

Demand Response in Commercial Buildings

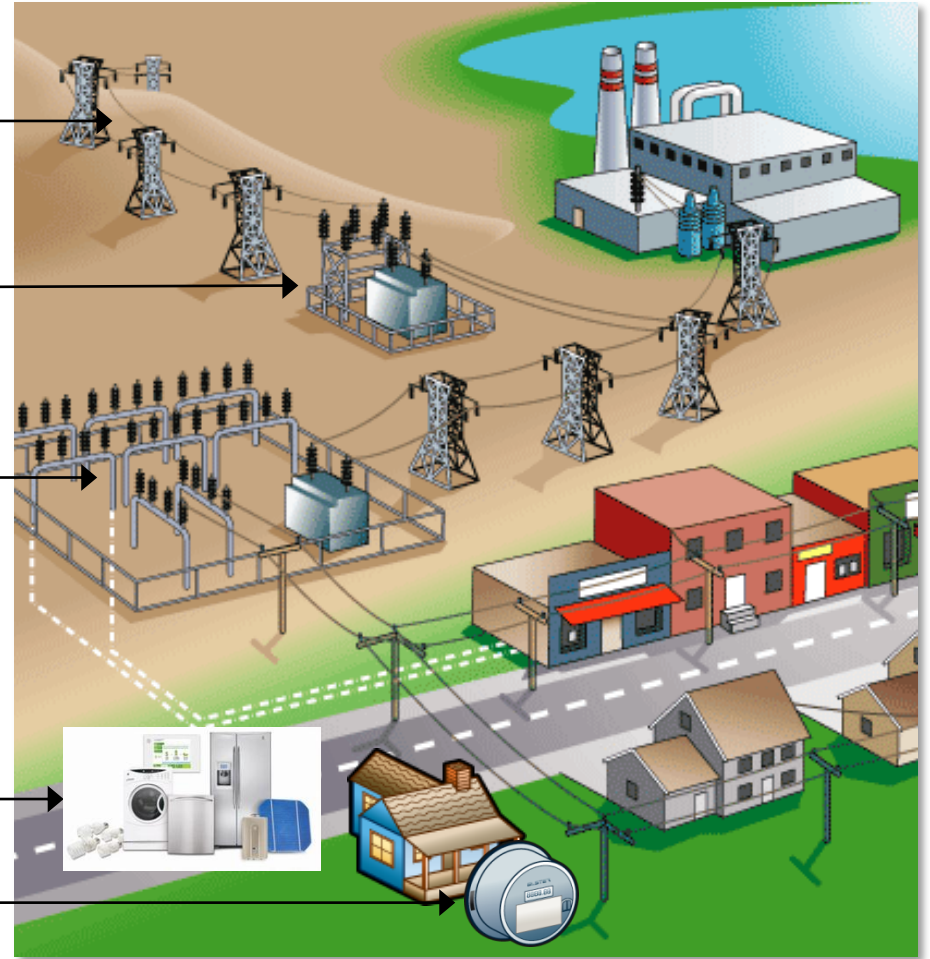
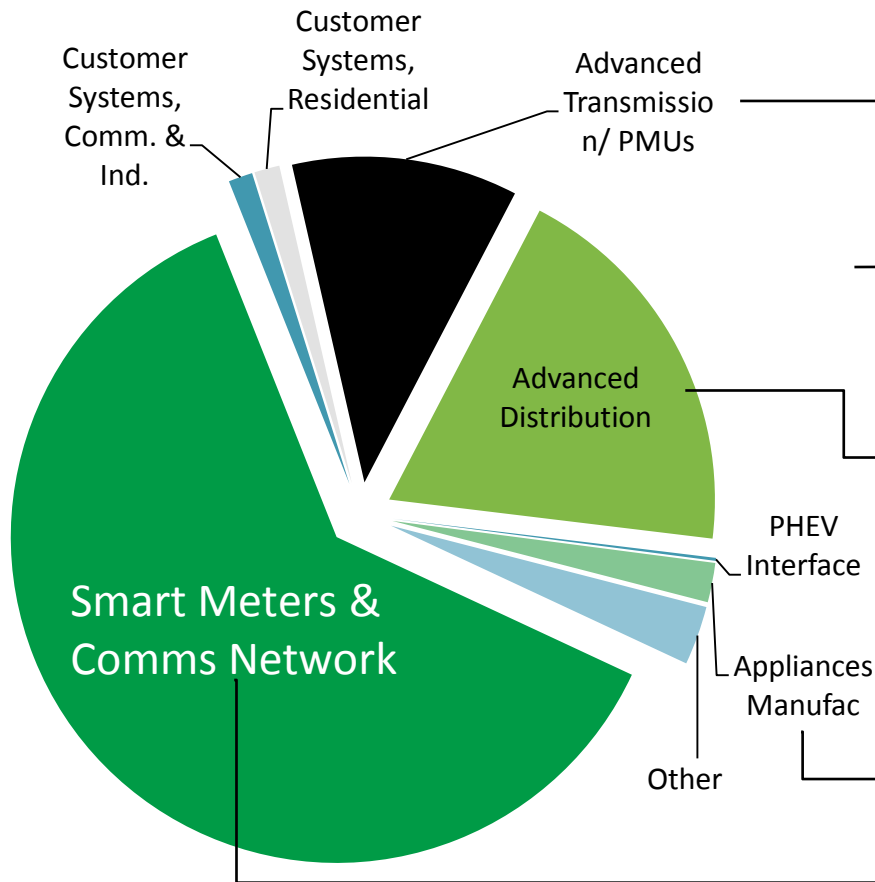
Technology as an enabler for scaling up





