

SCALING DEEP ENERGY RETROFITS

MARCH 20, 2014, VICTOR OLGAYAY, AIA,
CARA CARMICHAEL



Rocky
MOUNTAIN
INSTITUTE®





INTRODUCTION TO RMI

OUR PURPOSE

Rocky Mountain Institute transforms global energy use to create a clean, prosperous, and secure future.

WHAT WE DO

RMI advances market-based solutions in the 4 energy sectors. We engage businesses, communities, and institutions to cost-effectively shift to efficiency and renewables.

WHAT DIFFERENTIATES US

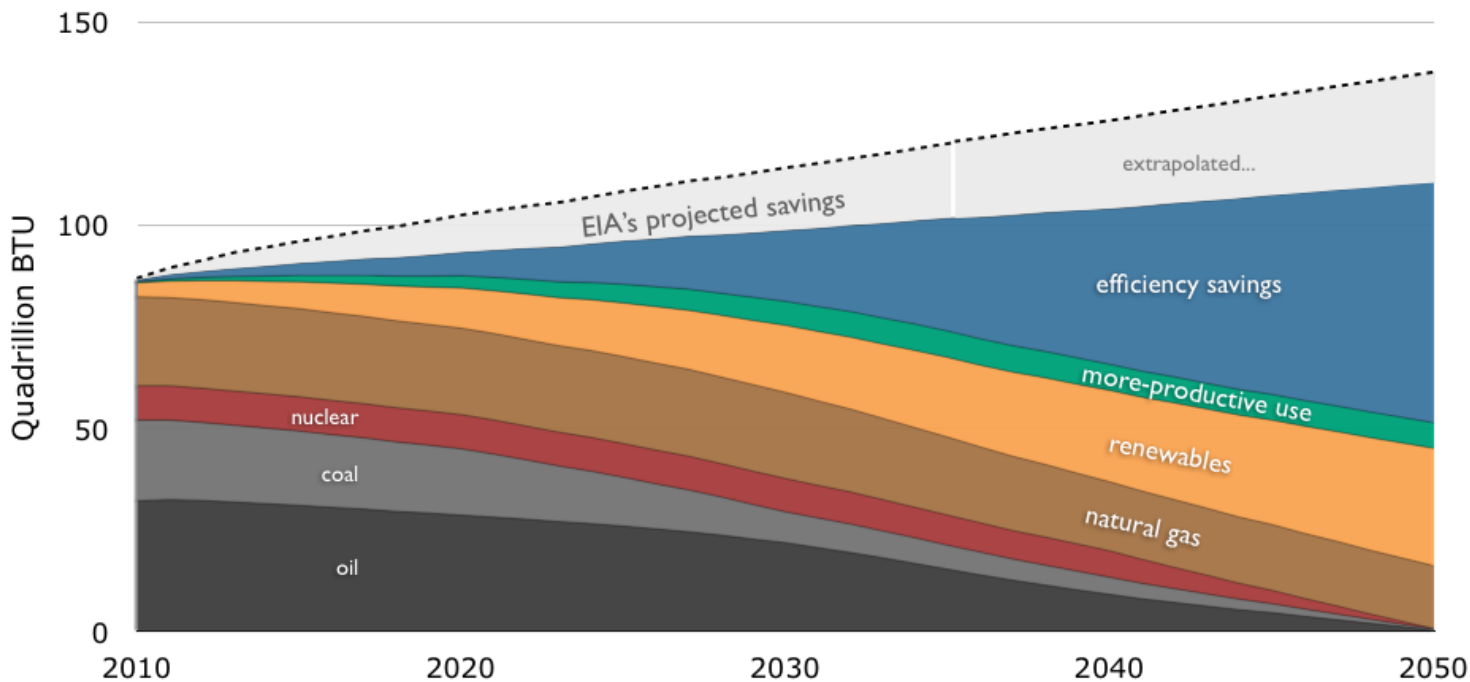
- Our whole-systems expertise unlocks market-based solutions that can be replicated and implemented now.
- As an independent, non-partisan nonprofit, we convene and collaborate with diverse partners—business, government, academic, nonprofit, philanthropic, and military—to accelerate and scale solutions.
- We boldly tackle the toughest long-term problems—challenges often ignored by those held to short-term results.
- We've been a leader in energy efficiency and renewables for more than 30 years.



REINVENTING FIRE

Efficiency is a fundamental component of the coming energy transition – much of it driven by high performing buildings.

