U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

Buildings as Grid(-interactive Efficient) Assets

DOE Lighting R&D Workshop

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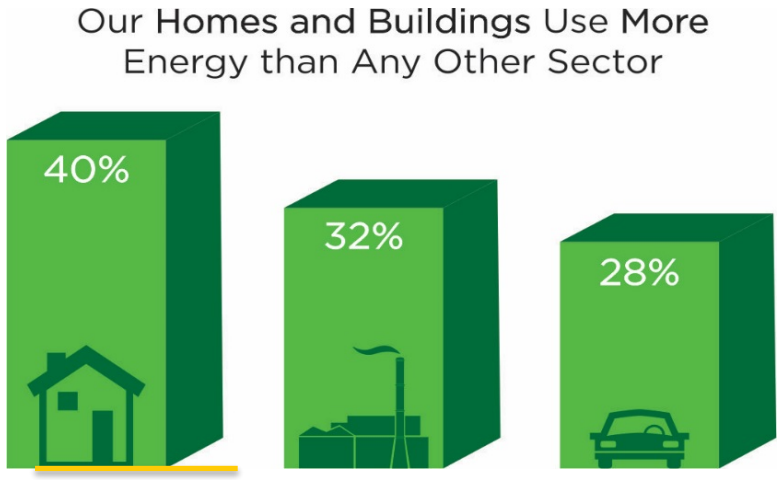
Our Homes and Buildings

There ~**125 million buildings** in America.

They use **40%** of America's **energy** and **75%** of its electricity.

More than 80% of them are 20 years old or older.

At least **20+% of this energy is wasted away** in buildings.

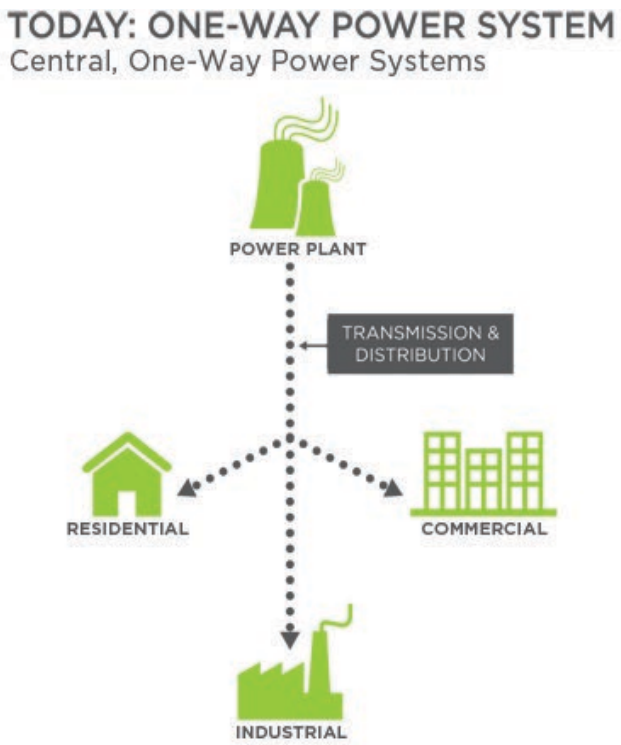


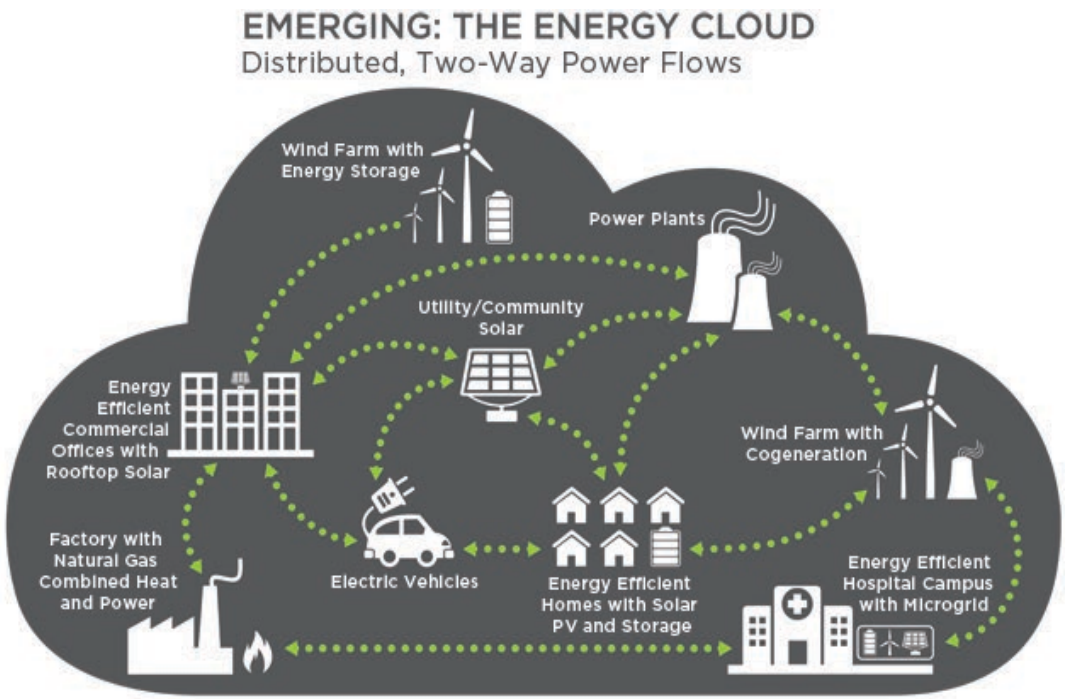
Buildings' **energy bill is $415 billion annually**, much of which is wasted

