SCALING DEEP ENERGY RETROFITS MARCH 20, 2014, VICTOR OLGYAY, AIA,

CARA CARMICHAEL



INTRODUCTION TO RMI

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

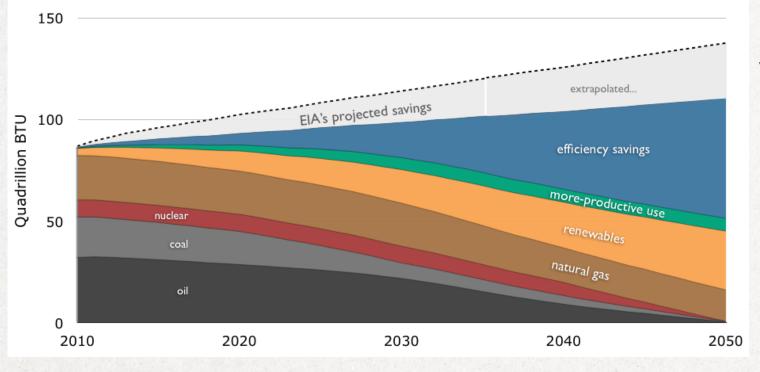
WHAT WE DO RMI advances market-based solutions in the 4 energy sectors. We engage businesses, communities, and institutions to cost-effectively shift to efficiency and renewables.

WHAT DIFFERENTIATE S 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.

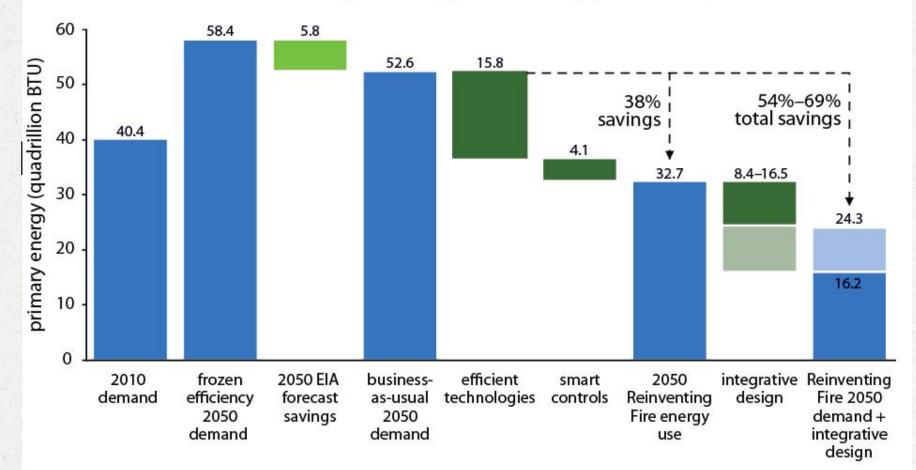


Energy Use in the U.S. Economy, 2010–2050

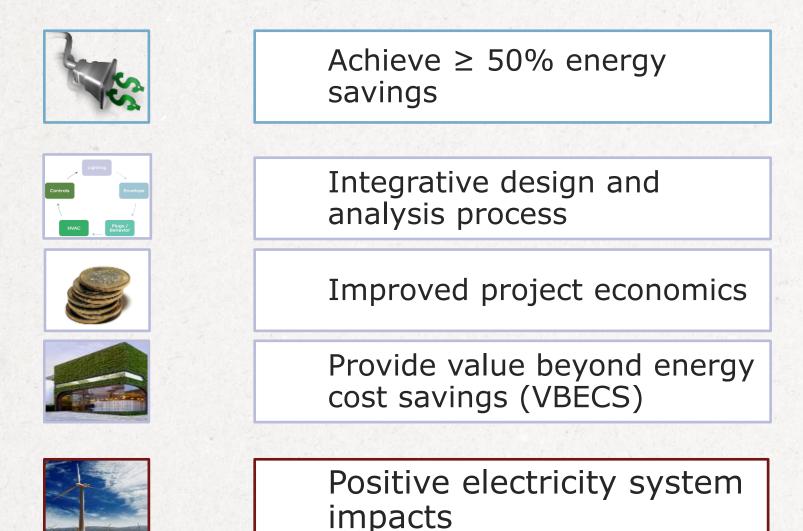
Vehicles Planes & Trains New Buildings Existing Buildings Industry Behavioral Electricity System

COST EFFECTIVE ENERGY EFFICIENCY IS AVAILABLE

U.S. buildings' energy efficiency potential, 2050



DEEP ENERGY RETROFITS....



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

- (2) Define End-User Needs
- (3) Understand Existing Conditions
- (4) Reduce Loads

Most people start here!