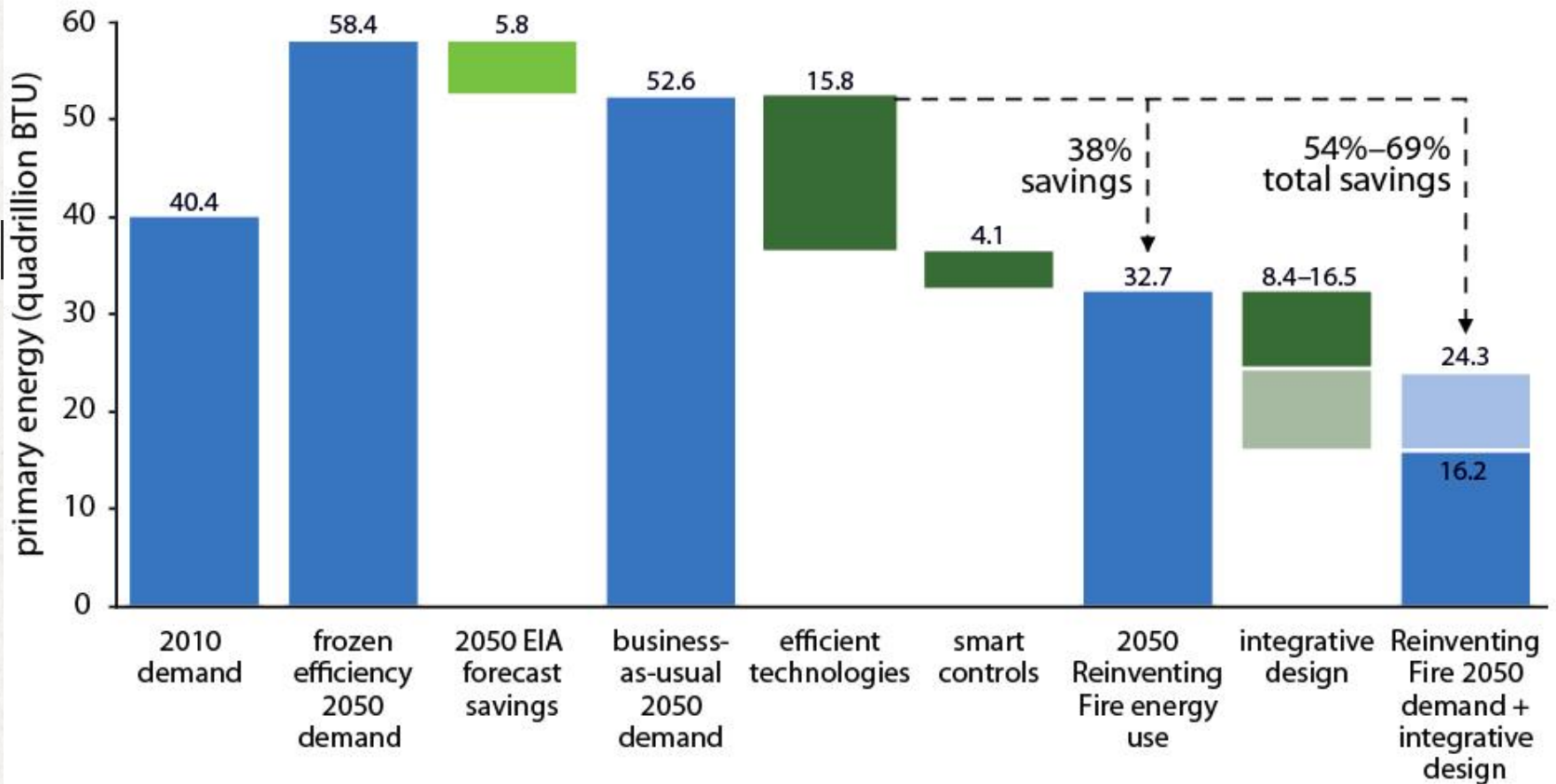
Energy Use in the U.S. Economy, 2010–2050



Vehicles
Planes & Trains
New Buildings
Existing Buildings
Industry
Behavioral
Electricity System

COST EFFECTIVE ENERGY EFFICIENCY IS AVAILABLE

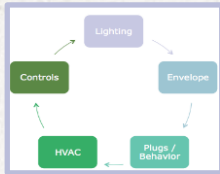
U.S. buildings' energy efficiency potential, 2050



DEEP ENERGY RETROFITS....



