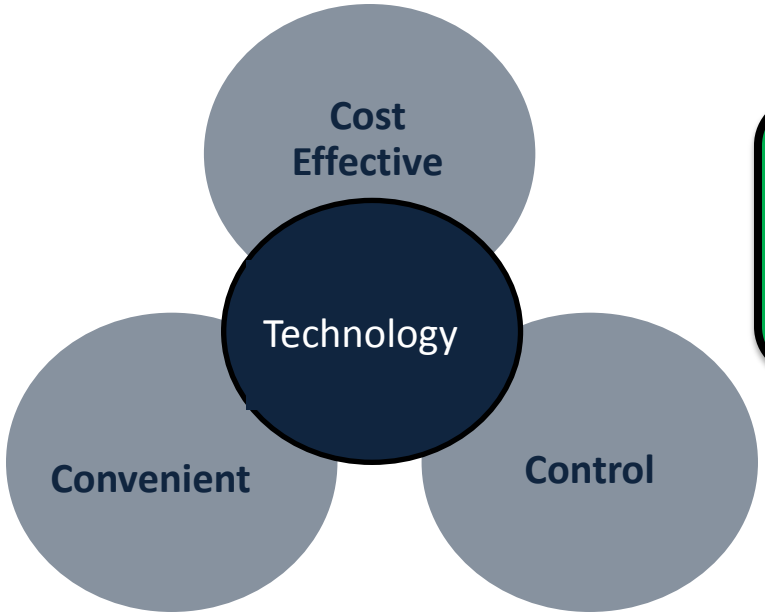
The Building Perspective on Demand Response

- **What do mid to large commercial buildings require in order to be interested in DR?**
  - **Cost Effective – economics have to work out**
  - **Convenient – building operators cannot take on a "second job" to manage load shedding**
  - **Control – unwilling to allow outside parties (utility, service provider, etc.) complete control over load**



Demand Response technology can help with all three

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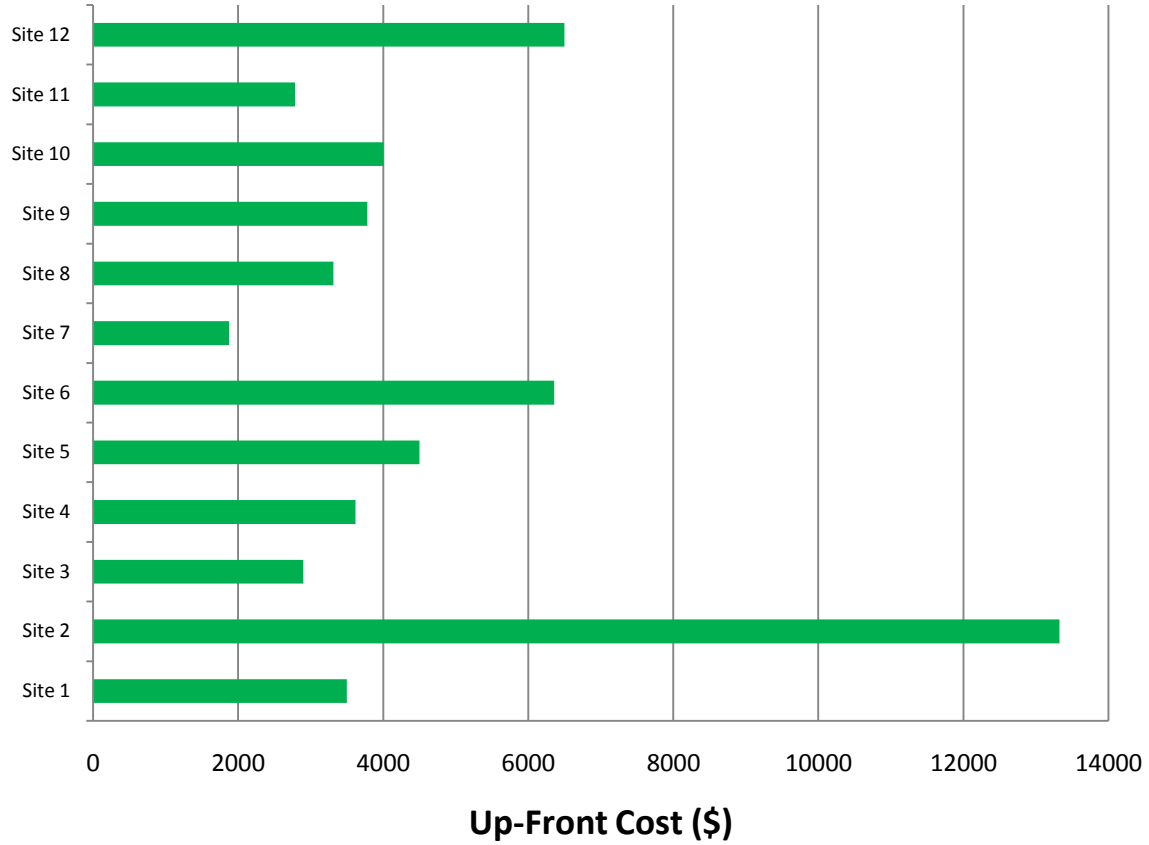
Cost Effective – Automating DR on Operations Budgets

Installation cost for DR automation technology



Median payback of projects under PG&E's Auto-DR program is 2.25 years

Source: PG&E/LBNL AutoDR Pilot, 2006.