Then go here

(5) Select Appropriate & Efficient Technology

(6) Find Synergies

(7) Optimize Controls

(8) Incorporate Renewables

(9) Realize the Intended Design

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

http://newbuildings.org/meta-report-search-deep-energy-savings

Byron G. Rogers Federal Office & Courthouse

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



Empire State Building

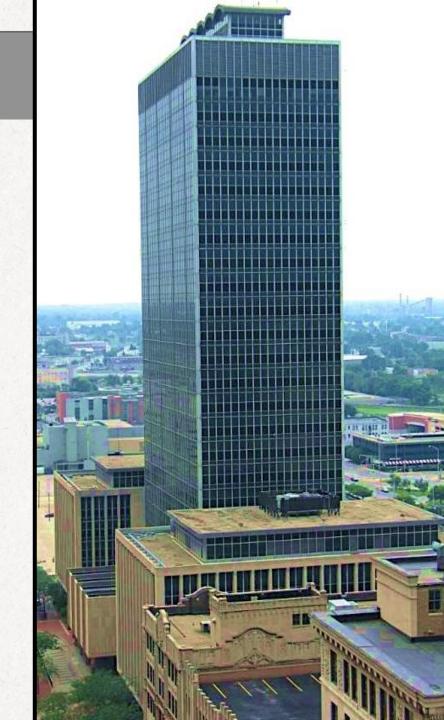
- Saved 38% of energy use with a 3-year payback
- 6,500 super windows rebuilt onsite
- Reduced internal loads allowed for a smaller cooling system

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

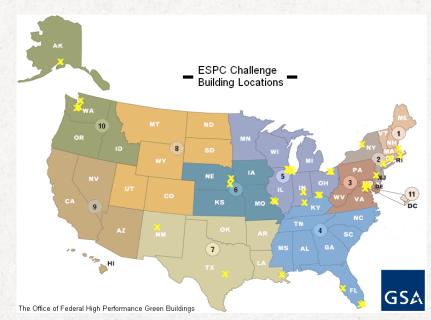


GSA National Deep Energy Retrofit Program

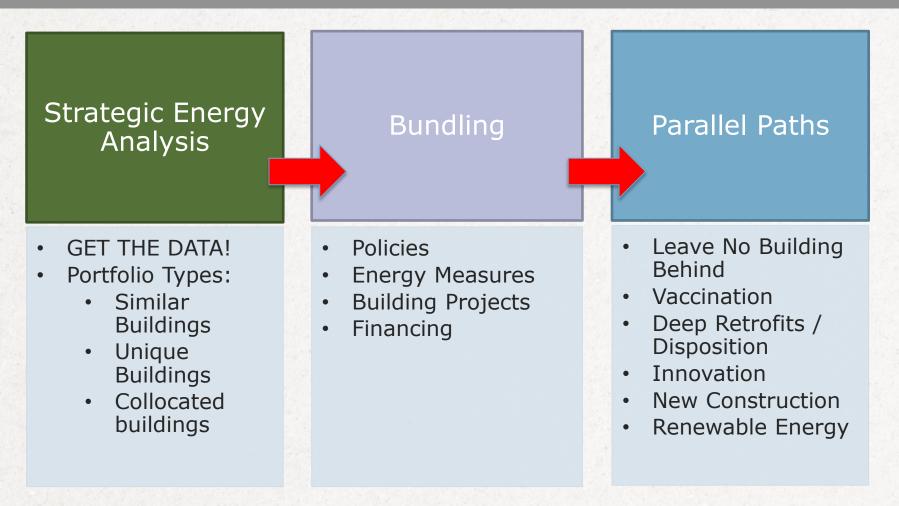
Goal: Demonstration projects on how to achieve Deep Retrofits using ESPC's

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



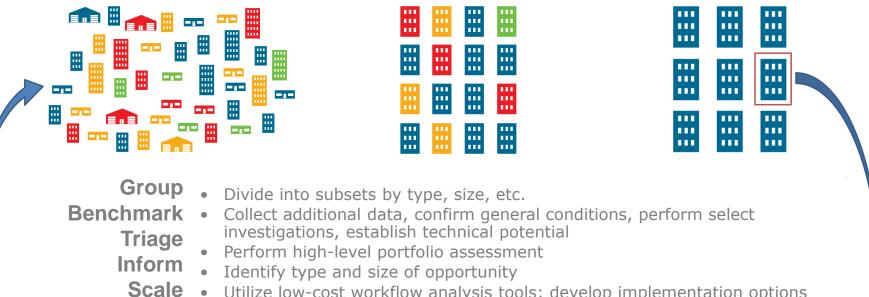


CRAFTING A BUILDING PORTFOLIO EFFICIENCY STRATEG



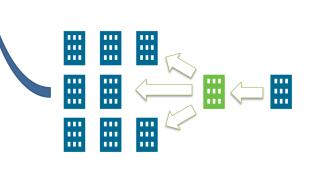
"We can do some of the measures in all of the buildings, and we can do all of the measures in some of the buildings." – Blake Herrschaft, RMI Engineer