Achieve $\geq 50\%$ energy savings



Integrative design and analysis process



Improved project economics



Provide value beyond energy cost savings (VBECS)



Positive electricity system impacts

TIME TO ACT !



1. Planned capital improvement
2. Major system replacement
3. Major envelope project
4. Code upgrades
5. New owner / refinancing
6. New use / occupancy type
7. Building greening
8. Large utility incentives
9. Mitigating an "energy hog"

#1: PURSUE THE RIGHT STEPS IN THE RIGHT ORDER

(1) Set Quantifiable Goals

(2) Define End-User Needs

(3) Understand Existing Conditions

(4) Reduce Loads

(5) Select Appropriate & Efficient Technology

(6) Find Synergies

(7) Optimize Controls

(8) Incorporate Renewables

(9) Realize the Intended Design

Most people start here!

Then go here

RESULTS FROM 50 DEEP RETROFITS



Integrated design & multiple measures are more critical to low-energy buildings than any given technology.



Major renovations offer a major opportunity for deep savings. **Re-positioning existing buildings** is currently an attractive real estate move.



Readily available technologies/strategies were used to create these deep energy retrofits. **Performance feedback** is key.



Building ratings, labels, champions and recognition were a strong influence on increased efficiency.

Source: NBI

© U.S. Green Building Council 2012

Byron G. Rogers Federal Office & Courthouse

- 28-38 kBtu/ft²-yr
- 60-70% reduction from 2009 use
- Efficiency alone, no renewables



Empire State Building

- Saved 38% of energy use with a 3-year payback
- 6,500 super windows rebuilt onsite
- Reduced internal loads allowed for a smaller cooling system
- Improved market traction



INDIANAPOLIS CITY-COUNTY BUILDING

- 731,000 SF
- Indianapolis, Indiana
- \$8.1M Retrofit
- Part of a larger portfolio retrofit program (61 buildings)
- Procured with an ESCO
 - Tax exempt municipal lease
 - 15 yr lease term
- Occupied during construction
- 46% energy cost reduction (\$776,674/yr)
- 90% steam use reduction