Buildings consume **up to 80% of peak electricity**, often the dirtiest and most expensive electricity utilities can make

Source: EIA Monthly Energy Review;; U.S. Energy Information Administration (CBECS 2012/RECS 2015); NAREIT Reits by the Numbers; Census Bureau Quarterly Retail E-Commerce Sales 4th Quarter 2016

Moving toward the grid of the future



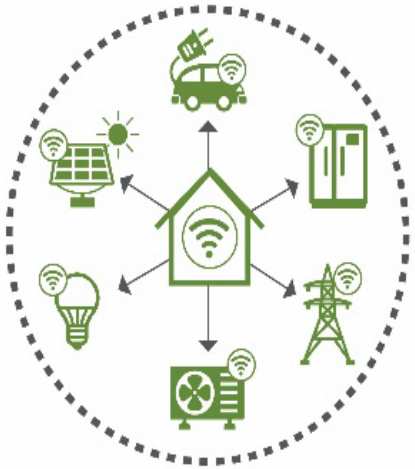


(Source: Navigant)

Characteristics of Grid-interactive Efficient Buildings

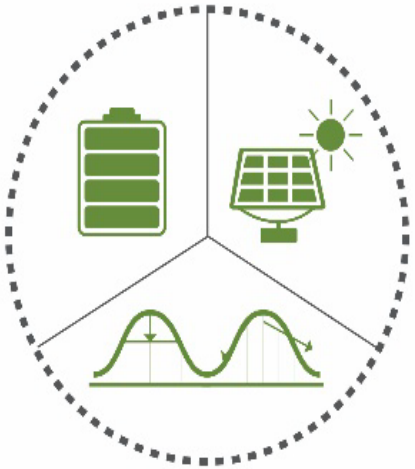
EFFICIENT

Persistent low energy use minimizes demand on grid resources and infrastructure



CONNECTED

Two-way communication with flexible technologies, the grid, and occupants



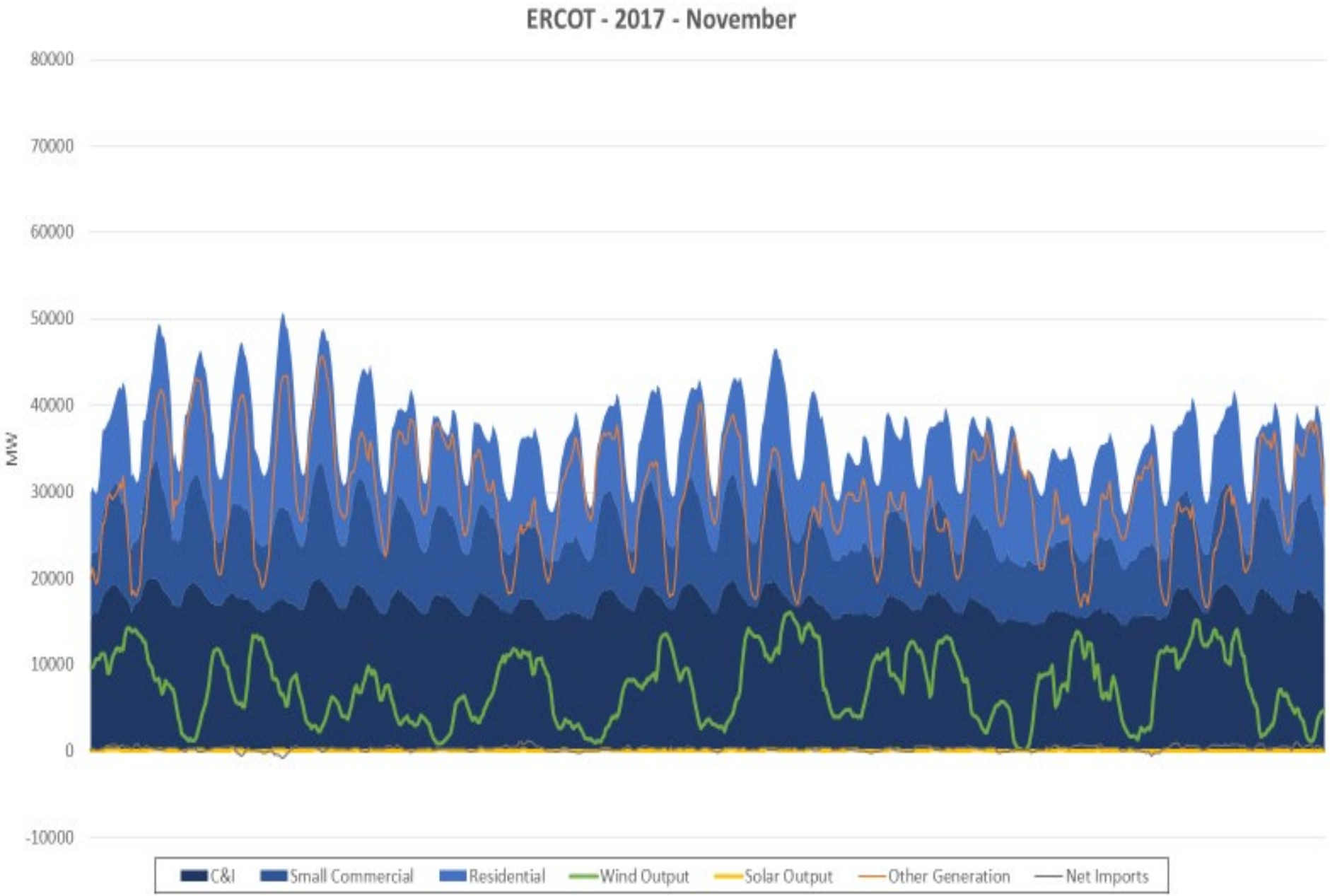
FLEXIBLE

Flexible loads and distributed generation/storage can be used to reduce, shift, or modulate energy use

