ENERGY EFFICIENCY AND NET-ZERO BUILDINGS: GSA & RMI ANSWER THE CALL

2015 GSA PRACTICE INTO PERFORMANCE WORKSHOP REPORT

Executive Summary

CONTACT
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1.OVERVIEW

THE GSA'S COMMITMENT

The nation's largest landlord is answering President Obama's call to pursue deep energy savings and net-zero energy in buildings. Earlier this spring, the President and Congress each issued directives that extended aggressive energy efficiency goals into the next decade, drawing attention to topics like net-zero energy and promoting sustainability more broadly in the federal government.[1] Shortly after these mandates were passed, the U.S. General Services Administration (GSA) and Rocky Mountain Institute (RMI) held the 2015 Practice Into Performance Workshop, convening the GSA, a variety of other federal agencies, and private energy service companies (ESCOs) to help the federal government achieve deeper energy savings through performance contracting. The event provided the perfect platform for all stakeholders to share past successes, acquire new tools, and break down barriers to achieve deep energy savings.

Translating deep energy retrofit best practices into performance is easier said than done, as demonstrated by the relatively low level of savings delivered from energy savings performance contracts (ESPCs) throughout the federal government, 19 percent on average[2]. Research and experience demonstrates that we can retrofit buildings economically to deliver much deeper energy, cost, and carbon savings.

GSA'S NATIONAL DEEP ENERGY RETROFIT PROGRAM

The GSA launched the National Deep Energy Retrofit (NDER) Program in 2011 to deliver deep energy savings through ESPCs. The 2015 Practice Into Performance Workshop is the fourth in a series of workshops convened by RMI and the GSA to raise the bar on energy savings, share best practices and continue the transparent dialogue between stakeholders.

[1] "Executive Order 13693" and "Energy Efficiency and Improvement Act of 2015"
[2] Shonder, John, "Energy Savings from GSA's National Deep Energy Retrofit Program"

Aggressive NDER program objectives include:

1. Move federal facilities towards net-zero energy consumption
2. Reduce water consumption at federal facilities
3. Implement cost-effective retrofits with aggregate payback periods of 25 years or less
4. Complete associated construction work without major tenant disruption
5. Use innovative technologies
6. Use renewable energy technologies
7. Use comprehensive and integrated whole-building approaches to determine energy conservation measures (ECMs)

By improving all aspects of the procurement process, the GSA has more than doubled the energy savings of their first round projects, achieving an average energy savings of 38 percent.

2. BEST PRACTICES TO DRIVE DEEP SAVINGS

The Workshop exhibited a number of best practices through exemplary case studies, presentations and panel discussions.

Best practices for deep energy retrofits using ESPCs include:[3]

1. Developing a **strong and comprehensive communication plan** that engages **all stakeholders early and often**
   - Engaging occupants, IT and security personnel in addition to agency leadership simplifies approvals
   - Occupants and facility managers can support solutions like plug load management
2. Setting **aggressive energy goals early** (at the notice of opportunity, reinforced throughout)
3. **Centralizing resources** and **streamlining the ESPC process**
   - Exemplified by GSA's Project Management Office (PMO) or the U.S. Army Engineering and Support Center, Huntsville (the Army's ESPC contracting center)
4. Developing **consistent practices between national and regional offices**
   - For example, the GSA PMO has standardized practices and serves as a critical resource for regional ESPC teams
5. Recognizing **additional benefits that ESPC projects can provide**
   - For example, operations and maintenance savings, water savings, building safety upgrades, aesthetic upgrades to the site, and the inherent value deep retrofits provide[4]
6. Blending **appropriated funding** to increase the scope and savings of ESPC projects
7. Applying the **Technical Potential tool** to develop **broad, creative, and integrated energy solutions on the path to net-zero energy** while also fostering **stakeholder engagement and buy-in**
8. **Removing artificial project limits**, such as maximum ECM payback thresholds

[3] Additional best practices are discussed in depth in "The Path to a Deep Energy Retrofit Using an Energy Savings Performance Contract"

[4] The "Deep Retrofit Value Guide" documents the benefits beyond energy cost savings.

Success stories demonstrating best practices:[5]

1. The New Carrolton Federal Building and Silver Spring Metro Center project exemplifies successful integrative design and communication principles to achieve a 60 percent energy reduction.
2. The Almeric Christian Federal Building showcases what is expected to be the first net-zero energy project under the federal ESPC process (pending year 1 verification).
3. The Ft. Buchanan ESPC project demonstrates significant energy and water savings across an entire military installation under the U.S. Army Engineering and Support Center, Huntsville's ESPC contract.
4. The King and Brickell Federal Buildings used appropriated funding and integrative design to drive substantial energy savings.

3. REACHING A BROADER AUDIENCE IN 2015

The 2015 workshop attracted diverse representatives from over 10 different federal agencies (some new to ESPCs), and a strong presence from the White House Council on Environmental Quality (CEQ).

Kate Brandt, Federal Chief Sustainability Officer at the White House CEQ, set the tone by describing the excitement that new federal sustainability goals have instilled. She spoke in support of the NDER program, ESPCs, and the ways in which these programs will help agencies meet their new energy reduction goals. Brandt also highlighted the importance of convening public and private partners to work toward these goals.

"Collaboration always yields better results than individual work, and this workshop is an excellent example of such a collaboration," says Kevin Kampschroer, GSA chief sustainability officer.

ONWARD AND UPWARD

With the direction of new federal mandates and ever-growing support from agencies like CEQ and the DOE, ESPC projects are certain to continue to grow in importance in the coming years. While these workshops are a small part of the overall federal ESPC program, their convening power and transparency provide a valuable forum for sharing lessons and forming ideas that will drive the federal ESPC program to new levels. Moving forward, RMI, GSA, FEMP and various other stakeholders will continue collaborating to attract new agencies to ESPC projects and drive deeper ESPCs within the federal government.

