

ENERGY EFFICIENCY & DEMAND RESPONSE

Deriving more value from commercial buildings



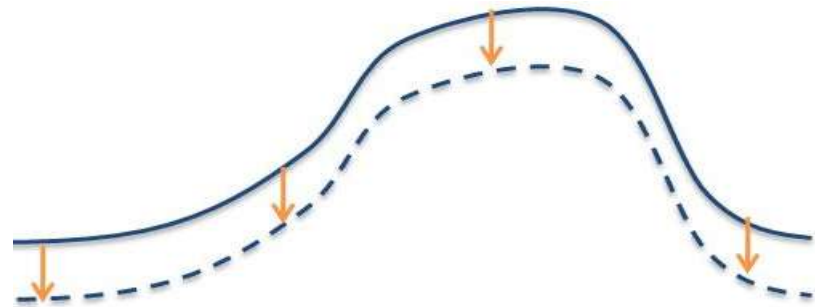
JOHNSON CONTROLS



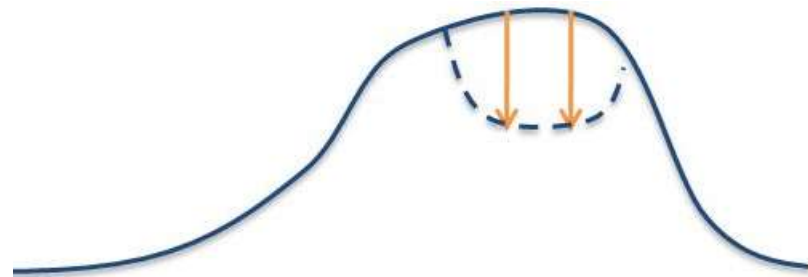
- Energy Efficiency: Largest Energy Services Company in North America with over \$5B in active guarantees.
- Demand Response: Completed acquisition of Energy Connect in July 2011, Hundreds of customers, hundreds of MW's.
- www.institutebe.com



Energy Efficiency: Using less energy to provide the same or improved level of service to the energy consumer in an economically efficient way¹



Demand Response: Changes in electric usage by end-use customers from their normal consumption patterns in response to changes in the price of electricity over time, or to incentive payments²



¹ National Action Plan for Energy Efficiency, 2006

² U.S. Dept of Energy, 2006

THE BIG PICTURE

Buildings as power plants in the grid of the future



Buildings can deliver services to the electric system comparable to conventional **power generation assets** and the “supply side”



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BASELOAD & ENERGY EFFICIENCY



Timing: Long lifetimes, all or most hours of the year

Communication: Limited needs because they are always “running”

Value: Long term planning as a resource for meeting both energy and peak capacity needs



Technology: Nuclear, coal, gas combined cycle, high efficiency equipment and controls for lighting, HVAC, motors, efficient building envelope

PEAK CAPACITY AND EXISTING DR



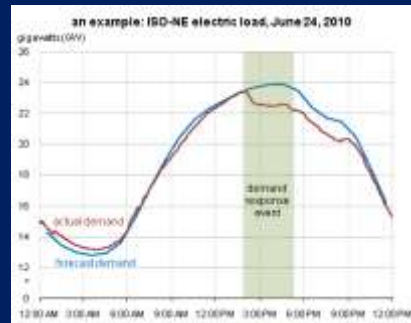
Timing: Day-ahead or day-of notification, ~100 hours per year

Communication: Event signals via phone/pager/internet

Value: Reliability tool to avoid outages or alleviate high price conditions



Event-based DR (hours)



Technology: Gas “peaker” plants, curtailment of industrial processes, resetting temperatures, slowing fans and pumps, dimming or switching off lights

ANCILLARY SERVICES & “FAST DR”



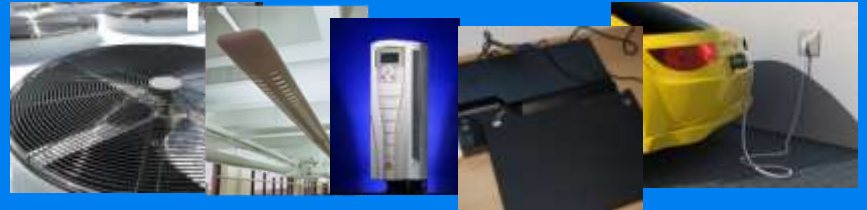
Timing: Minutes or seconds of notification, events minutes to hours

Communication: Fully automated, two-way systems for event signaling, participation confirmation, telemetry and monitoring during events

Value: Operational tool for meeting demand and increasing grid stability; more important as variable energy resources play a larger role in supply



Ancillary Services (minutes)



Technology: Variable speed drives, electronic equipment, dimmable lighting and other loads that can be centrally controlled and can be changed on short timescales.