Technology makes the smart grid possible...

...and buildings are the next wave

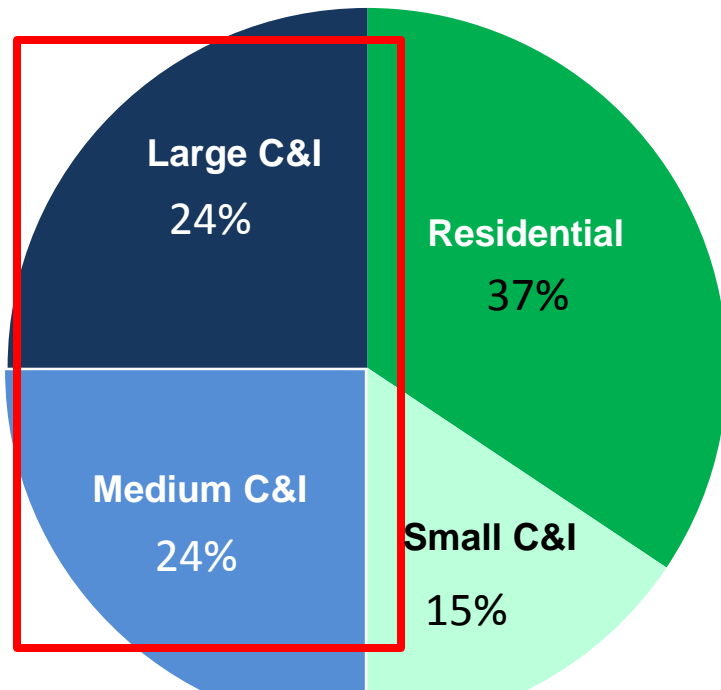


Source: Johnson Controls analysis of **\$3.4 billion** in SGIG awarded October 2009



Commercial buildings – big load, large potential

U.S. Electricity Demand (GW)