[5] These success stories and other deep energy savings projects will be featured in an upcoming RMI/GSA report.

4. ATTACHMENTS

1. Agenda
2. List of attendees
3. Workshop presentations
4. "The Path to a Deep Energy Retrofit Using an Energy Savings Performance Contract" – an agency's guide for using ESPCs to achieve deep energy savings

Practice into Performance Workshop Agenda

Date and Location:
The Workshop will be conducted on Wednesday, June 3rd 2015 from 8:30am – 5:00pm EDT. It will be hosted at GSA HQ (1800 F Street NW, Washington, DC – Room #1153).

The GSA Practice into Performance Workshop will build on the National Deep Energy Retrofit (NDER) program successes. The workshop will include a recap on NDER program improvements due to ESCO feedback, past engagements, details on which suggestions have really made a difference and case studies.

Workshop objectives:
1. Raise the bar on energy savings delivered through ESPC's;
2. Share best practices with Federal Agencies;
3. Continue the transparent dialogue between stakeholders;
4. Apply the technical potential exercise, working towards net zero solutions.

Agenda: Wednesday, June 3rd 2015

8:30am	**Welcome, agenda, introductions (GSA and RMI)** Welcome from GSA leadership, agenda, objectives, around the room introductions, and recap of past progress
9:00	**Power Kickoff (Kate Brandt – CEQ, Dr. Tim Unruh – FEMP and Norman Dong – GSA commissioner)** Panel discussion and presentations.
10:00	**Success stories Round 1 (Presented by various attendees)** 2 case studies presented by key project stakeholders.
10:30	**Introduction to breakout groups #1 and #2** Introduction to technical potential concept and breakout group tasks. Also an overview of breakout group #2 roles and tasks.
10:45	**Break and find breakout rooms**
11:00	**Technical potential exercise (break out group #1)** Small groups will examine holistic solutions to maximize efficiency and bundle measures, on the path to net zero energy.
12:00pm	**Lunch**
12:30	**Constraints and solutions exercise (break out group #2)** Generate ideas to overcome constraints by changing roles and perspectives, emphasizing increased stakeholder communication.
1:30	**Break and return to large room**
1:45	**Reconvene, report out to large group** Report out by team. Discuss the big wins.
2:45	**Success stories Round 2 (Presented by various attendees)** 1-2 case studies presented by key project stakeholders.
3:15	**Break**
3:30	**The cost effectiveness of deep retrofits presentation (John Shonder, DOE)**
4:00	**Panel Discussion (Sharon Conger, Kevin Kampschroer - GSA, Skye Schell - FEMP, moderated by RMI)** Update on previously identified strategies to overcome barriers and vision looking forward.
4:45	**Parting thoughts (Kevin Kampschroer – GSA)**
5:00	**Adjourn**

LIST OF ATTENDEES

Ronald Allard
GSA

Ed Anderson
FPL

Denise Avery-Craft
GSA PBS

Phyllis Baker*
Honeywell

Barbara Bird
NORESCO

Roy Bousquet*
Northrop-Grumman supp. USAF

Steven Boyle
Pepco Energy Services

Jason Bray
USACE Huntsville

Nicole Bulgarino
Ameresco

Cara Carmichael
Rocky Mountain Institute

Peter Chornyak
Siemens Government Technologies

Chris Cockrill*
GSA

Phil Coleman
Lawrence Berkeley National Laboratory

Jeff Coles
Schneider Electric

Sharon Conger
GSA

Nicole Cosmann*
Navy Energy Office

John Crowley
GSA

Javier Cruz*
GSA

Lance Davis
GSA

Priya Desai
USACE Huntsville

Todd Feltman*
GSA

Michael Gartman*
Rocky Mountain Institute

Lara Gast*
VA

Christopher Golden
HUD

Juan Gooch
GSA

Daniela Gorenxa
NAVFAC

Chris Halpin*
GSA PBS

Christine Harada
GSA PBS

Tom Hattery
DOE FEMP

Nancy Henry
FAA

Cecilia Hernandez
USDA

David Insinga
GSA

Nickolas Johnson
Clark Energy Group

Catherine Johnson
VA

Matt Jungclaus
Rocky Mountain Institute

Kevin Kampschroer
GSA

Wayne Latham*
DOE

Britta Macintosh
NORESCO

Pam Maines
Pepco Energy Services

Reginald McNulty*
GSA

Gareth Montgomery
Navy Installations Command

Andrew Morton
Johnson Controls

Jeff Niesz
Pepco Energy Services

Joshua Noonan
HUD

Victor Olgyay
Rocky Mountain Institute

Kinga Porst
GSA

Stephen Rebetsky
Defense Logistics Tenant Agency

Erik Reitz*
GSA

Jennifer Riley
Air Force SAF/IEN

Kurmit Rockwell
DOE FEMP

John Saams
Siemens Government Technologies

Skye Schell
DOE FEMP

Craig Schiller
Rocky Mountain Institute

Jeff Sherman
Navy

John Shonder
DOE Sustainability Performance Office

Bob Slattery
Oak Ridge National Laboratory

Randy Smidt
Army

Susan Stadsklev
GSA Capital Planning

Emily Stoddart
DOE

Derek Supple
Johnson Controls

Tannis Taylor*
GSA

Calissa Ubi
Honeywell

Tim Unruh
DOE FEMP

Cynthia Vallina
Air Force

Jason Vass
Ameresco

Terry Watson
Architect of the Capitol

Martin Weiland
GSA

Jody Wilkens
Trane

*Called in to the meeting

WELCOME AND OBJECTIVES

Objectives:

1. Raise the bar on energy savings
2. Share best practices
3. Continue the transparent dialogue between stakeholders
4. Apply the technical potential exercise, working towards net zero solutions