ALL THREE ALLEVIATE T&D CONSTRAINTS



Energy efficiency and all forms of demand response reduce strain on the grid during critical times:

- Improving reliability and stability in the near term, and
- Reducing cost through avoided additions over time



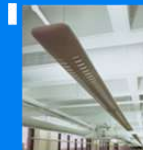
Energy efficiency (years)



Event- and price-based DR (hours)



Ancillary Services (minutes to seconds)



BUT WHAT ABOUT THE CUSTOMER?

Financial and technical reasons to pursue EE & DR



Financial



Two revenue streams enhance economics:

- Bill savings through energy efficiency and peak management (TOU rates, demand charges)
- Revenue from wholesale market or grid operator

Multiple benefits accrue to single decision-maker

Data/Technology



Near real time electricity data is important to both EE & DR

- Shared hardware and database
- Measurement & Verification
- Opportunity to increase depth and quality of savings through analytics

Single database supporting multiple “applications”

EE + DR PRO FORMA

Sample office building in New York City



- 500,000 sf office building with regional average energy use & rates
- **Energy efficiency:** lighting, retro-commissioning, light HVAC improvements for total savings of 16% and 3.5 year simple payback = \$300,000 per year
- **Demand Response:** 10% reduction from 2.1 MW peak demand at \$100/kW = \$21,000 per year
- Roughly 10x more value from energy efficiency, but DR can augment project