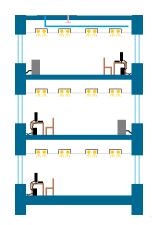
PORTFOLIO ANALYSIS PROCESS



- Utilize low-cost workflow analysis tools; develop implementation options
- Create plan to implement options to meet economic and energy targets Plan

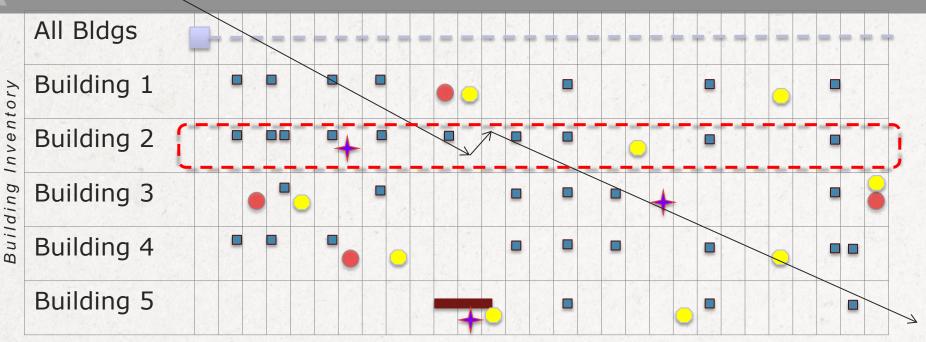
Carry out strategic plan; verify, modify, communicate success Implement







Use Time when Mapping a Building Portfolio Strategy



Calendar Years

- "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, Ioans, and purchase agreements



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BUNDLE BUILDINGS FOR BROAD SAVINGS

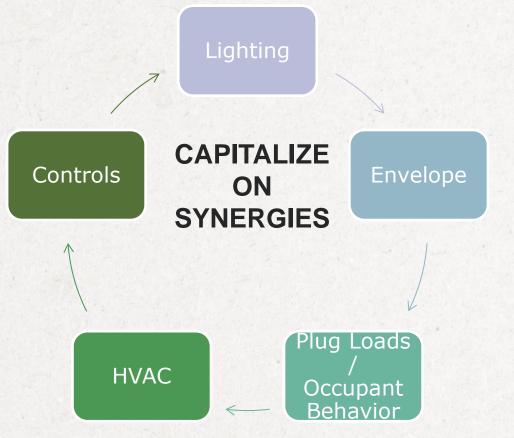
Building Projects

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.
	\$209,00	\$59,000	10 yrs.

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BUNDLE MEASURES FOR DEEPER SAVINGS WITH MORE BENEFITS



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

ALIGN ANALYSIS WITH DETAIL

Tool	Approach	Data	Bench- mark	Opportun- ities	Measures	Costing	Calibration	Custom Simulation	M&V
EnergyStar	Adjusted metric	Utility bills	\bigcirc						
FirstView	Regression	Utility bills, temp data	\bigcirc	\bigcirc	\bigcirc				
LEAN	Regression	Utility bills, temp data		\bigcirc	\bigcirc				
Retro- ficiency	No/low- touch, in- house algorithms	Utility bills, basic site info			\bigcirc		\bigcirc		
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



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



EXCHANGE ARMY & AIR FORCE EXCHANGE SERVICE

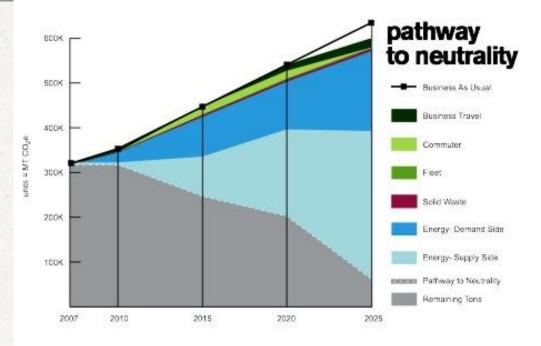
83 retail centers, 23 in subset (mixed-climate, 100,000+ ft2)