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AGENDA

8:30	Welcome, Introductions
9:00	Power kickoff
10:00	Success stories
10:45	Break
11:00	Technical Potential Breakout
12:00	Working Lunch
12:30	Barriers and Solutions Breakout
1:30	Break
1:45	Report out
2:45	Success stories
3:15	Break
3:30	Cost effectiveness Presentation
4:00	Unleashing Agency Opportunity Panel Discussion
5:00	Adjourn

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INTRODUCTIONS

AROUND THE ROOM…

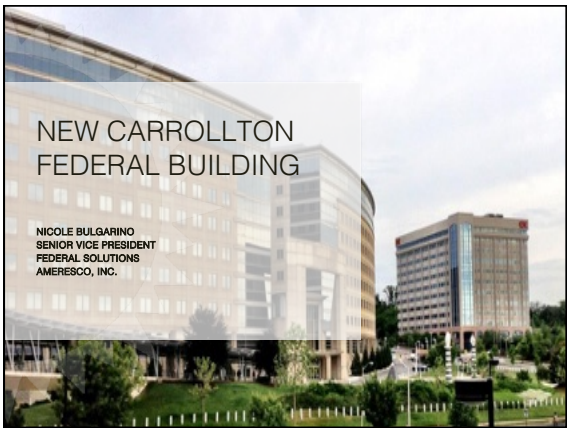
NAME, ORGANIZATION, TITLE

POWER KICKOFF

KATE BRANDT, CEQ
DR. TIM UNRUH, FEMP
NORMAN DONG, GSA

SUCCESS STORIES

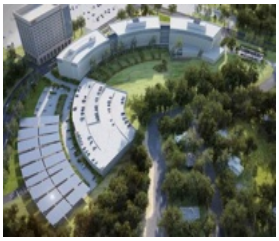
NEW CARROLLTON
ALMERIC CHRISTIAN FEDERAL BUILDINGS



NEW CARROLLTON FEDERAL BUILDING

NICOLE BULGARINO
SENIOR VICE PRESIDENT
FEDERAL SOLUTIONS
AMERESCO, INC.

KEY FACTS



Building Characteristics:

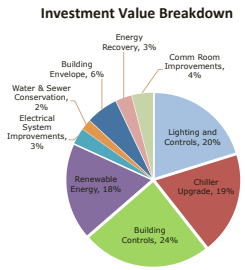
- **Location:** Near Washington, DC
- **Floor Area:** 1.2 million ft²
- **Original Construction:** 1994
- **Tenant:** IRS
- **Baseline EUI:** 121 kBtu/ft²

Project Details:

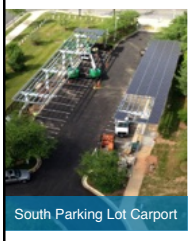
- **ESCO:** Ameresco
- **Managing Agency:** GSA
- **Project Duration:** 38 months
- **Investment Value:** $40M
- **Projected Energy Reduction:** 60%
- **Projected Savings:** $2.5M per year
- **Contract Term:** 22 years

TECHNICAL SPECIFICATIONS

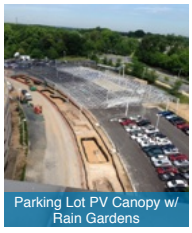
- Integrative HVAC Improvements
  - Over 40% chiller down-sizing
  - Integrated controls and sensors
  - Geothermal heat rejection
  - Exhaust-to-OA heat recovery
- Other Key ECMs
  - Lighting and controls
  - Building envelope improvements
  - Water conservation
  - Solar PV
- M&V
  - Individual metering: PV
  - Option A: water conservation
  - Option C: all other ECMs



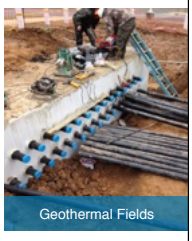
RENEWABLE COMPONENTS



South Parking Lot Carport



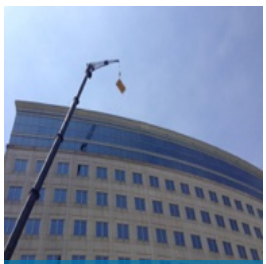
Parking Lot PV Canopy w/ Rain Gardens



Geothermal Fields

CHILLER PLANT UPGRADE & HEAT RECOVERY

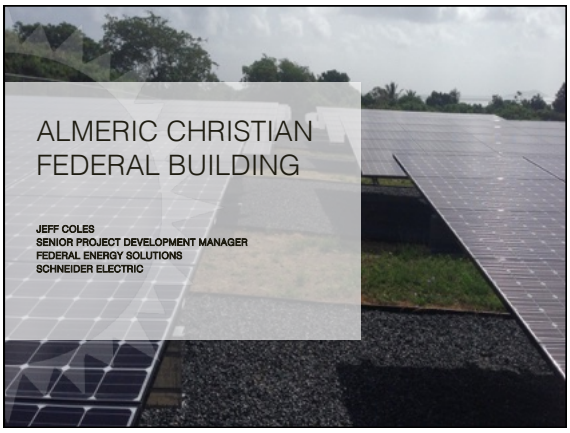
Chiller Plant Upgrades



Recovery Coil Installation

KEYS TO SUCCESS

- Integrative Design and Focus on End-Use
- Project Champions
  - National GSA office
  - Building Facility Manager
  - Project facilitator
- ECMs Saved with Design Compromises
  - PV array and rain gardens
  - Window films and roof replacement
- Well-Structured Communication Plan
- NDER Program
  - Standardization of processes
  - Streamlining of legal and logistical hurdles
  - Potential for improvements in commissioning of integrative design



ALMERIC CHRISTIAN FEDERAL BUILDING

JEFF COLES
SENIOR PROJECT DEVELOPMENT MANAGER
FEDERAL ENERGY SOLUTIONS
SCHNEIDER ELECTRIC

KEY FACTS

Building Characteristics:

- **Location:** St. Croix, Virgin Islands
- **Floor Area:** 57,872 ft²
- **Original Construction:** 1989
- **Tenant:** US Marshal's Office
- **Baseline EUI:** 57 kBtu/ft²
- **Local Utility Rate:** $0.52/kWh

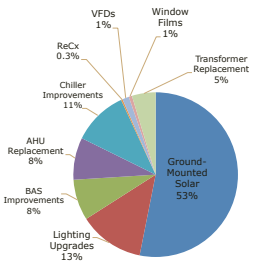
Project Details:

- **ESCO:** Schneider Electric
- **Managing Agency:** GSA
- **Project Duration:** 24 months
- **Investment Value:** $6.37M
- **Projected Energy Reduction:** 100%
- **Projected Savings:** $500,000/yr
- **Contract Term:** 19 years

TECHNICAL SPECIFICATIONS

- Key ECMs
  - Building Automation System
  - Lighting upgrades
  - Chiller and AHU upgrades
  - 462 kW ground-mounted solar PV
- M&V
  - Option B: PV system
  - Option C: all other ECMs

Investment Value Breakdown



KEYS TO SUCCESS

- Unique Project Characteristics
  - Utility rates
  - Security requirements
- Well-Structured Communication Plan
- Project Buy-In
  - Proactively addressed tenant concerns
  - Non-energy upgrades
- Potential for Improvements in Information Collection and Dissemination
  - More existing asset data needed
  - Standardized central location for all project information

TECHNICAL POTENTIAL BREAKOUT

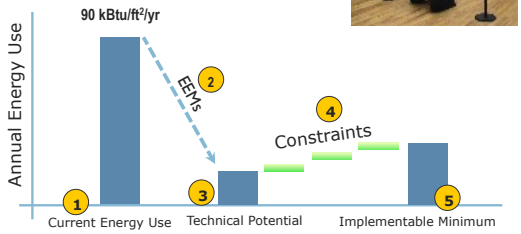
NECESSARY ELEMENTS FOR COST EFFECTIVE DEEP RETROFITS

Achieve ≥ 50% energy savings

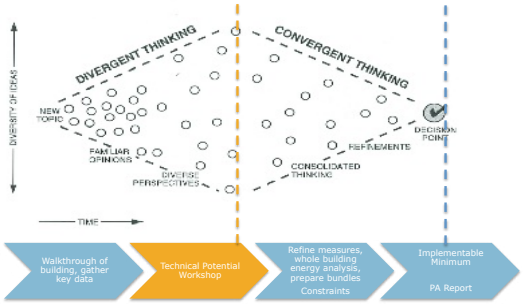
1. Pursue the right steps in the right order
2. Deep Triggers
3. **Focused analysis:**
   Technical Potential & Bundling measures
4. Engage occupants
5. Quantify the value beyond energy cost savings
6. Deep retrofit over time
7. Buildings as a grid asset

TECHNICAL POTENTIAL TOOL

- Challenges conventional ways of thinking
- Leads to more aggressive goal setting
- Explicitly determines where ground has been lost
- Go much farther, faster
- Engages and inspires key stakeholders



APPLYING THE TECHNICAL POTENTIAL



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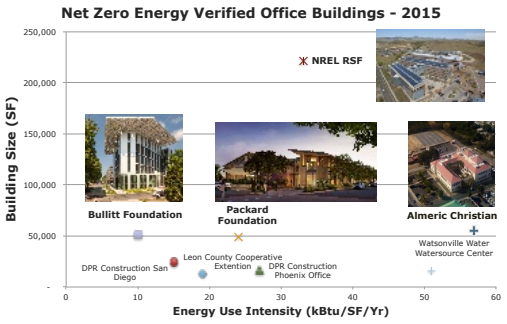
GOING DEEP IS A REQUISITE TO NET ZERO ENERGY



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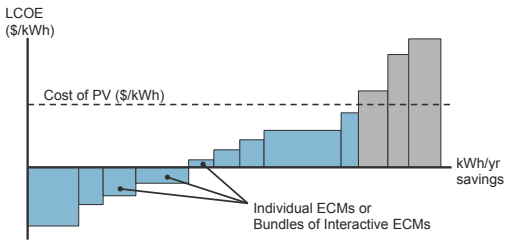
NET ZERO ENERGY

Cost savings from efficiency should be weighed against the avoided cost for renewables that would be needed to off set that load.



NET ZERO IN THE FEDERAL GOVERNMENT

- Accelerating Federal Sustainability Goals
  - 2015 EO 13693 → New construction and major RR&A plans by FY2020 (5k+ GSF) designed for **net-zero energy**; set 2025 goal for **existing** buildings to net-zero.
  - 2009 EO 13514
  - EISA 2007
  - 2006 Guiding Principles
  - EPAct 2005
- Other net zero energy requirements
  - California
  - LBC Certification
  - Schools and Universities (PCC)
  - Cities and communities

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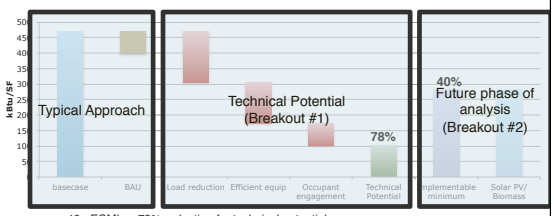
GLOBAL PHARMACEUTICAL – R&D CAMPUS

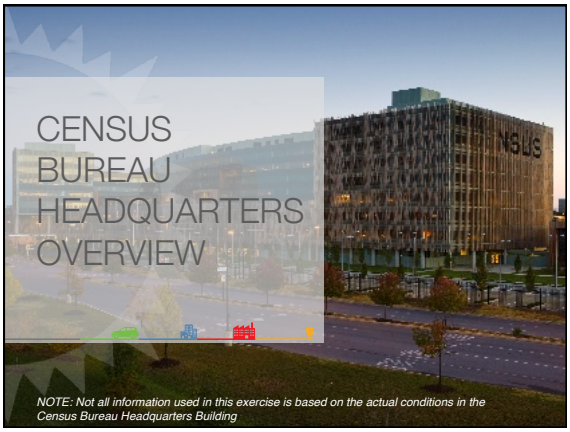
- Almost 1M SF
- Investigating becoming the first net zero campus
- Motivated by:
  - Corporate social and environmental sustainability
  - Attract and retain top talent
  - Safety and productivity
  - Brand enhancement

TECHNICAL POTENTIAL

- 2 day workshop to brainstorm the technical potential – stakeholders included decision makers, ESCO, facilities, occupants, financial, technical experts.