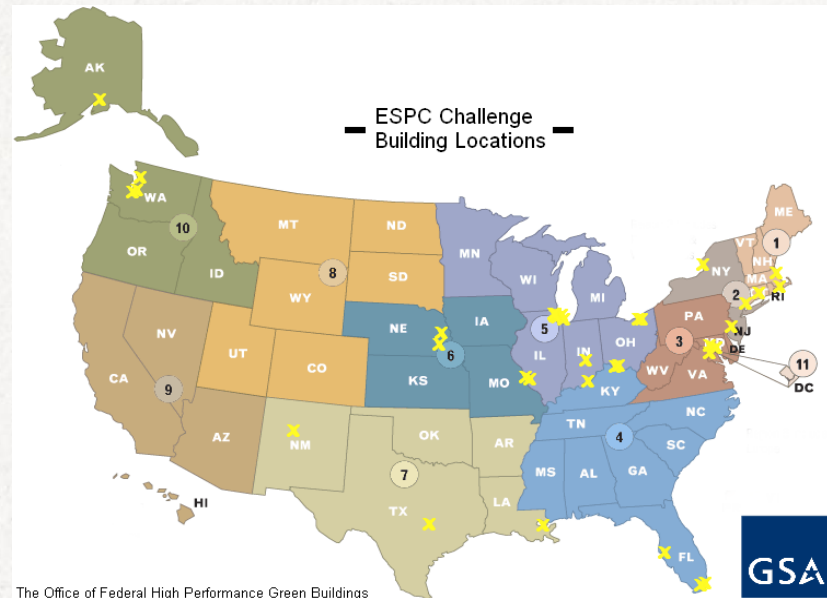




GSA National Deep Energy Retrofit Program

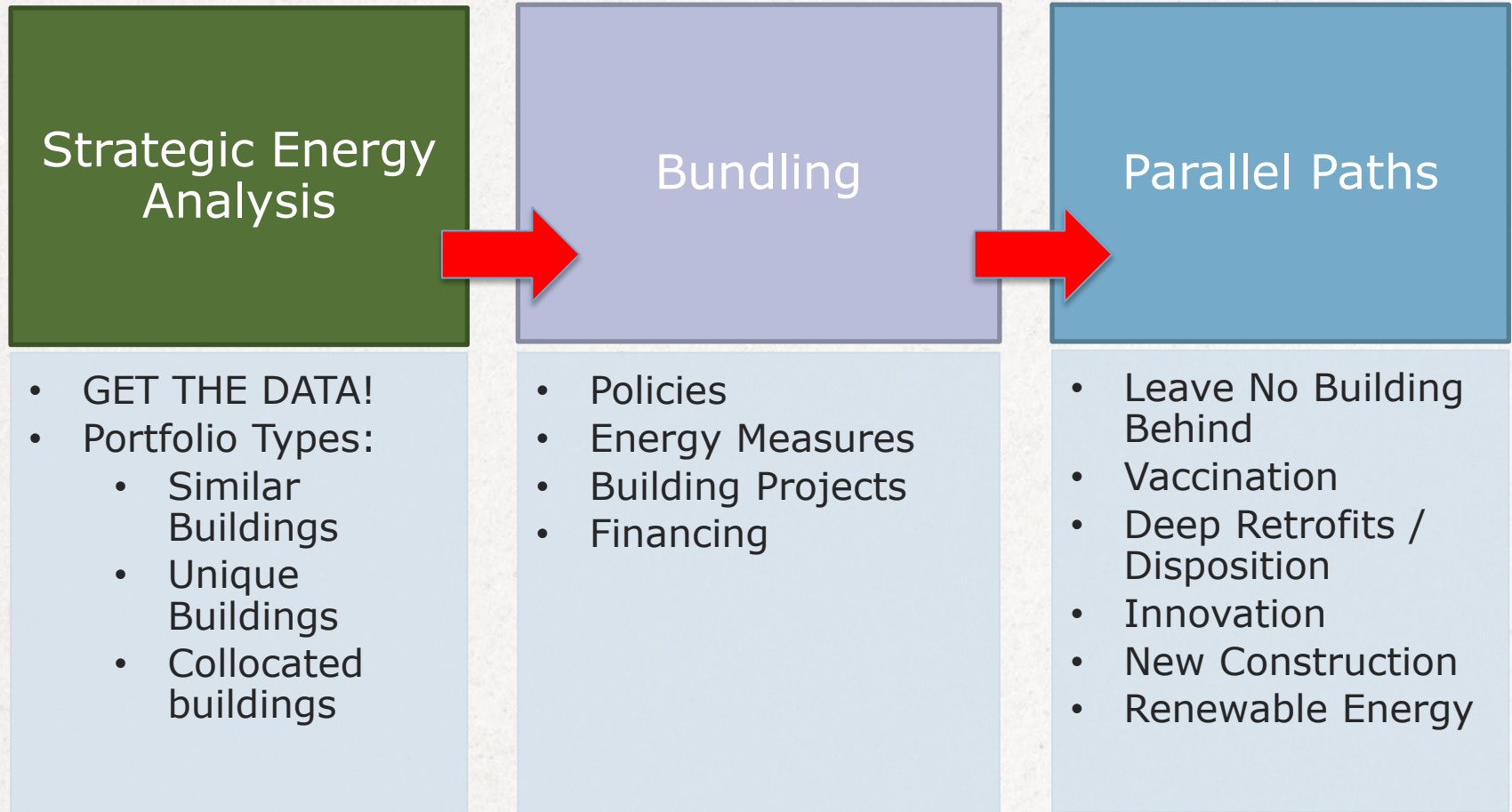
Goal: Demonstration projects on how to achieve Deep Retrofits using ESPC's

- Round 1: 30-35 GSA/PBS buildings
- Doubled energy savings (18%-39%)
- 10x increase in ESPC projects
- Participation from almost all GSA regions



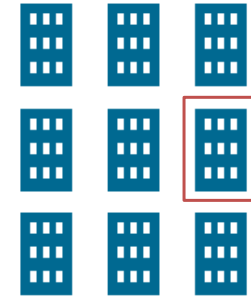
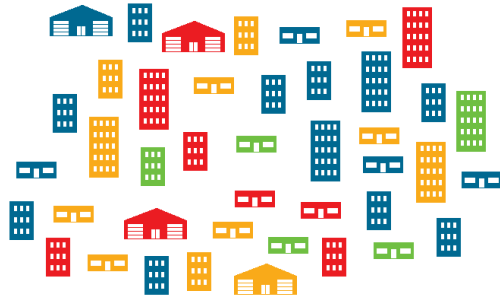