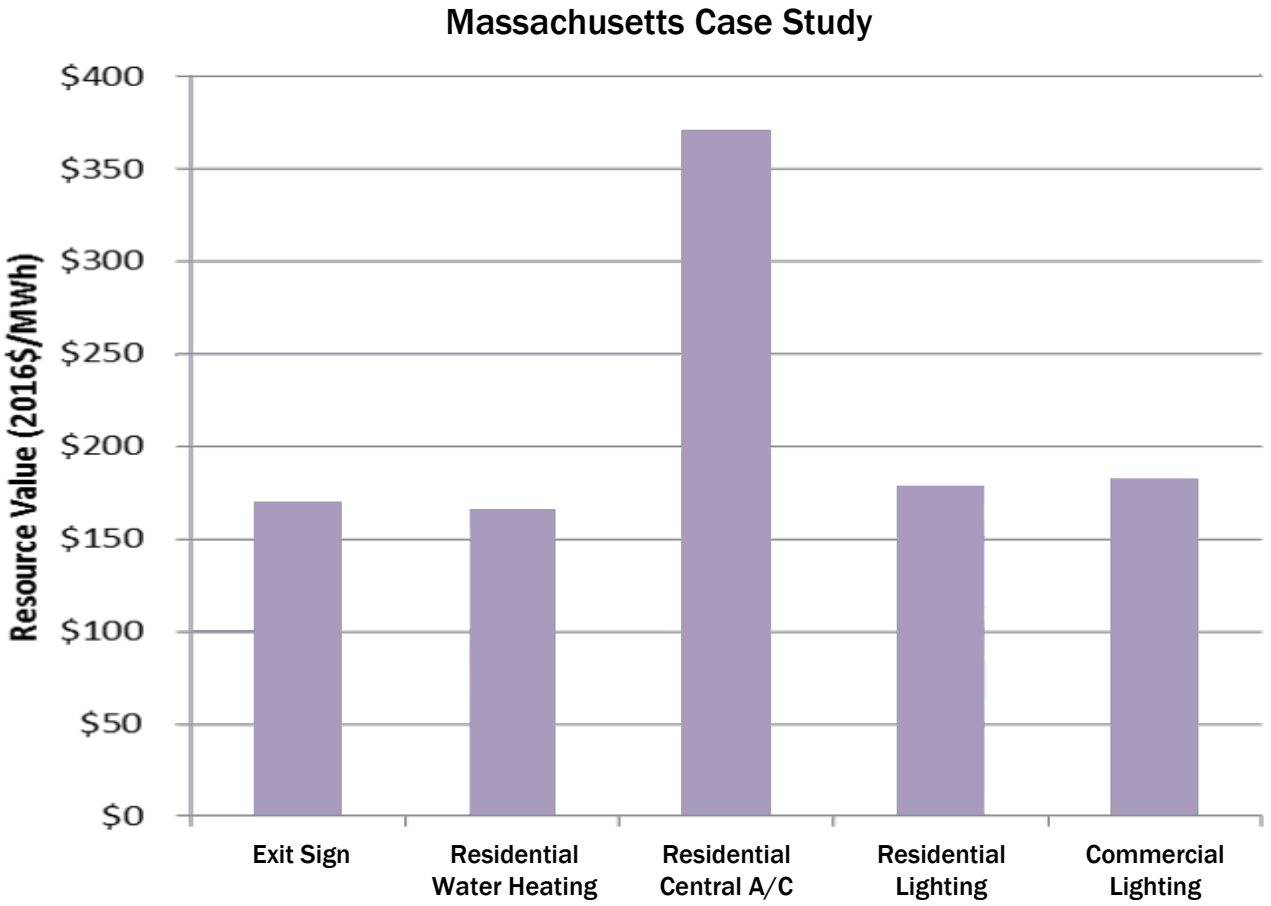
SMART

Computing, data analytics, and machine learning supported by sensors and controls co-optimize efficiency, flexibility, and occupant preferences

www.energy.gov/eere/buildings/geb


ERCOT - 2017 - November
80000
70000
60000
50000
40000
30000
20000
10000
0
-10000
MW
C&I
Small Commercial
Residential
Wind Output
Solar Output
Other Generation
Net Imports