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

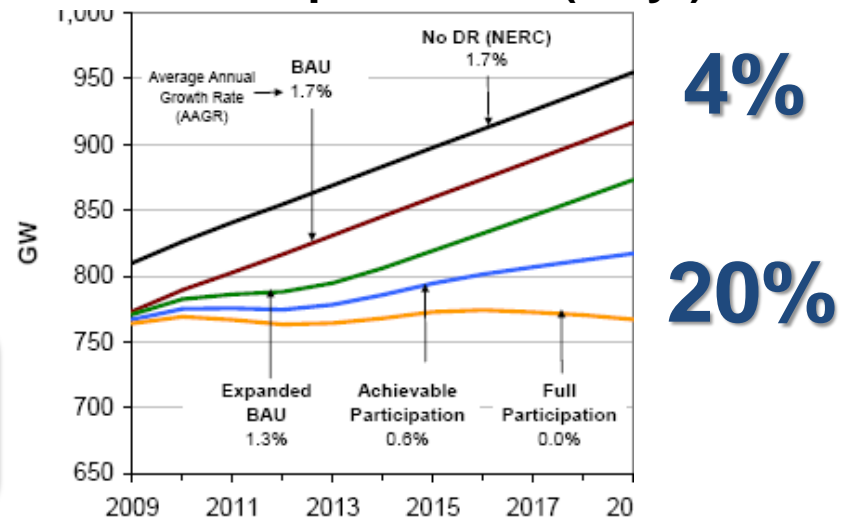
Buildings over 50,000 sf in the U.S.

5% of buildings

50% of floor space

56% of energy consumption

Potential Impact of DR (10-yr)

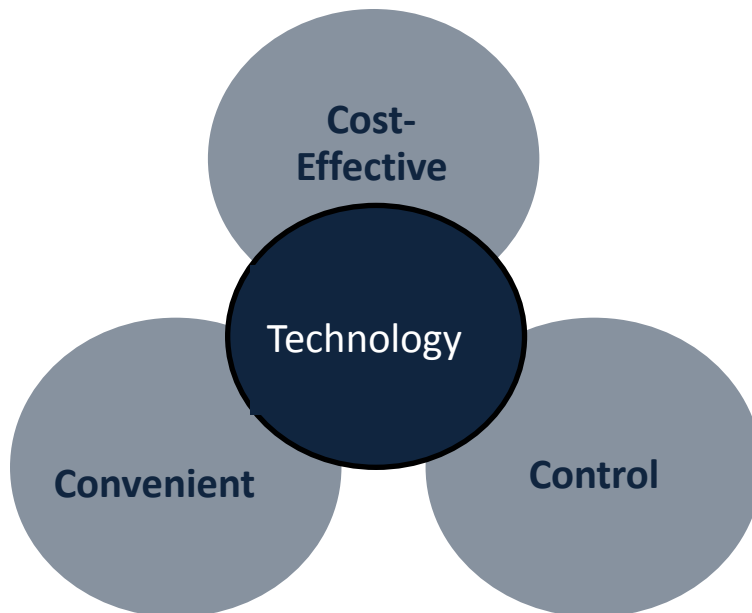


Source: North American Electric Reliability Corporation (2009) "2009 Summer Reliability Assessment"
 FERC (2009) "A National Assessment of Demand Response Potential"