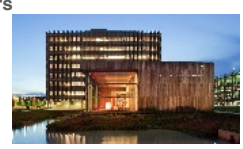
- 40+ ECM's = 78% reduction for technical potential
- ECM's analyzed and confirmed by energy analysis, 40% implementable minimum
- Solar + Biomass generation to get to net zero



CENSUS BUILDING KEY FACTS

U.S. Census Bureau Headquarters

Location:	Suitland, MD
Date complete:	2007
Size:	1.5MM SF
	8 stories (occupied)
Occupancy:	6,000 employees
Primary Use:	Open office,
	Data centers
Certification:	LEED Gold
	Energy Star Score 91



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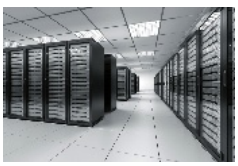
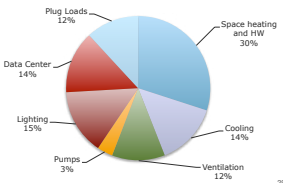
CENSUS BUILDING ENERGY CONSUMPTION

Annual natural gas consumption:	51,500 MMBtu
Annual electricity consumption:	35,175,840 kWh
Total energy consumption:	171,500 MMBtu
Total EUI:	110 kBtu/SF/yr
Peak Electrical Demand:	6,700 kW
Energy cost:	$4.5MM+ per year



Energy End Use Breakdown



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CENSUS BUILDING FEATURES

Key Features:

- Open office plan
- Natural lighting with daylight controls
- Electric CHW cooling system
- Natural gas HW heating system
- Underfloor air distribution with occupant-controlled diffusers
- 2 data centers with high peak loads
- Desktop PCs at each workstation

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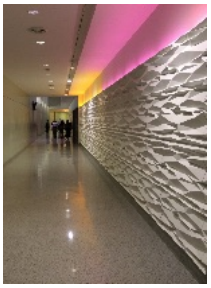
PROJECT GOALS

- Retrofit to net-zero energy
- Provide a visually appealing space that supports productivity
- Meet employee comfort without over-cooling, over-heating, or over-lighting
- Simplify maintenance practices without increasing budget



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POTENTIAL FOR ROOFTOP PV

- 70% energy reduction to achieve net-zero energy with on-site solar PV
- Achieving 70% energy savings requires **creative ECM brainstorming** and **holistic design**
- The **technical potential exercise** helps achieve both

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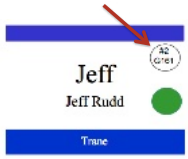
TECHNICAL POTENTIAL BREAKOUT GROUPS

Group #	Room number	Leaders
#1	G117	Cara
#2	G161	Matt
#3	G151	Craig
#4	G143	Victor



BREAKOUT GROUP REPORT OUT

5 MINUTES PER GROUP

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SUCCESS STORIES

KING BRICKELL FEDERAL BUILDING
FORT BUCHANAN

KEY FACTS

Building Characteristics:

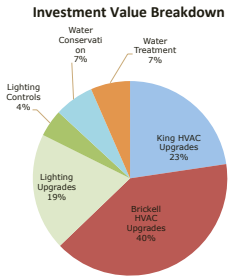
- **Location:** Miami, FL
- **Floor Area:** 580,000 ft² total
- **Original Construction:** King- 1993
  Brickell- 1972
- **Tenants:** USAO, USDA, USCG, DOL, HUD, CBP, Navy Federal Credit Union
- **Baseline EUI:** 60 kBtu/ft²

Project Details:

- **ESCO:** FPL Energy Services, Inc.
- **Managing Agency:** GSA
- **Project Duration:** 32 months
- **Investment Value:** $4.36M
- **Projected Energy Reduction:** 40%
- **Projected Savings:** $249k per year
- **Contract Term:** 12 years

TECHNICAL SPECIFICATIONS

- HVAC Replacement and Upgrades
  - Existing system oversized
  - BAS optimization and load reduction
- Other Key ECMs
  - Lighting upgrades
  - Water conservation and treatment
- M&V
  - Option A: HVAC equipment, lighting, water conservation
  - Option B: HVAC controls, water treatment



KEYS TO SUCCESS

- Right-Timing and Right-Sizing
  - Appropriated funds for planned HVAC replacement
  - Right-sizing and load reduction measures reduced replacement system size
  - Savings over BAU funded aggressive ECMs
- Well-Structured Communication Plan
  - Continued involvement of design team
  - Built trust among tenants and GSA
- Potential for Process Improvements
  - Required on-site meetings
  - More time for ECM exploration
  - Clarification of M&V process

FORT BUCHANAN

RANDY SMIDT
STAFF ENGINEER
ENERGY AND UTILITIES
HQ DEPARTMENT OF U.S. ARMY

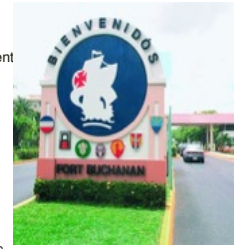
KEY FACTS

Building Characteristics:

- **Location:** Guaynabo, Puerto Rico
- **Number of Buildings:** 73
- **Total Floor Area:** 1.7 million ft²
- **Original Construction:** 1940-present
- **Baseline EUI:** 55 kBtu/ft²
- **Utility Rate:** $0.22/kWh

Project Details:

- **ESCO:** Johnson Controls, Inc.
- **Managing Agency:** U.S. Army
- **# Task Orders:** 2*
- **Project Duration:** 38 months
- **Investment Value:** $71.1M
- **Projected Energy Reduction:** 53%
- **Projected Savings:** $4.8M per year
- **Contract Term:** 17-20 years



*: Third task order currently in progress

TECHNICAL SPECIFICATIONS

- Key ECMs
  - Lighting replacements and controls
  - HVAC improvements
- Water Conservation
  - Rainwater harvesting
  - Smart irrigation system
  - 70% reduction, 52 Mgal/yr saved
- Renewables
  - 5.4 MW solar PV
  - 875 kW wind turbines
  - 106 MmBtu/yr solar thermal
- M&V
  - Option B: renewable systems
  - Option A: all other ECMs

	Invested	First-Year Savings	Simple Payback
PV Generation	$28.43M	$1.53M	19 yrs
Lights & Occupancy Sensors	$7.38M	$1.1M	7 yrs
HVAC	$7.04M	$613k	12 yrs
Wind Generation	$5.10M	$179k	29 yrs
Water Solutions	$4.35M	$590k	7 yrs
Air Cooled Chiller	$4.26M	$236k	18 yrs
EMCS	$3.29M	$445k	7 yrs
LED Street Lights	$890k	$85k	11 yrs
Roof Insulation & Reflective Membrane	$660k	N/A	N/A
Retro-Commissioning	$570k	$5k	11 yrs
Solar Water Heating	$180k	$5k	33 yrs
Total	$62,150,000	$4,788,000	

KEYS TO SUCCESS

- ECM Bundling
  - $23.5M shorter-payback ECMs (7-12 years)
  - $38.0M longer-payback ECMS (18-33 years)
- Aggressive Goals
  - Specified Net Zero Water pilot site
  - Program supported by Army goals (e.g. security)
  - Program established project philosophy for water *and* energy
- Value Beyond Energy Savings
  - Projected O&M savings: $268k/year
  - O&M and water contribute 18% of total savings
- Project Champion and Interdisciplinary Project Team

THE COST EFFECTIVENESS OF DEEP RETROFITS

JOHN SHONDER, DOE

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GSA NDER Round 1 Results

ENERGY

John Shonder
Sustainability Performance Office
US Department of Energy

June 3, 2015

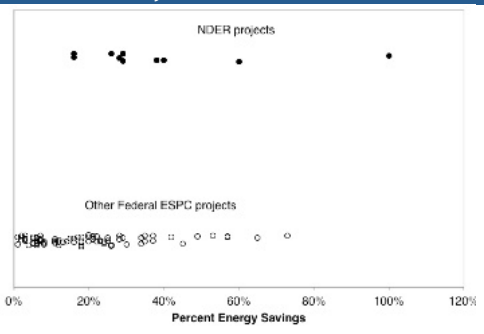
GSA NDER ROUND 1

- On March 20, 2012, GSA issued notice of opportunity for a nationwide deep energy retrofit (NDER) Among the objectives for the project were the following:
  - Retrofit plans that move a building toward net zero energy consumption
  - Use of innovative technologies
  - Use of renewable energy technologies
  - Unstated objective: deeper energy savings than had been achieved in the past

NDER RESULTS

- 10 Task Orders (projects) awarded
- Total implementation price of $172 million
- 14.7 million square feet of floorspace
- Will reduce GSA's energy use by 365 billion Btu per year

NDER COMPARED WITH OTHER FEDERAL ESPC/UESC PROJECTS



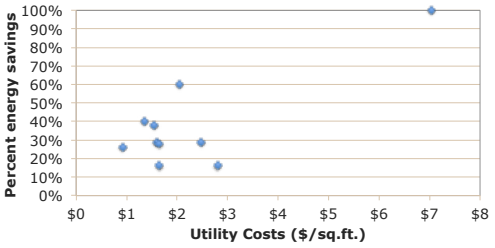
GSA Did Achieve Deeper Energy Savings

- A sample of 70 non-NDER federal ESPC projects achieved an average of 18.5% savings
- Average savings of 10 NDER was 38%, more than twice the other projects
- Wilcoxon rank sum test shows the difference in means is statistically significant at the p=0.003 level

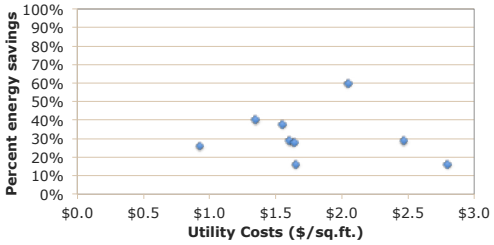
Some Potential Drivers For Deeper Energy Savings

- Energy prices
- Baseline energy use index (EUI)
- Amount of "one-time savings"
- Is there some way to select buildings that present opportunities for deep savings?