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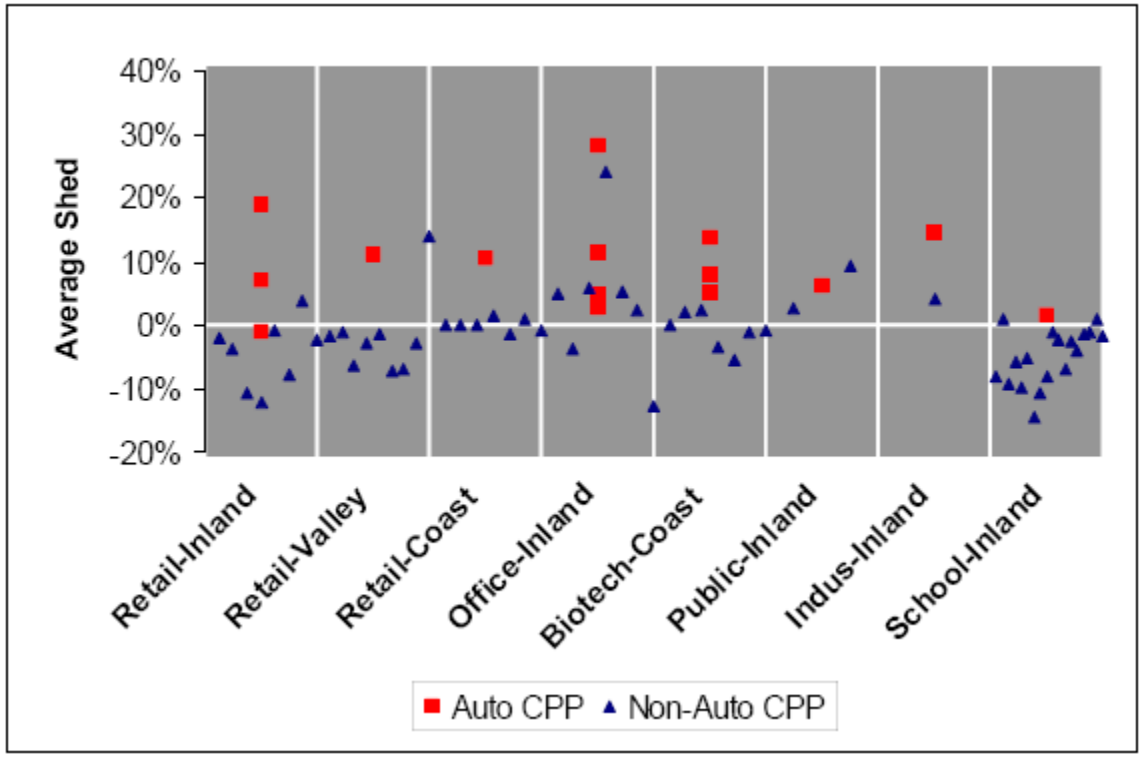
Convenient – If it's not easy, no one will do it



5% load response without technology

vs.

10% load response with auto-DR technology

Two pilot studies show that automation leads to better response

Source: Global Energy Partners (2007) "PG&E 2007 Auto-DR Program Assessment"
2006 CRA SPP C&I Report; Demand Response Research Center

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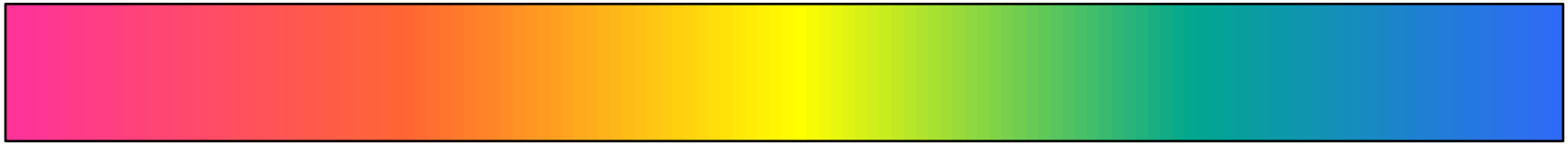
Control – A "Spectrum" of Demand Response Options

Logic, decision making and control can sit with the load-serving entity, the customer, or anywhere between (e.g. a curtailment service provider):