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

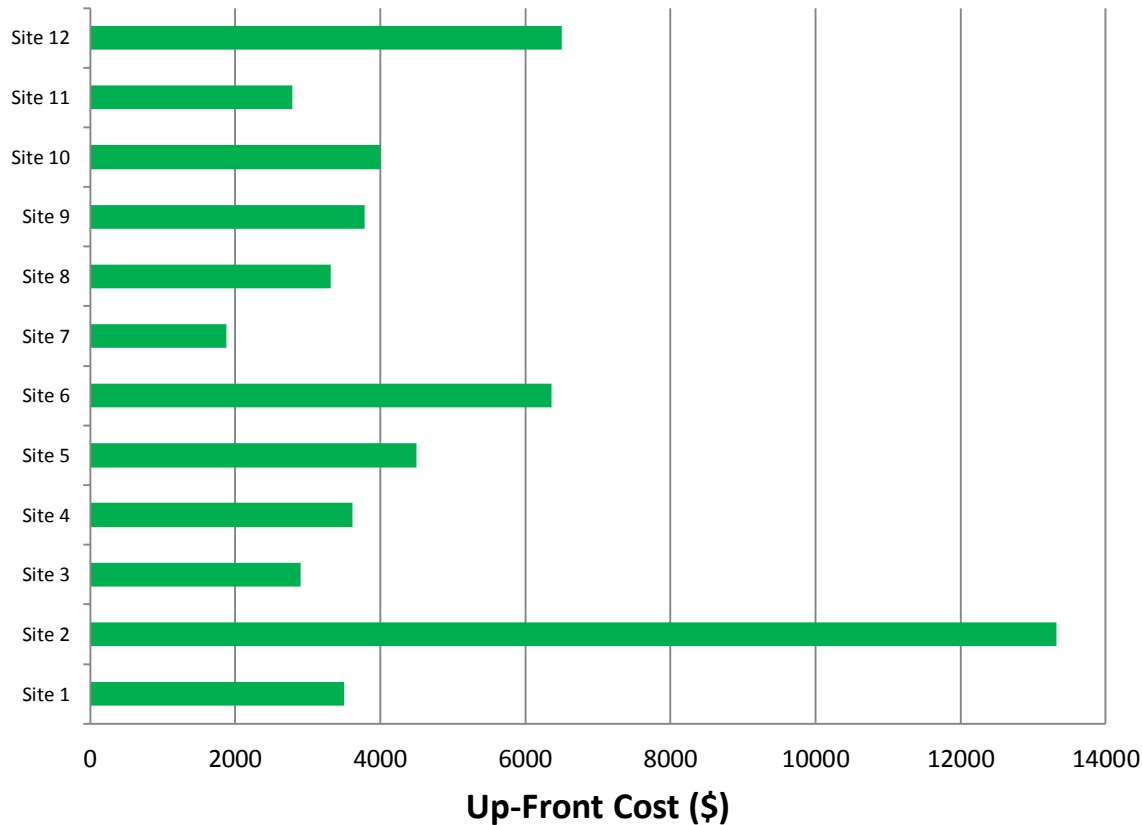


Demand Response **technology** can help with all three



Cost-effective – Automating DR on operations budgets

Installation cost for DR automation technology

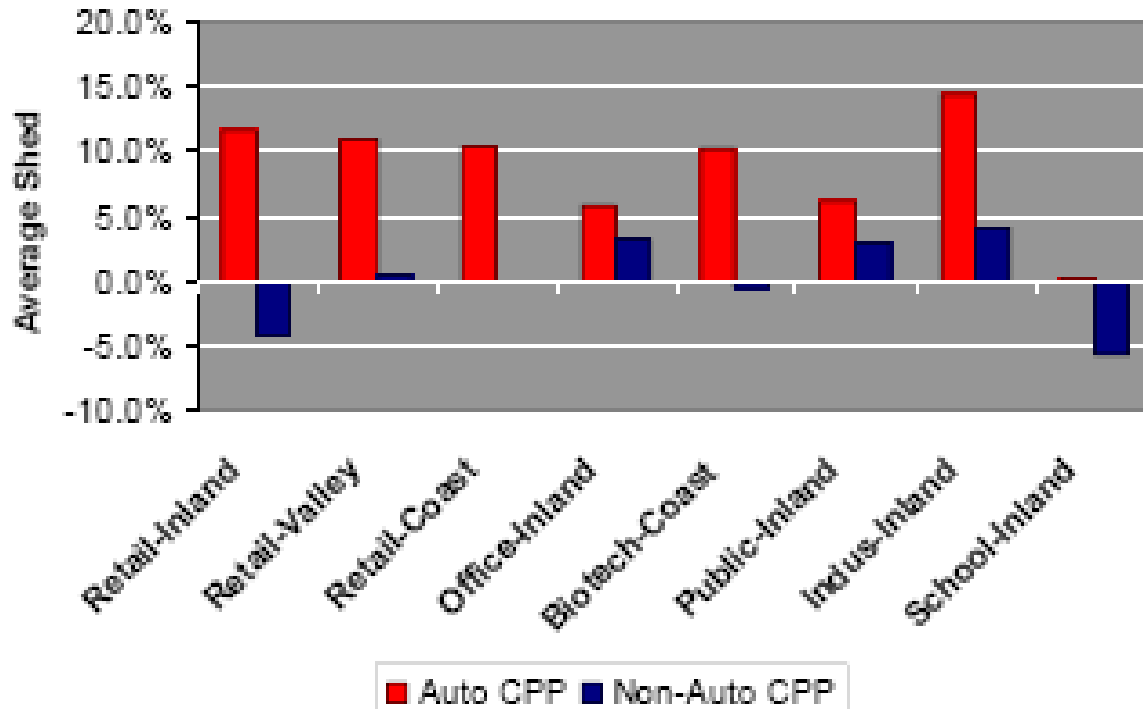


Median payback of projects under PG&E's Auto-DR program is 2.25 years

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



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



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. an curtailment service provider):