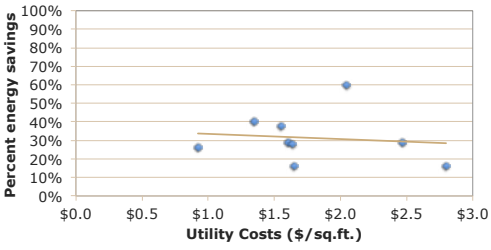
Percent Savings Appears Related To Baseline Utility Costs, But …



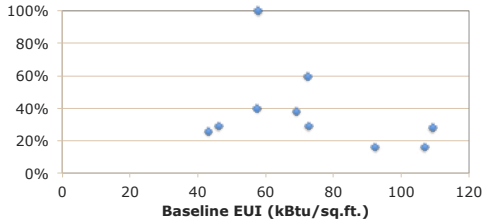
With High-Leverage Point Removed, Savings Unrelated To Baseline Utility Costs



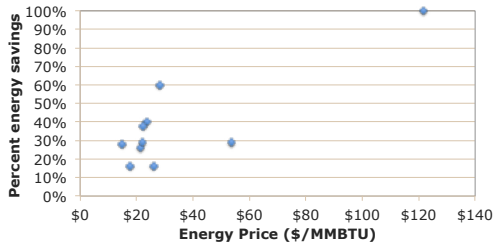
Relation Opposite To What We Expect



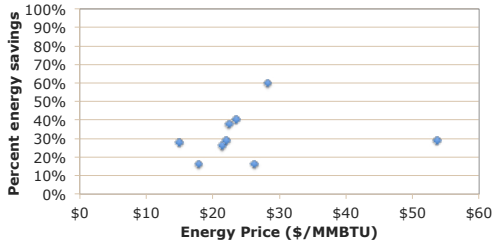
Percent Savings Also Appears Unrelated To EUI



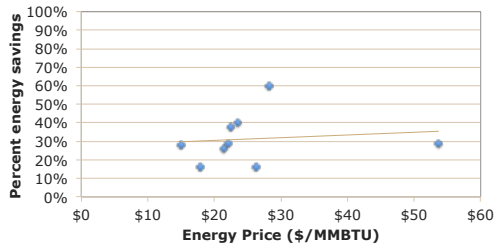
Percent Savings Appears Related To Baseline Energy Unit Price, With Outlier



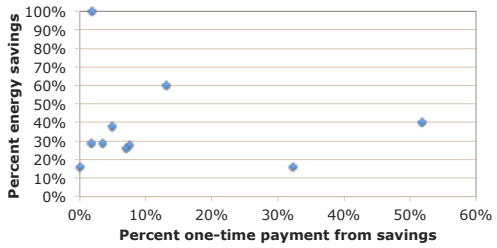
With Outlier Removed Savings Appears Unrelated To Baseline Energy Unit Price



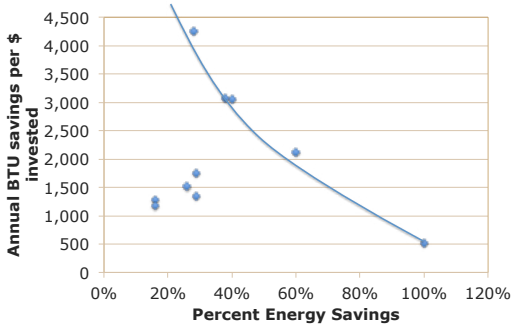
Percent Savings Increases With Energy Price, But Slope Not Significant



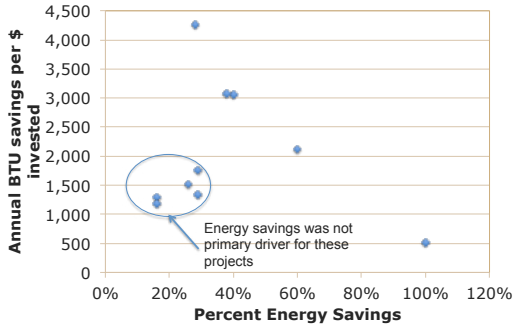
Amount of One-Time Payment Also Unrelated To Percent Savings Achieved



BTU/$ Invested vs. Percent Savings



Different Classes of Projects



How GSA Achieved These Results

- Emphasis on deep retrofits in the notice of opportunity
- Design charettes reinforced the need for ESCOs to dig deeper and propose ECMs with longer simple paybacks
  - Confidence to propose long payback ECMs on part of ESCO
  - Confidence to accept long payback ECMs on part of regional offices
- Central Program Management Office provided central source of information for GSA regional managers

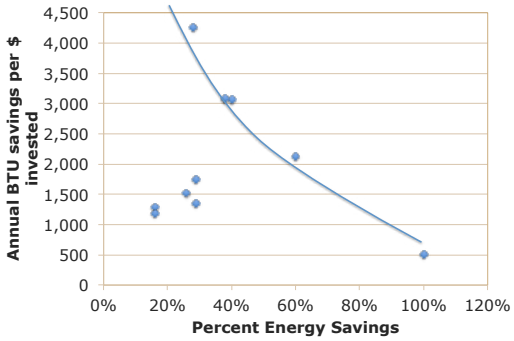
What is not (necessarily) required to achieve deep savings

- High energy prices
- High energy consumption
- Advanced ECMs
- Large payments from savings in implementation period
- O&M savings

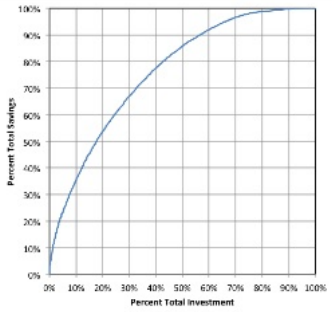
What Is Required To Achieve Deep Retrofits

- Buildings that have not undergone recent energy retrofit projects
- Emphasis from agency
- Thorough audit process to identify ECMs
- Integrated design approach
- Realization that deep retrofits cost more (in terms of energy savings per dollar invested)

Postscript: Are deep retrofit projects life cycle cost effective?