Not All Energy Efficiency is Equally Valuable

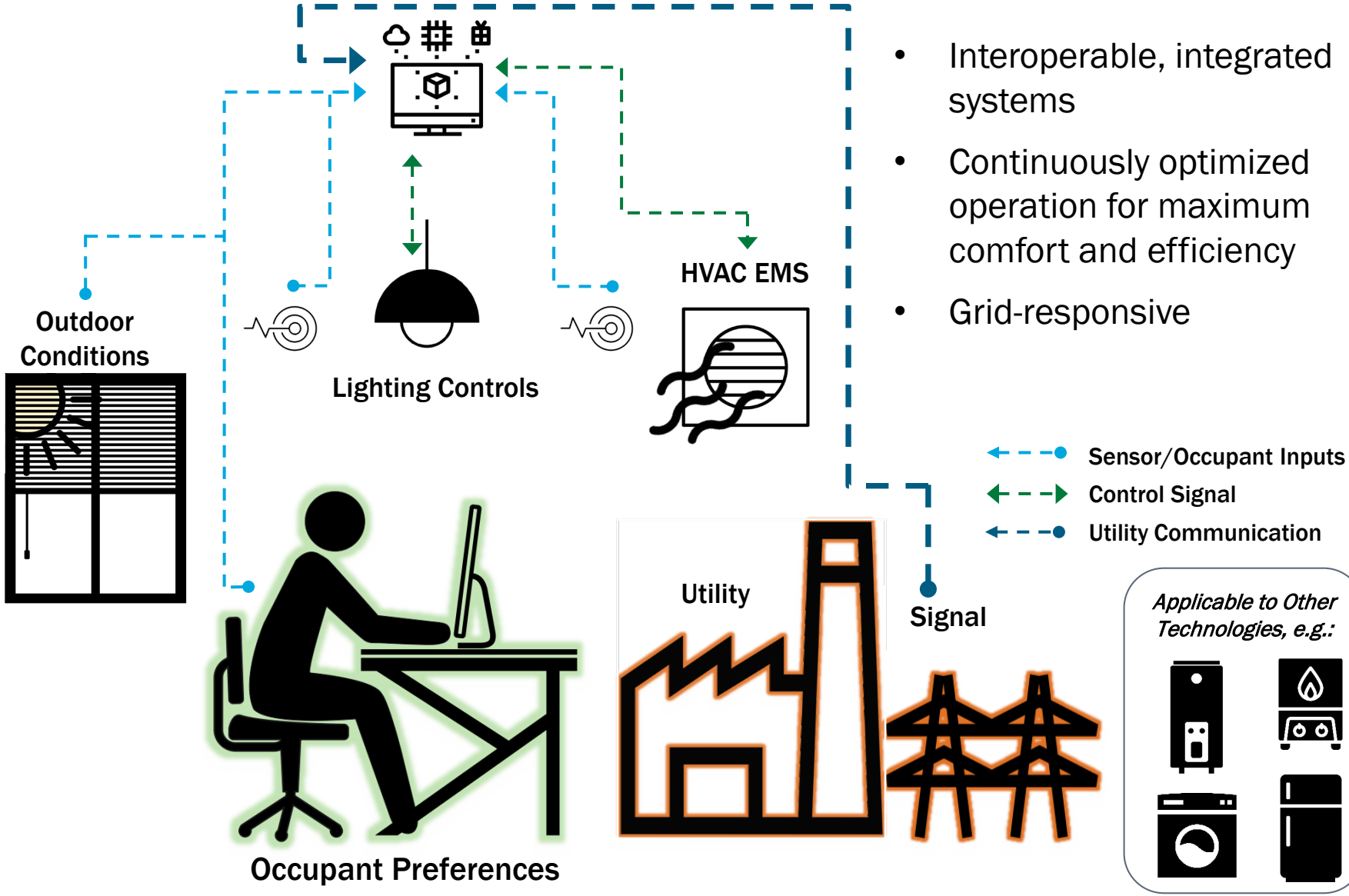


Time-varying value of energy efficiency savings by load shape

(reflects publicly available data only)