	Central Control		Autonomous Control	
	<ul style="list-style-type: none"> • Direct Load Control 	<ul style="list-style-type: none"> • Interruptible Tariff • CSP Capacity Programs • Emergency Programs 	<ul style="list-style-type: none"> • Critical Peak Pricing • CSP Energy Programs • Voluntary Demand Bidding 	<ul style="list-style-type: none"> • Real Time Pricing • Direct Bids into Wholesale Markets
“Call Events”	Administrator	Administrator	Administrator	Customer
“Opt in/out”	Administrator	Administrator	Customer	Customer
“Flip Switch”	Administrator	Customer	Customer	Customer

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



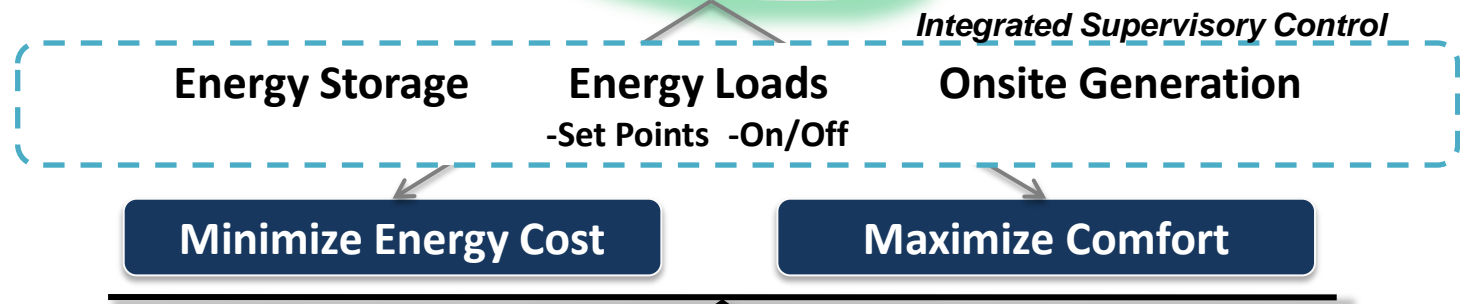
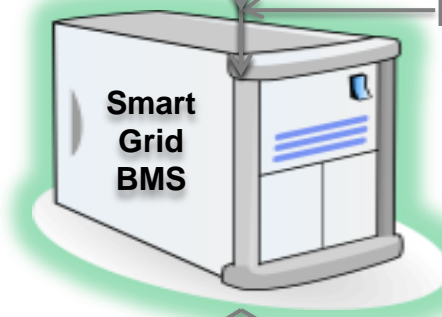
Technology can help with **cost-effectiveness**, increase **convenience** and maintain **control**

