U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

Grid-interactive Efficient Buildings

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Grid-interactive Efficient Buildings

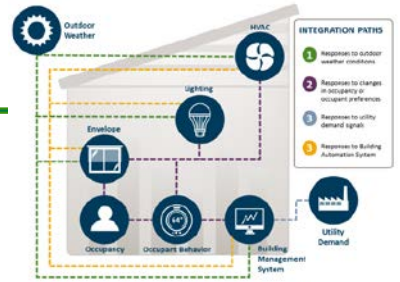
- **Buildings are dynamically managed** to grid requirements and occupant needs.
- Building loads are flexible enough to enable **localized grid management** based on location, time of the day, time of year, and across years
- Combinations of **building loads, onsite generation, and onsite energy storage are optimized** to minimize cost to the building owner, the utility customer, and the broader electricity system.

Why?

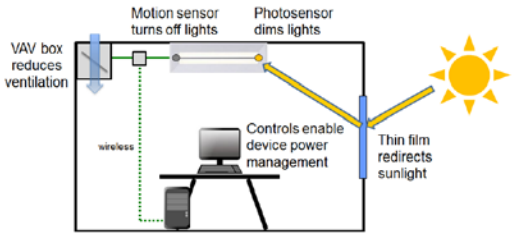
Residential and commercial buildings =

- 75% of all U.S. electricity drive
- 80% of peak demand, and buildings are
- expected to drive nearly 70% of projected electricity-use growth through 2040 (EIA 2017)

Connectivity creates systems synergies, more optimization opportunity.



ISOP Technology Communication Pathways



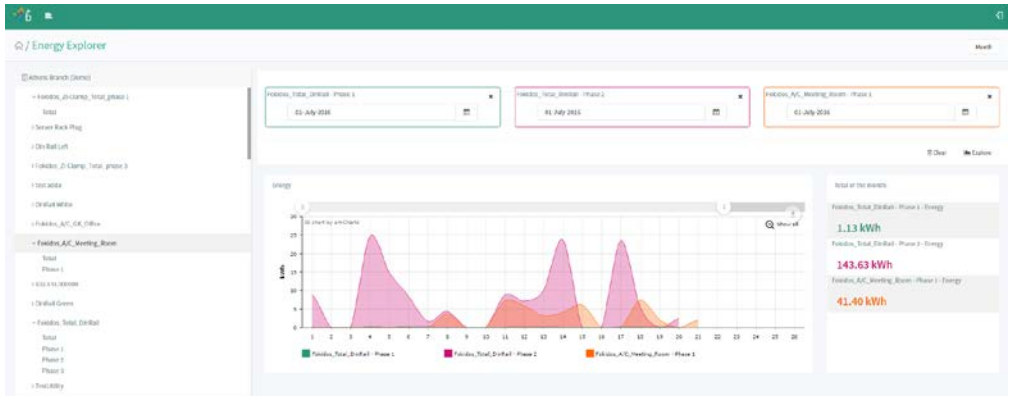
Comparison of component- vs. systems-based savings for three integrated systems.

Option	Lighting EUI (kWh/sf/yr)	Lighting Savings relative to Baseline	Lighting Savings relative to Component-based Retrofit
Baseline (Fluorescent, scheduled control)	3.68	–	–
Component-based Retrofit (simple LED)	1.36	63%	–
Automated Shading and Daylighting	0.64	83%	53%
Workstation-Specific and Daylighting	0.31	92%	77%
Task / Ambient and Occupancy	0.67	82%	51%

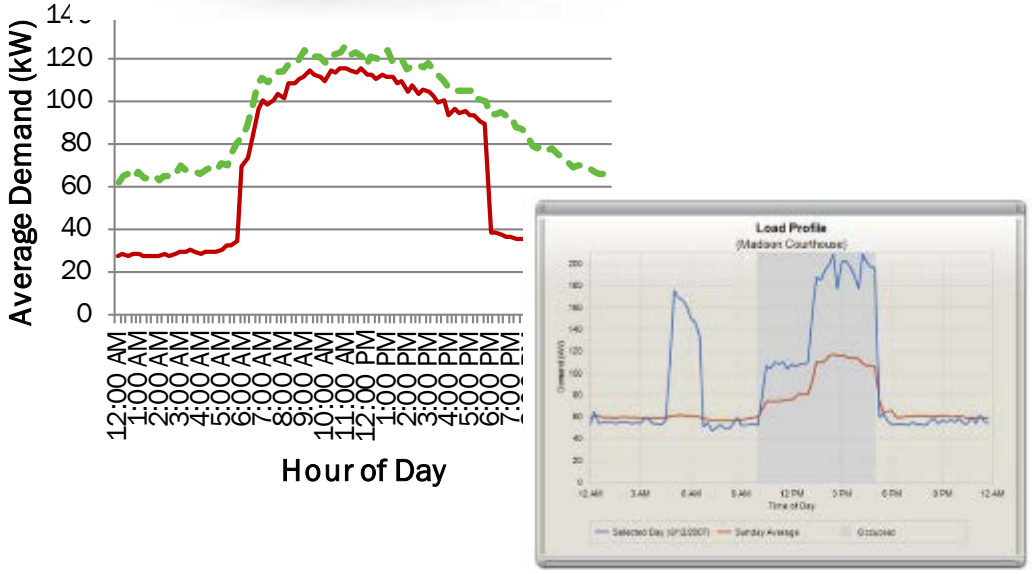
SOURCE: Lawrence Berkeley National Laboratory, *Energy Savings of Systems-Based Building Retrofits: A Study of Three Integrated Systems*. (DRAFT) Cindy Regnier, Paul Mathew, Alastair Robinson, Peter Schwartz, Jordan Shackelford, Travis Walter.