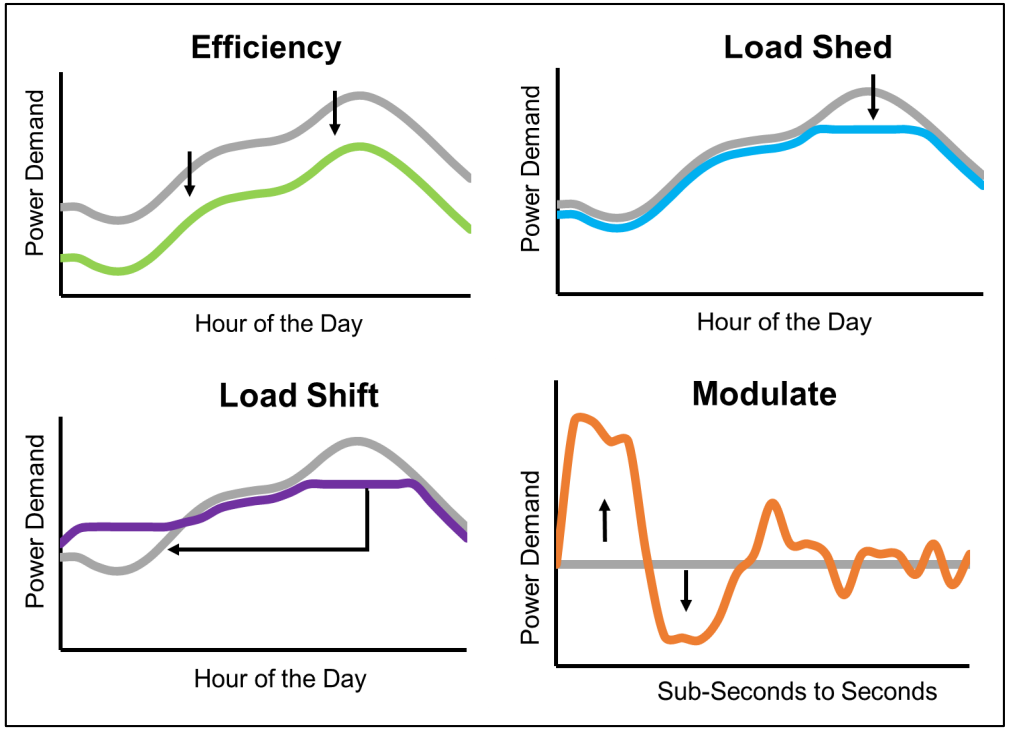
Source: ***Time-Varying Value of Electric Energy Efficiency*** *June 2017* N.Mims, T.Eckman & C.Goldman, LBNL, for BTO