CRAFTING A BUILDING PORTFOLIO EFFICIENCY STRATEGY



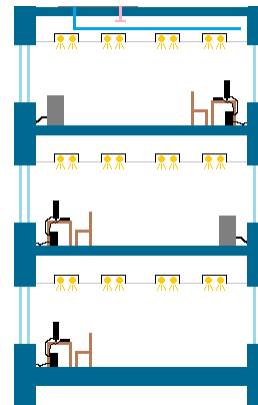
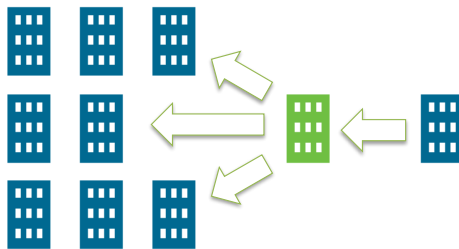
“We can do some of the measures in all of the buildings, and we can do all of the measures in some of the buildings.” – Blake Herrschaft, RMI Engineer

PORTFOLIO ANALYSIS PROCESS



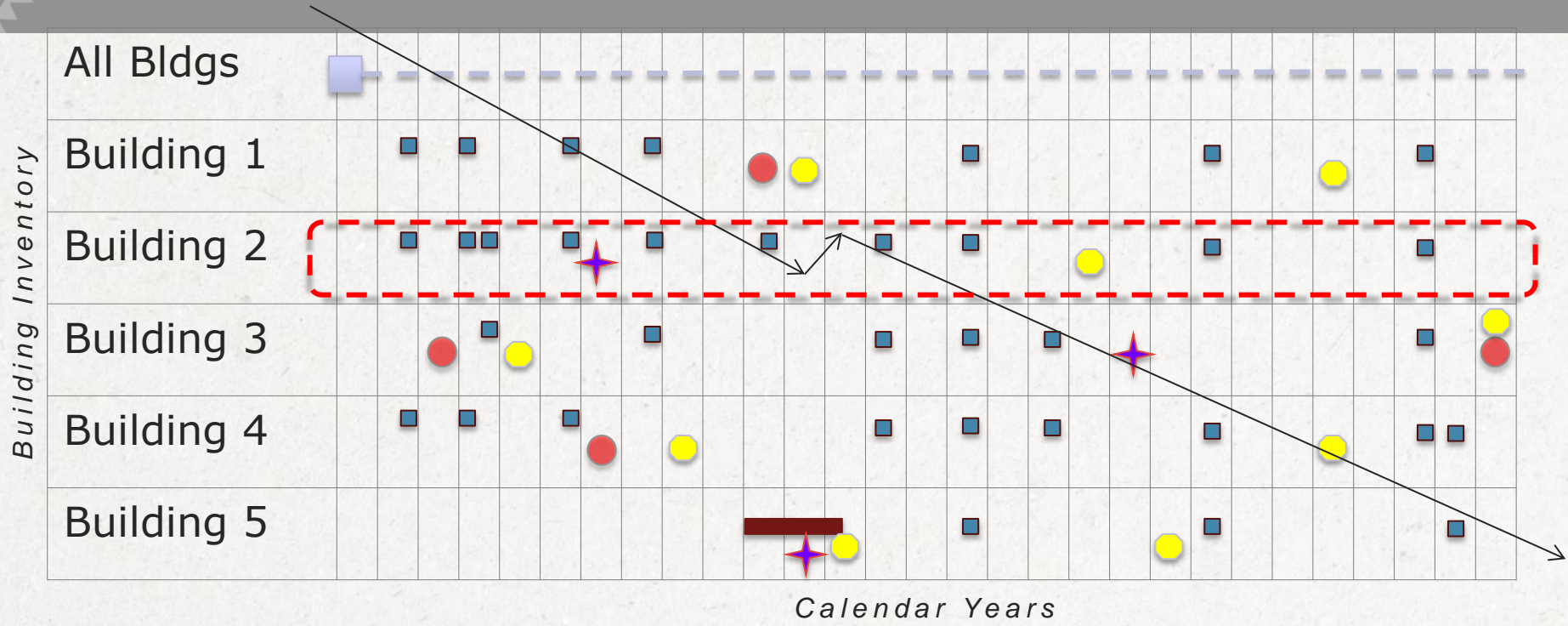
Group
Benchmark
Triage
Inform
Scale
Plan
Implement

- Divide into subsets by type, size, etc.
- Collect additional data, confirm general conditions, perform select investigations, establish technical potential
- Perform high-level portfolio assessment
- Identify type and size of opportunity
- Utilize low-cost workflow analysis tools; develop implementation options
- Create plan to implement options to meet economic and energy targets
- Carry out strategic plan; verify, modify, communicate success