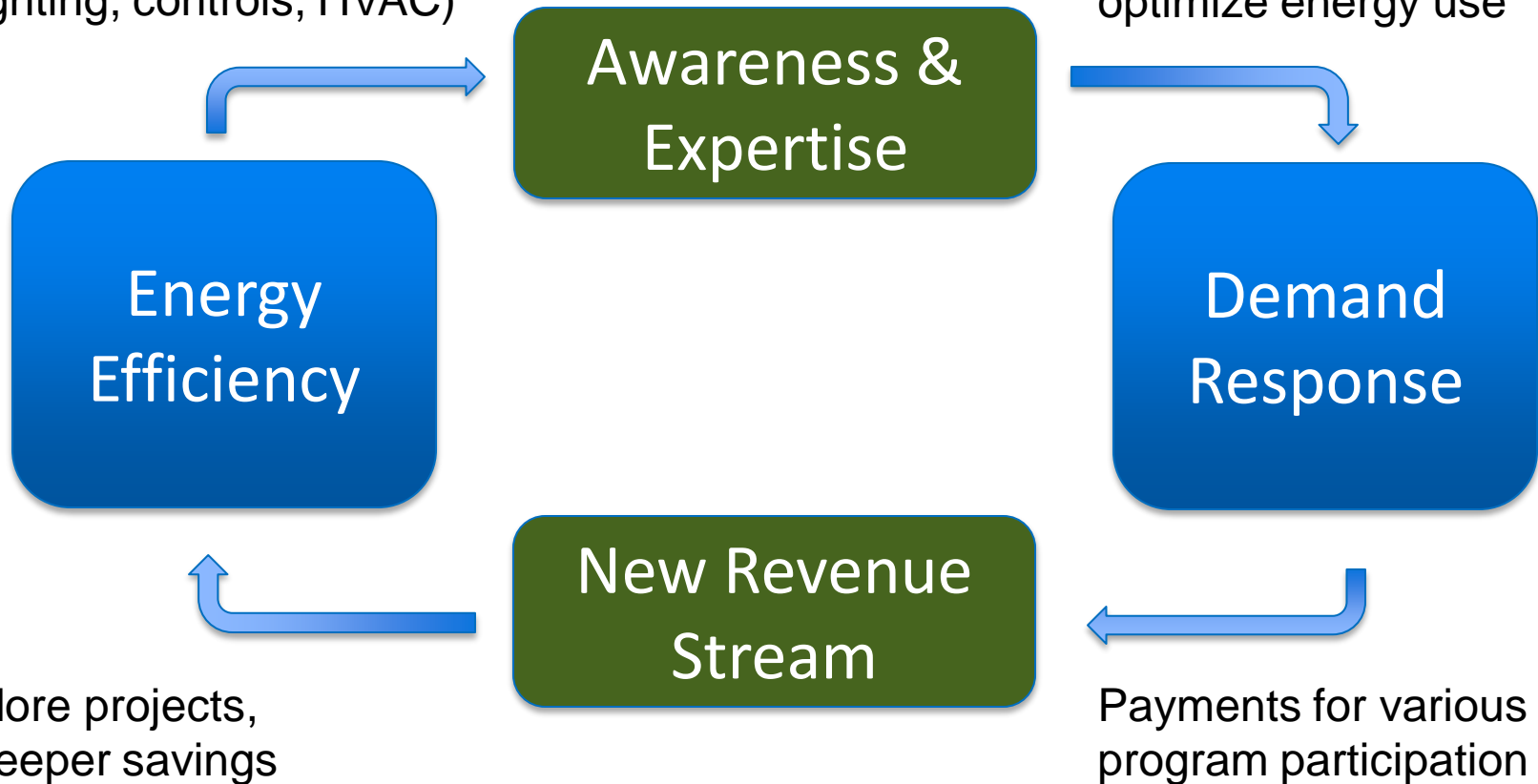
THE HOLY GRAIL OF BEHAVIOR

How EE drives DR, and vice versa



“Entry level” efficiency
(lighting, controls, HVAC)

Additional ways to
optimize energy use

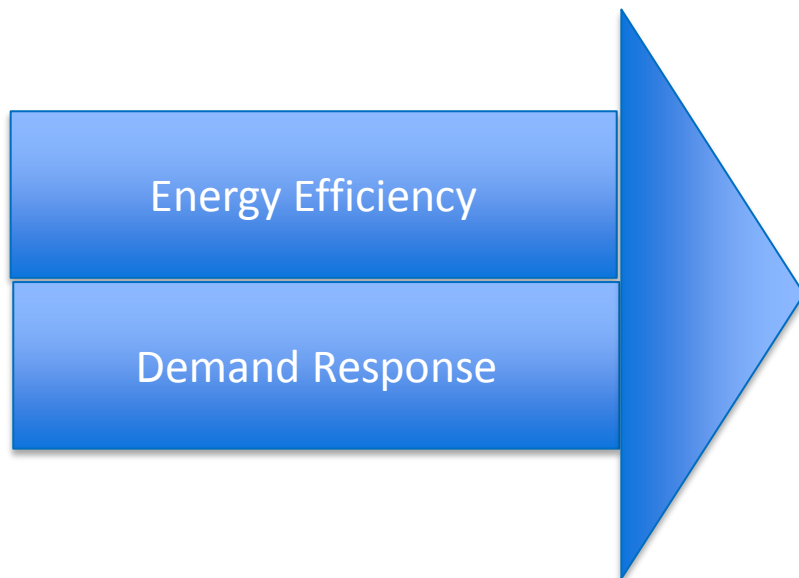


More projects,
deeper savings

Payments for various DR
program participation

BEYOND LABELS

Next steps toward integrated energy management



1. **Demand management** includes day-to-day changes to loads to minimize bills.
2. **Energy storage** enables more load-shaping.
3. **Energy procurement** involves shopping for a retail rate that best suits the load profile

NOT ALL FUN AND GAMES

Potential problems with combined EE and DR



- 1. Timescales.** Efficiency generates savings over periods of months and years, often tracked by monthly utility bills. Demand response requires at least 15 minute resolution and often goes to intervals of a few seconds.
- 2. Organizational structure.** Demand response has traditionally been the domain of the facility operators and building engineers. Integrating with energy efficiency requires buy-in from the financial organization and the new technology solutions require IT departments to be included as well.
- 3. Incentive Programs Silos.** EE and DR look similar to a facility operator, but for governments and electric utilities they are two separate programs with unique objectives. In practice, integrating DR and EE can present administrative challenges in interfacing with two different programs.



THANKS!



Visit www.instituteBE.com for more on DR, EE and other topics