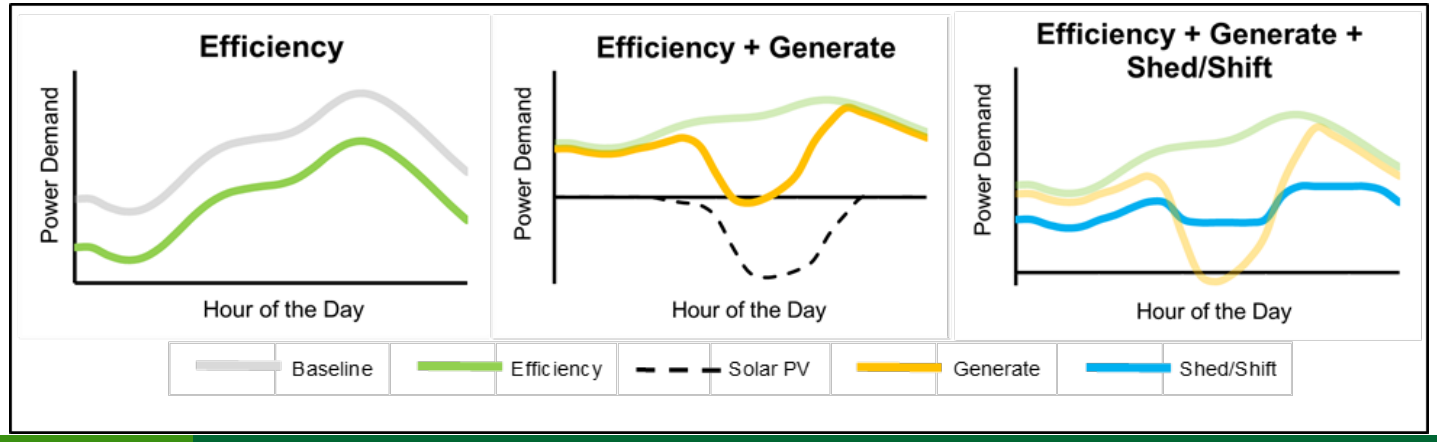
Interactions with Building Occupants



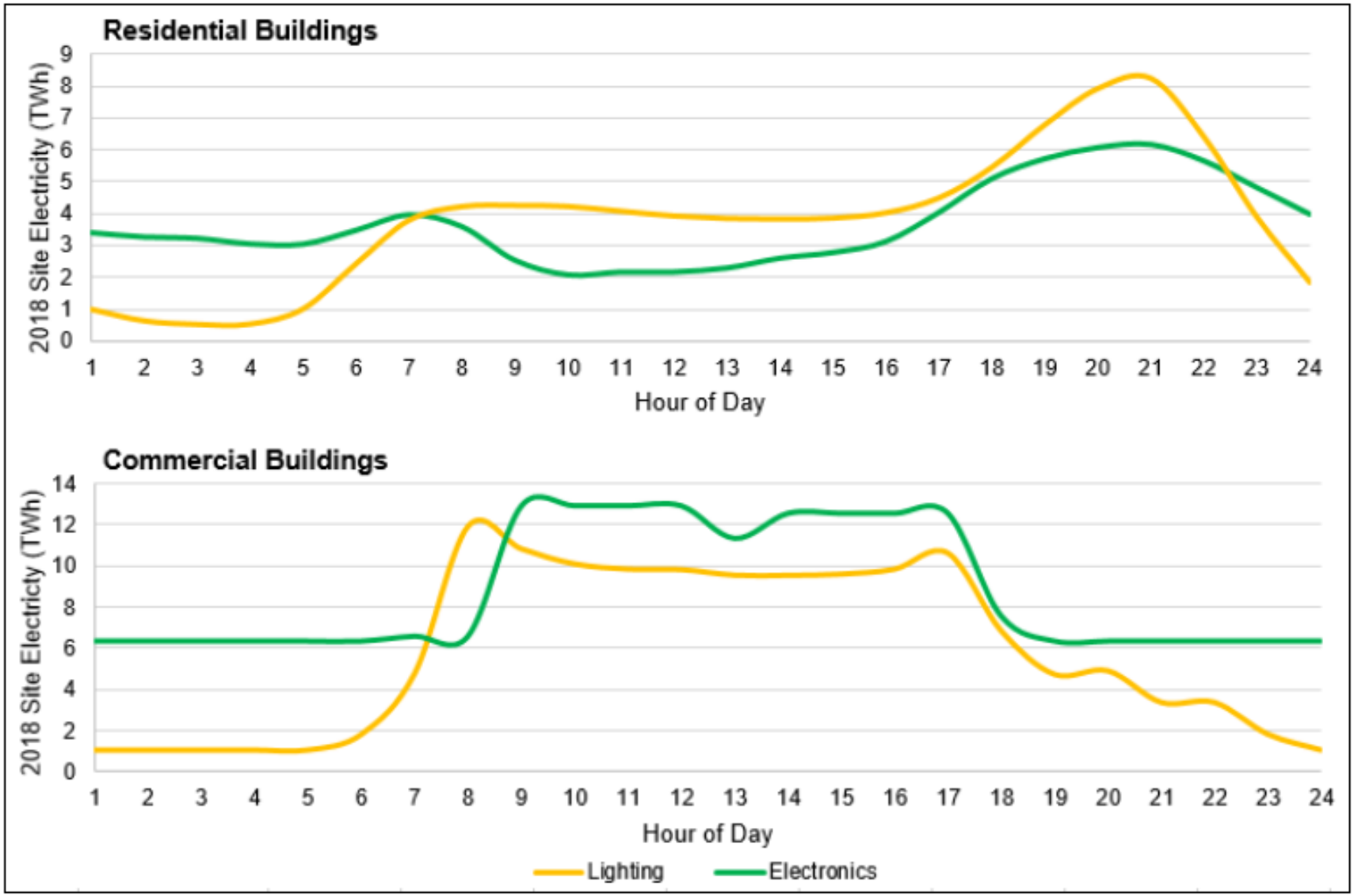
- Interoperable, integrated systems
- Continuously optimized operation for maximum comfort and efficiency
- Grid-responsive