USE TIME WHEN MAPPING A BUILDING PORTFOLIO STRATEGY



- "LNBB" – EMS + Continuous Cx & Ongoing Corporate/Institutional Policies
- Vaccination – Broadcast Targeted Energy Measures and Upgrades Across Many Buildings
- Deep Energy Retrofits – Go Deep at the Right Time (*dashed red line is a virtual deep energy retrofit*)
- Innovation – Pilot Projects
- New Construction – Super-Efficient Construction Standards and IPD Approach
- Clean Energy – On-Site Renewable Energy Installations

PORTFOLIOS WORK AS SYSTEMS

Bundle *Internal Policies*

Institutional Change: What motivates?



Bundle *Measures*

Optimize, don't itemize



Bundle *Buildings*

Spread costs, reduce risk, plan ahead



Bundle *Financing*

Incentives, loans, and purchase agreements



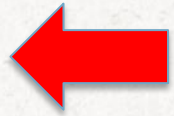


BUNDLE BUILDINGS FOR BROAD SAVINGS

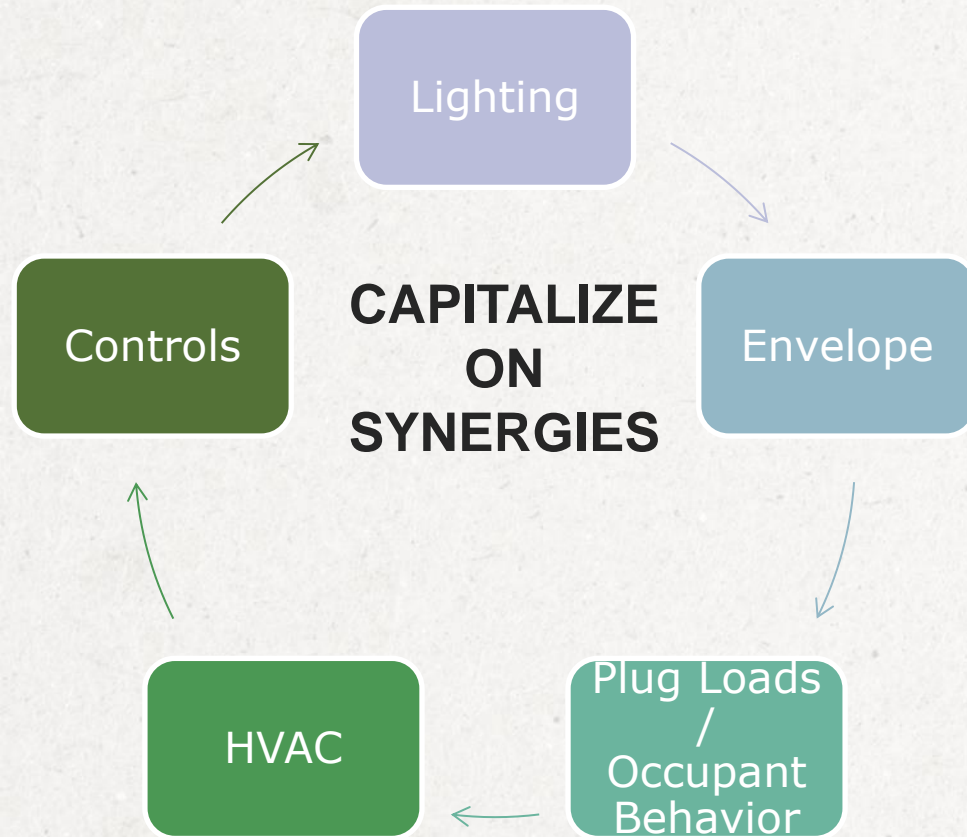
Building Projects

Spread costs,
reduce risk, plan
ahead with right
timing.

PROJECT	COST	SAVINGS	SIMPLE PAYBACK
Building A	\$180,000	\$30,000	6 yrs.
Building B	\$110,000	\$9,2000	12 yrs.
Building C	\$95,000	\$8,8000	11 yrs.
Building D	\$220,000	\$11,000	20 yrs.
	\$209,000	\$59,000	10 yrs.