...the systems yielded *additional* savings of 51-77%

Building Owners

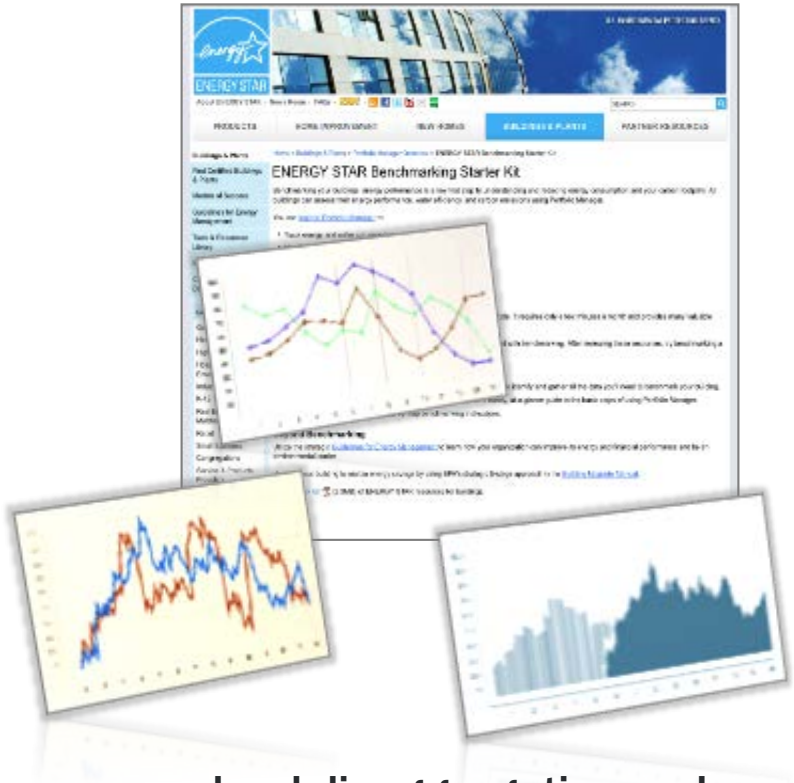


low-cost sensing



grid-interactive

peel & stick

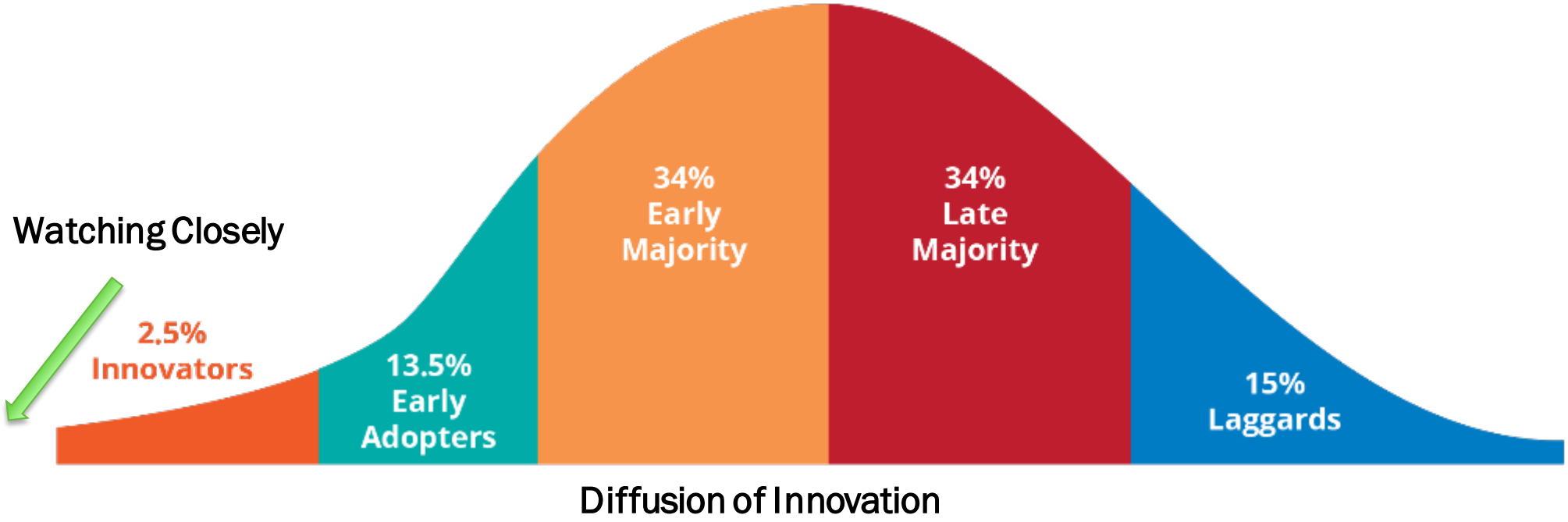


load disaggregation and virtual metering

Grid Stakeholders

Flexibility: The ability to respond to changing energy availability and pricing in response to grid needs while maintaining building energy services and occupant comfort. (Source: Adapted from DOE. "Grid Modernization Multi-Year Program Plan." Nov. 2015. https://energy.gov/sites/prod/files/2016/01/f28/Grid%20Modernization%20Multi-Year%20Program%20Plan.pdf)

Interoperability: The capability of two or more networks, systems, devices, applications, or components to exchange and readily use information—securely, effectively, and with little or no effort by the user. (Source: Pacific Northwest National Laboratory. "Reference Guide for a Transaction-Based Building Controls Framework." April 2014. https://energy.gov/sites/prod/files/2014/06/f16/PNNL-23302_draft.pdf)

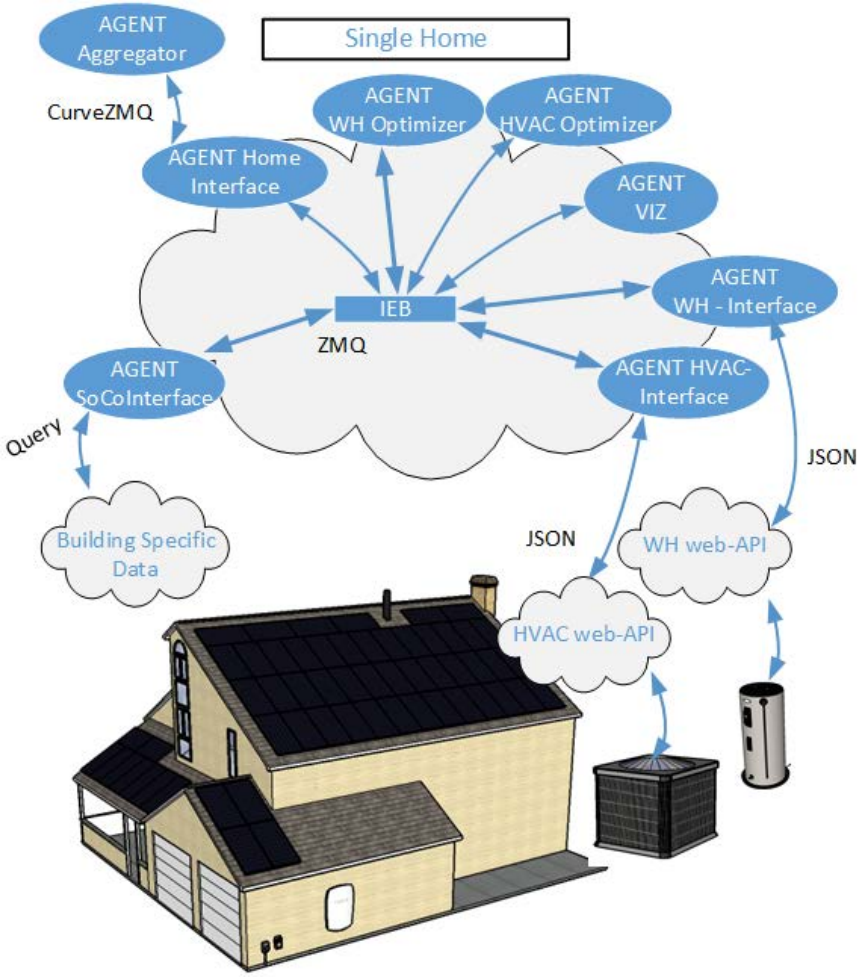


Buildings as a Resource: Example Community

Who? Oak Ridge National Lab, Southern Company

What? Autonomous integration and negotiation of load resources with a microgrid controller

Agent	Purpose	
Home Interface	Data Pass through and collector of optimization and electrical consumption projections for Aggregator agent	✓
HVAC Interface	Translates HVAC decisions and status to vendor API	✓
Water Heater Interface	Translates Water Heater decisions and status to vendor API	✓
HVAC Optimizer	Utilizes building specifications, forecasted weather data, building parameter data, price forecast, and HVAC status data to optimally schedule HVAC and provide expected electrical consumption.	✓
Water Heater Optimizer	Utilizes predicted water consumption, price forecast, and Water Heater status data to optimally schedule Water Heater and provide expected electrical consumption.	
SoCoInterface	Pulls data from Southern Company API which includes weather, building specifications, historical load measurements by circuit, device credentials, and historical data.	✓
Learning	Utilizes data collected from SoCo stored data to perform predictions on hot water usage, internal heat loads, building parameters, etc.	✓



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