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

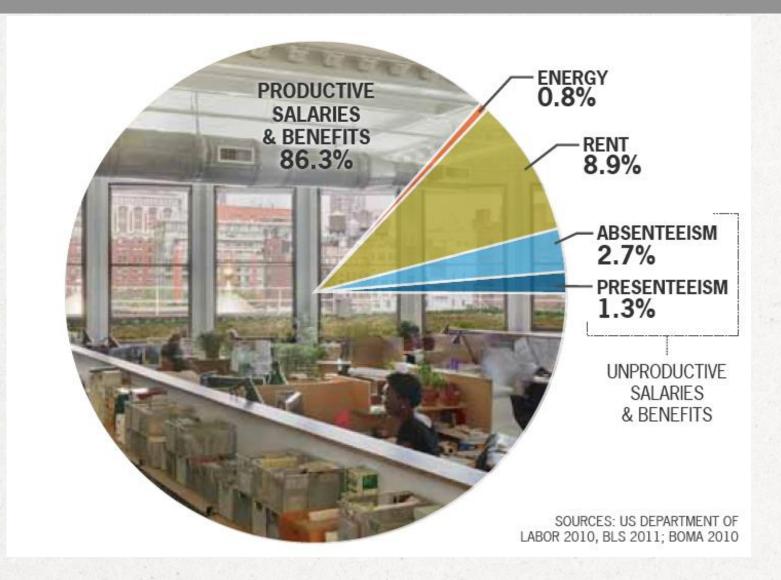
ARIZONA STATE UNIVERSITY



- 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



DEEP RETROFIT VALUE: BEYOND ENERGY COST



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

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Home > Retrofit Depot			Text Size AAA C SHARE	
F	energy a	s turned into practice and real and cost savings.	THE RETROFIT GUIDES	
		ETROFIT STORIES		
• • • RetroFit 101	The Blueprint Get Conn	ected Tools & Resources		
		acted 10015 with		
	source for Deep Energy Retrofits!	the second s		
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Existing Buildir	ngs			
Advanced Buildings	0		Related News	
xisting Buildings	Buildings account for nearly 40 percent of States. Typical commercial buildings use	e, on average, twice the energy of	<u>New Buildings Institute</u> Welcomes New Executive Director	
Getting to 50 Gero Energy	buildings. With roughly 80 billion square United States alone, updating existing bi	efficient buildings and three to four times that of the nation's highest performing buildings. With roughly 80 billion square feet of existing commercial space in the United States alone, updating existing buildings is a critical patway to meeting climate and energy policy goals, utility efficiency targets and real estate objectives.		ice
	Studies of Deep Energy Savi	ince in Existing Buildings	New guide outlines best practices for cutting energy used by plug-in devices	
	A Search for Deep Energy Savings in I This two-phase set of work was conduct Efficiency Alliance (NEEA) regional Existir	Existing Buildings ted as part of the Northwest Energy ing Building Renewal (EBR) initiative to		
	accelerate commercial market adoption retrofits. A Meta Report builds on phase	n of deep, integrated energy-efficient e 1 work, which developed an initial list of mprovement of 30%+ energy savings from	f I	
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ENERGY Energy Eff	ficiency &		EERE Home Programs & Offices Consumer Info	lom
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About	Advanced Energy Retrofit Gu	ides Pc	pular Commercial Lin	k
Take Action to Save Energy	The Advanced Energy Retrofit Guides (AERGs)	The second state stat		(
Activities	were created to help decision makers plan, dealon, and implement energy improvement		,ess atories	~
179d Tax Calculator Advanced Energy Design	projects in their facilities. With energy managers in mind, they present practical guidance for kick-	Section .		
Guides Advanced Energy Retrofit Guides	starting the process and maintaining momentum throughout the project life cycle. These guides are primarily reference documents, allowing energy managers to consult the particular sections that address the most pertinent topics	Carlos Control	Walmart Partnership Brings LEDs to Barking Lots	•
Building Energy Data Exchange Specification	Useful resources are also cited throughout the	Advantices somethy Boon Res Empres Verginations	Parking Lots	
Buildings Performance Database	guides for further information. Each AERG is tailored specifically to the needs of a specific	Healthcare Facilities Tools	15	0
Data Centers	building type, with an emphasis on the most effective retro-commissioning and retrofit	Ausert for Parlie and All Parlies and All Parl	EnergyPlus Whole Building Energy	_
Energy Asset Score	measures identified by experts familiar with those unique opportunities and challenges. The guides	The Advanced Energy Retrofit Guides (AERGs) help building owners and O	Simulation DoenStudio Energy Simulation Applicati	
Energy Modeling Software	and a providence of any constructions that	(AERGs) help building owners and _ O	/penStudio Energy Simulation Application	.ion