BUNDLE MEASURES FOR DEEPER SAVINGS WITH MORE BENEFITS



- downsizing or eliminating mechanical and other systems - and therefore avoiding capital costs
- allowing for more cost-effective measures to “finance” measures that provide value beyond energy cost savings (VBECS)



ALIGN ANALYSIS WITH DETAIL REQUIRED

Tool	Approach	Data	Bench- mark	Opportun- ities	Measures	Costing	Calibration	Custom Simulation	M&V
EnergyStar	Adjusted metric	Utility bills	●						
FirstView	Regression	Utility bills, temp data	●	●	○				
LEAN	Regression	Utility bills, temp data		●	○				●
Retro- ficiency	No/low- touch, in- house algorithms	Utility bills, basic site info			●	●	●		
simuwatt	Med-touch, EnergyPlus simulation model	Utility bills, site walk through, floor plans			●	●	●	●	

Note: partial list; inclusion in list does not imply endorsement

U.S. AIR FORCE BASE RETAIL CENTERS



EXCHANGE
ARMY & AIR FORCE EXCHANGE SERVICE

Example	Area (sf)
Retail	83,000
Stock floor	25,000
Back of house	5,000
Food court	5,000
Dining area	6,500
Corridors	9,000

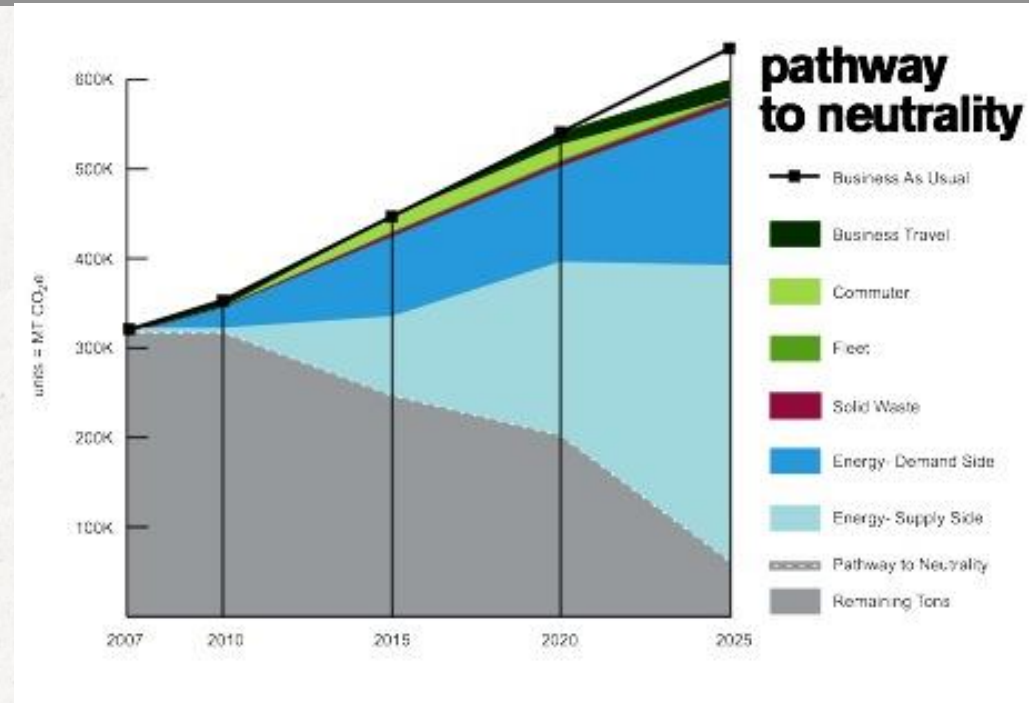
83 retail centers, 23 in subset (mixed-climate, 100,000+ ft²)