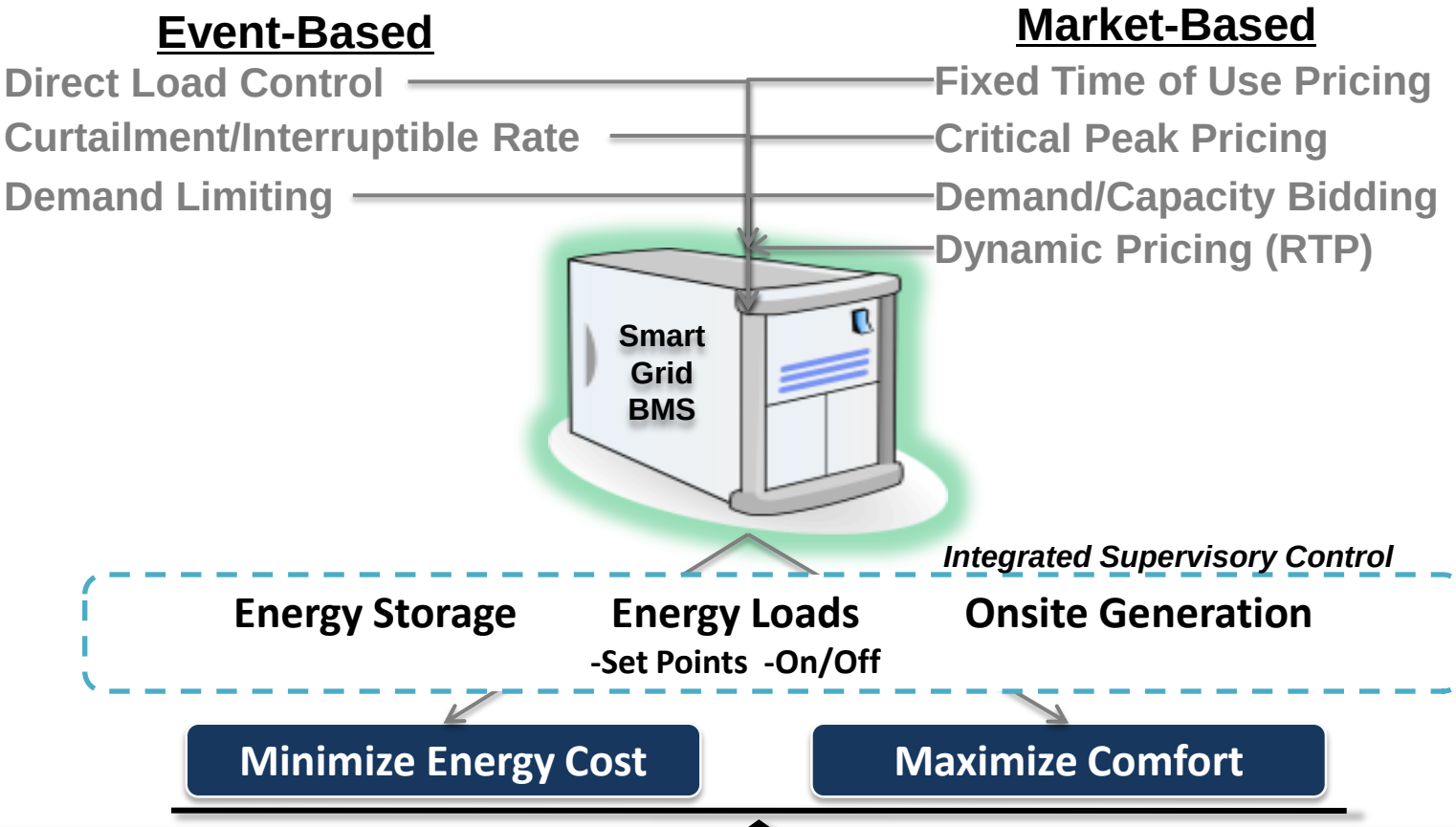
Central Control — **Autonomous Control**



- Direct Load Control (AC Cycling)
- Interruptible Rate
- Wholesale Capacity Programs
- Traditional "Aggregator" Model
- Critical Peak Pricing
- Wholesale Energy Programs
- Voluntary Demand Bidding
- Pure Real -Time Price

Historical DR has been centrally controlled, but there is a push to the right of the spectrum. Buildings benefit.

Technology can help with cost-effectiveness, increase convenience and maintain control



Example of an Automated Demand Response Event

Dispatches thermal storage or gen-sets in response to loss in solar PV output

Automatically dims lighting

Throttles servers for non-critical applications

Provides real-time visibility to building managers

Ensures fans do not overcompensate for new CHW set points

Adjusts space temp. and chilled water temp. set points

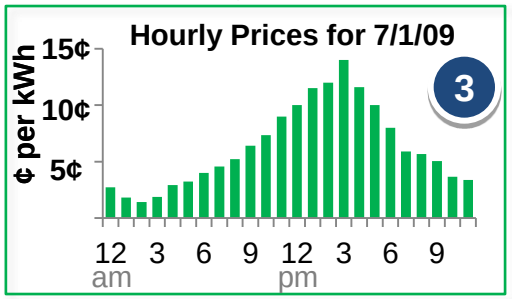
Prevents PHEVs from charging during peak hours

High summer temps drive up cooling loads

1

Marginal cost of power increases, T&D systems become congested

2



Curtailment signal or real-time price provided by ISO/utility

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Case Study – Automated Demand Response:

Georgia Institute of Technology

- Georgia Institute of Technology is on a dynamic hourly tariff from Georgia Power.
- Each hour, the building management system reads prices for the next 48 hours from the utility's web-service feed.
- The facilities director sets the price threshold for automated load shedding mode.

Savings during initial summer 2006 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 load for participating buildings