Event-Based

- Direct Load Control
- Curtailment/Interruptible Rate
- Demand Limiting

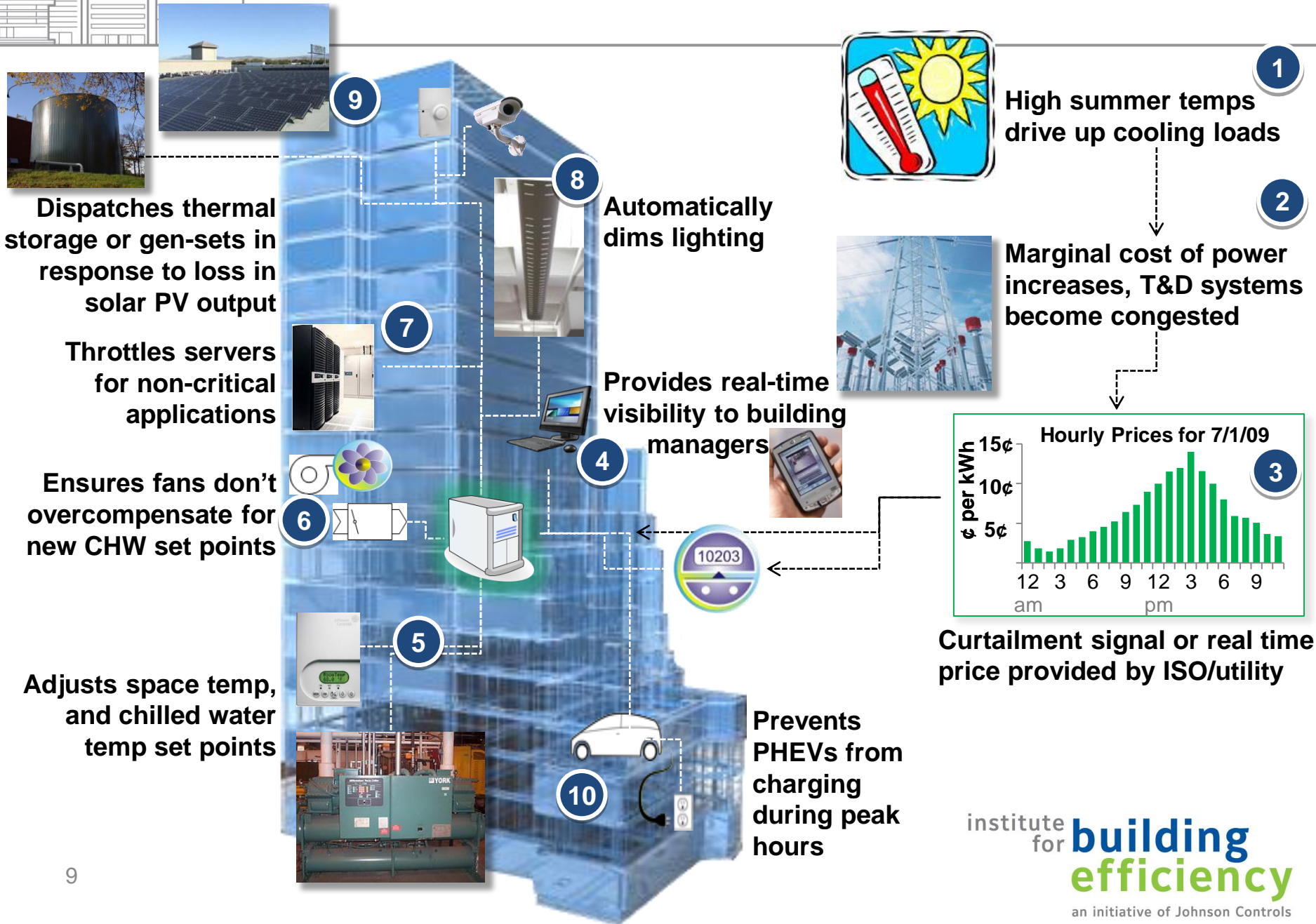
Market-Based

- Fixed Time of Use Pricing
- Critical Peak Pricing
- Demand/Capacity Bidding
- Dynamic Pricing (RTP)







Building owner pre-defines load reduction strategies, levels and thresholds based on and comfort and cost preferences

An example of an automated demand response event





Three example projects in three different markets

Project	DR Program	Load Shed (kW)	Revenue/Savings	Hours	Notes
Georgia Tech  	Georgia Power Real Time Price	96	\$790: \$8/kW-yr	<50	Operators identify threshold prices and trigger events automatically (with override potential).
PA Higher Ed 	PJM Capacity and Energy	3,000	\$257,000: \$84/kW-yr	~100	Combined demand response and energy efficiency in contract. Partial automation.
Bell Trinity Square 	NR Canada Pilot	500	\$0 Voluntary!	15	Pilot project to demonstrate opportunity for DR in Ontario. Full automation.