- 83 triaged
- 2 detailed assessments to inform strategic plan for 23

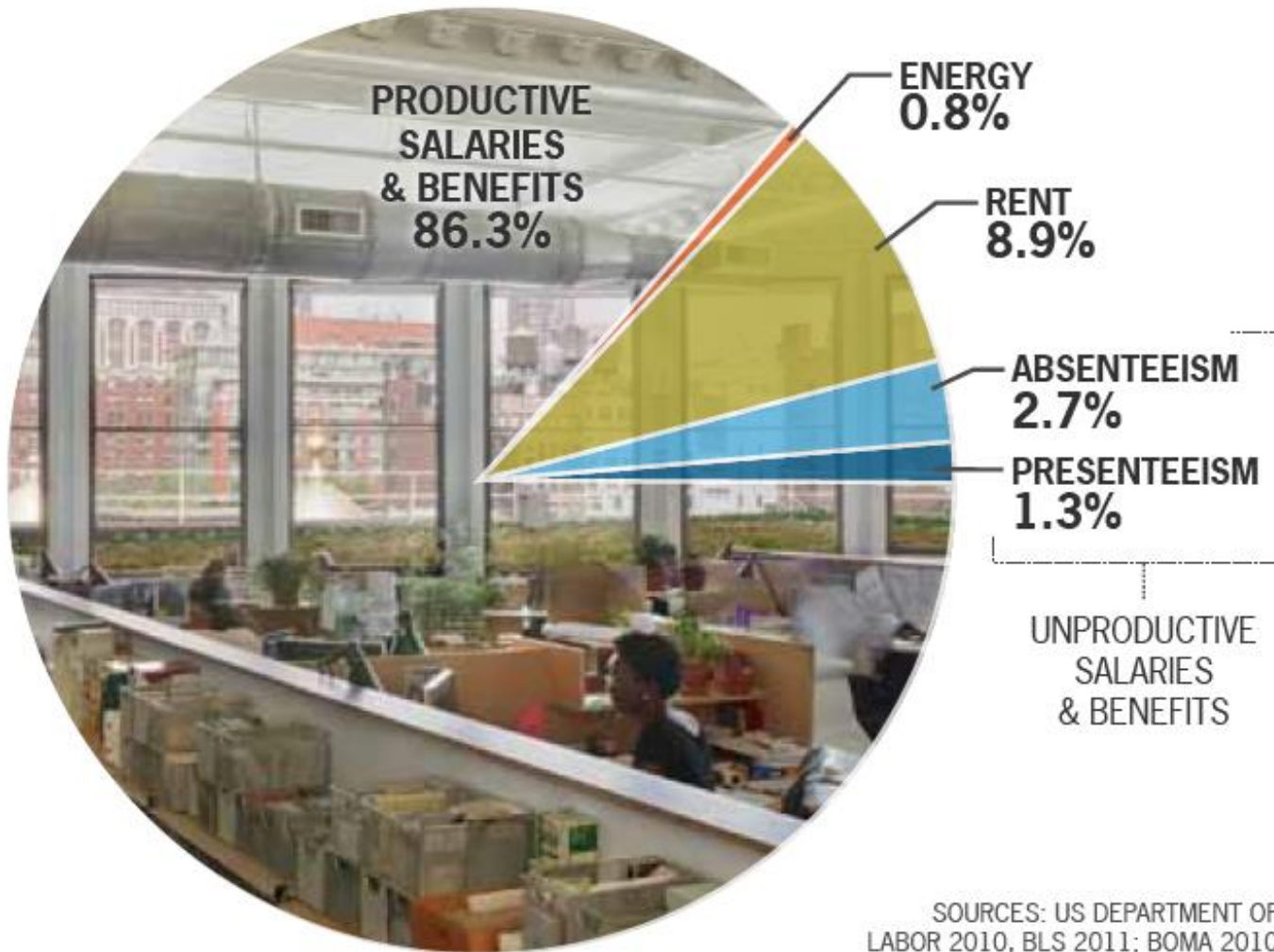
ARIZONA STATE UNIVERSITY



- Carbon Neutral by 2025
- Biggest university in US
- Delivered through ESPC
- RMI/Ameresco creating plan
- Dedicated behavior analyst and program
 - Lab behavior
 - Dorm use/awareness



VALUES BEYOND ENERGY COST SAVINGS



SOURCES: US DEPARTMENT OF LABOR 2010, BLS 2011; BOMA 2010

DEEP RETROFIT VALUE: BEYOND ENERGY COST



http://www.rmi.org/retrofit_depot_depreetrofitvalue



MEET YOUR PORTFOLIO GOALS AND MANDATES

Cost efficient portfolio planning:

1. Get good baseline energy data!
2. Plan your portfolio energy strategy
3. Define a business-as-usual baseline to account for avoided capital costs
4. Right-time deep retrofits
5. Demand all the savings – Ask the ESCO to go deep
6. Pursue the right steps in the right order
7. Quantify the value beyond energy cost savings

ADDITIONAL RESOURCES

- Retrofit Depot (from RMI)
 - www.retrofitdepot.org
 - DRV paper
 - Process guides
 - Case studies
 - Tools
 - Dr. Retrofit
- New Buildings Institute
 - www.newbuildings.org
 - Case studies of deep retrofits
 - Process analysis
- NREL
 - www.nrel.gov
 - Advanced energy retrofit guides