Demand Flexibility Provided by GEB

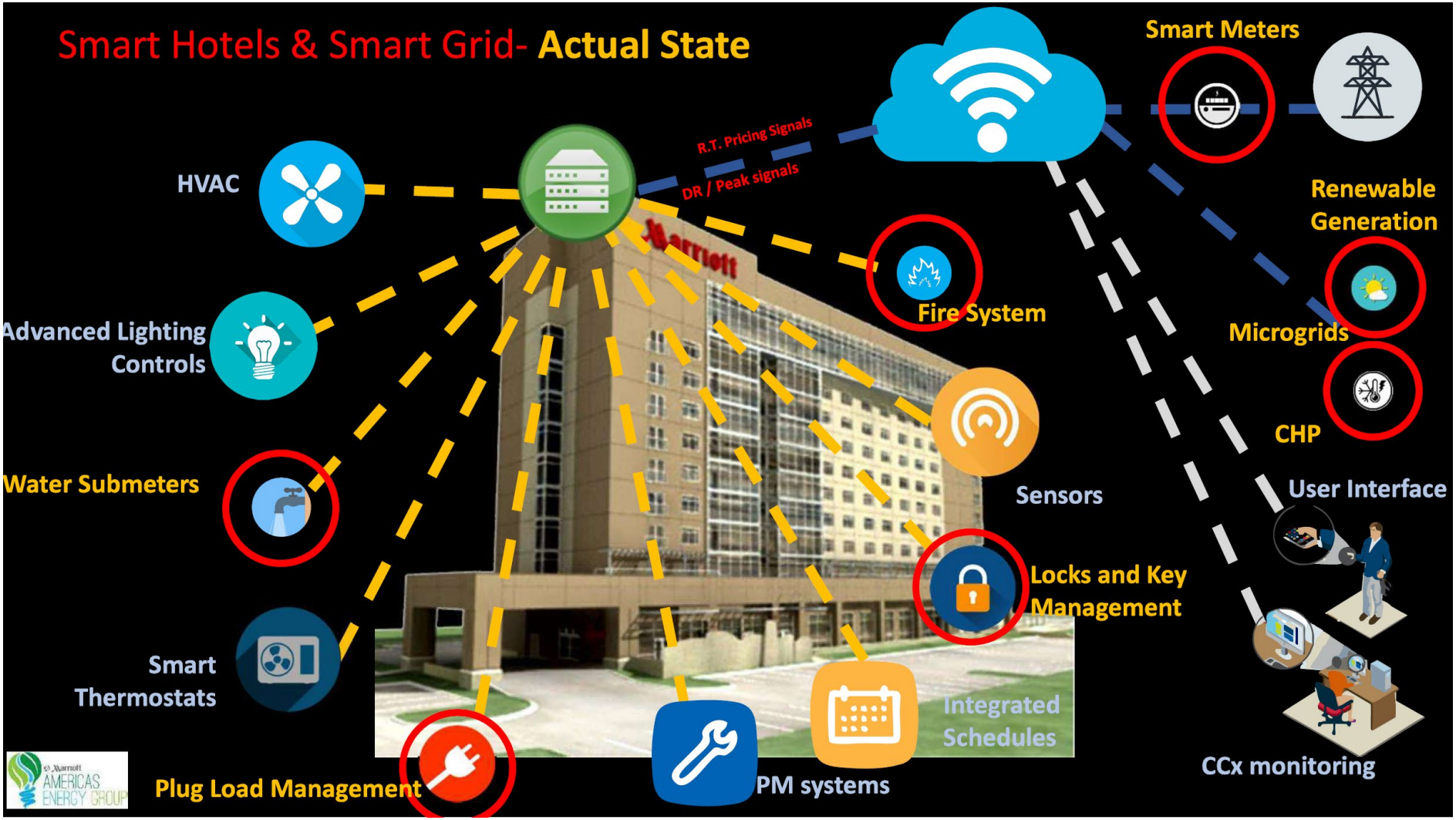




Lighting load profiles

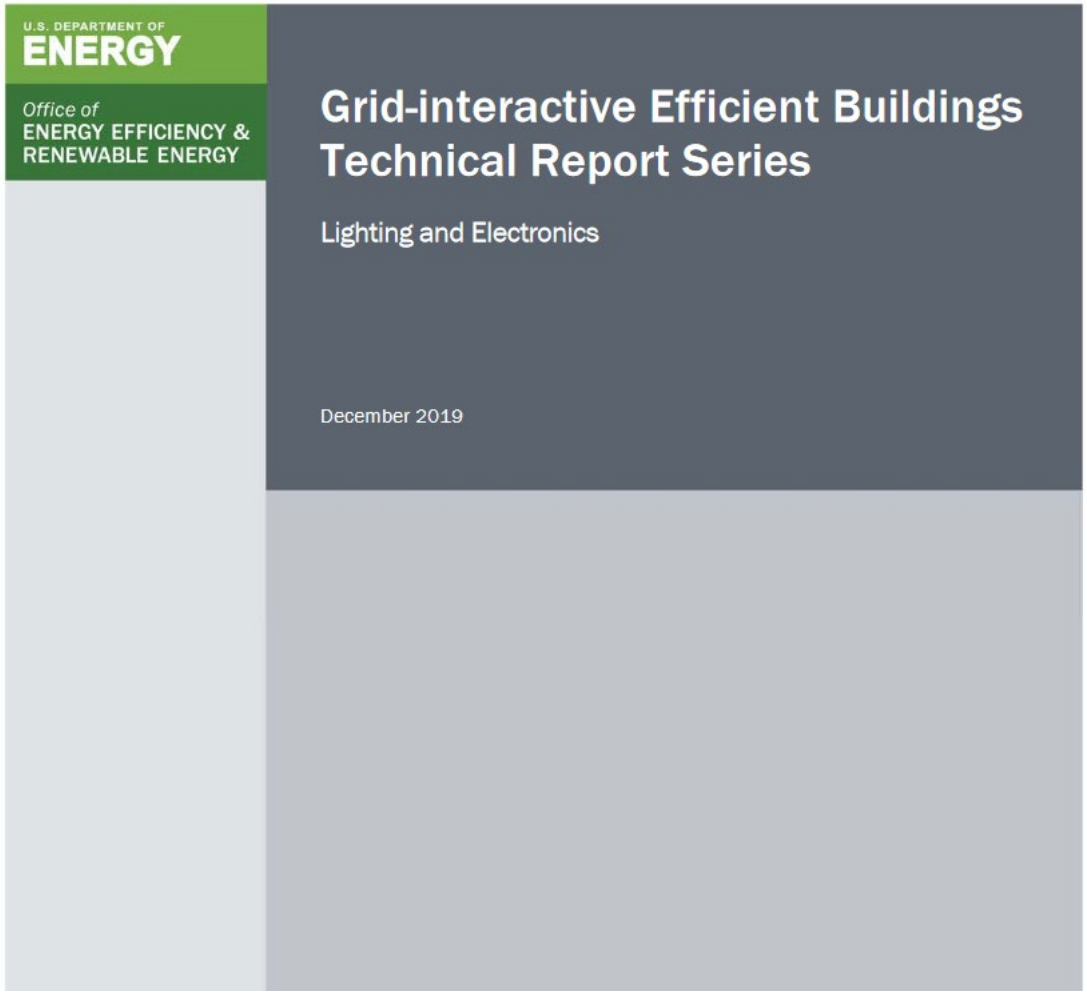


Remembering the bigger picture



Source: Douglas Rath, Marriott International

GEB Technical Report: Lighting and Electronics



www1.eere.energy.gov/buildings/pdfs/75475.pdf