Analysis of EISA 432 database



Balance sheet for 20% savings

Year	Loan Balance	Principal pmt	Interest pmt	O&M cost	Guaranteed Savings	Savings to Government	Discounted Savings
1							
2	$ 6,211	$ -			$ -		
3	$ 5,874	$ 337	$ 248	$ 121	$ 707	$ 1	$ 1
4	$ 5,512	$ 362	$ 235	$ 124	$ 722	$ 1	$ 1
5	$ 5,124	$ 388	$ 220	$ 126	$ 736	$ 1	$ 1
6	$ 4,708	$ 416	$ 205	$ 129	$ 751	$ 1	$ 1
7	$ 4,263	$ 445	$ 188	$ 131	$ 766	$ 1	$ 1
8	$ 3,787	$ 476	$ 171	$ 134	$ 781	$ 1	$ 1
9	$ 3,279	$ 508	$ 151	$ 137	$ 797	$ 1	$ 1
10	$ 2,738	$ 541	$ 131	$ 139	$ 813	$ 1	$ 1
11	$ 2,162	$ 576	$ 110	$ 142	$ 829	$ 1	$ 1
12	$ 1,549	$ 613	$ 86	$ 145	$ 845	$ 1	$ 1
13	$ 897	$ 652	$ 62	$ 148	$ 862	$ 1	$ 1
14	$ 205	$ 692	$ 36	$ 151	$ 880	$ 1	$ 1
15	$ -	$ 205	$ 8	$ 154	$ 897	$ 530	$ 328
16	$ -	$ -	$ -	$ 157	$ 915	$ 758	$ 455
17	$ -	$ -	$ -	$ 160	$ 933	$ 773	$ 449
18	$ -	$ -	$ -	$ 163	$ 952	$ 789	$ 444
19	$ -	$ -	$ -	$ 166	$ 971	$ 805	$ 438
20	$ -	$ -	$ -	$ 170	$ 991	$ 821	$ 433
21	$ -	$ -	$ -	$ 173	$ 1,010	$ 837	$ 428
22	$ -	$ -	$ -	$ 177	$ 1,031	$ 854	$ 423
23	$ -	$ -	$ -	$ 180	$ 1,051	$ 871	$ 417
24	$ -	$ -	$ -	$ 184	$ 1,072	$ 888	$ 412
25	$ -	$ -	$ -	$ 187	$ 1,094	$ 906	$ 407
Total		$ 6,211	$ 1,852		$ 20,407	$ 8,845	$ 4,643

Balance sheet for 40% savings

Year	Loan Balance	Principal pmt	Interest pmt	O&M cost	Guaranteed Savings	Savings to Government	Discounted Savings
1							
2	$ 13,889	$ -			$		
3	$ 13,302	$ 587	$ 556	$ 271	$ 1,415	$ 1	$ 1
4	$ 12,668	$ 634	$ 532	$ 277	$ 1,443	$ 1	$ 1
5	$ 11,986	$ 682	$ 507	$ 282	$ 1,472	$ 1	$ 1
6	$ 11,253	$ 733	$ 479	$ 288	$ 1,502	$ 1	$ 1
7	$ 10,466	$ 787	$ 450	$ 294	$ 1,532	$ 1	$ 1
8	$ 9,623	$ 843	$ 419	$ 299	$ 1,562	$ 1	$ 1
9	$ 8,720	$ 902	$ 385	$ 305	$ 1,593	$ 1	$ 1
10	$ 7,756	$ 964	$ 349	$ 312	$ 1,625	$ 1	$ 1
11	$ 6,728	$ 1,029	$ 310	$ 318	$ 1,658	$ 1	$ 1
12	$ 5,631	$ 1,097	$ 269	$ 324	$ 1,691	$ 1	$ 1
13	$ 4,463	$ 1,168	$ 225	$ 331	$ 1,725	$ 1	$ 1
14	$ 3,220	$ 1,243	$ 179	$ 337	$ 1,759	$ 1	$ 1
15	$ 1,899	$ 1,321	$ 129	$ 344	$ 1,794	$ 1	$ 1
16	$ 497	$ 1,403	$ 76	$ 351	$ 1,830	$ 1	$ 1
17	$ -	$ 497	$ 20	$ 358	$ 1,867	$ 992	$ 576
18	$ -	$ -	$ -	$ 365	$ 1,904	$ 1,539	$ 866
19	$ -	$ -	$ -	$ 372	$ 1,942	$ 1,570	$ 855
20	$ -	$ -	$ -	$ 380	$ 1,981	$ 1,602	$ 845
21	$ -	$ -	$ -	$ 387	$ 2,021	$ 1,634	$ 835
22	$ -	$ -	$ -	$ 395	$ 2,061	$ 1,666	$ 824
23	$ -	$ -	$ -	$ 403	$ 2,103	$ 1,700	$ 814
24	$ -	$ -	$ -	$ 411	$ 2,145	$ 1,734	$ 805
25	$ -	$ -	$ -	$ 419	$ 2,187	$ 1,768	$ 795
Total		$ 13,889	$ 4,884		$ 40,814	$ 14,218	$ 7,225

Conclusions

- During the contract, there is very little cost savings, as guaranteed savings are passed to the ESCO
- Economics must consider savings that accrue to the government after the term of the contract
- Deeper savings increase the term of the contract, meaning fewer years are available after the ESPC is closed out
- But the higher level of savings in the out years mean that the deep retrofit project has greater savings for the government

Panel Discussion

Kevin Kampschroer, GSA
Sharon Conger, GSA
Skye Schell, FEMP

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THE PATH TO A DEEP ENERGY RETROFIT

USING AN ENERGY SAVINGS PERFORMANCE CONTRACT

DEEP ENERGY RETROFITS

Seven key steps will help owners reach deeper energy savings through Energy Savings Performance Contracts (ESPCs). ESPCs are partnerships between a Federal agency and an energy service company (ESCO) that allow Federal agencies to complete energy-savings projects without upfront capital costs or special Congressional appropriations.

What is a deep energy retrofit?

Deep energy retrofits integrate a variety of energy conservation measures (ECMs) through a whole building approach to achieve superior energy savings compared to conventional retrofits, often approaching or exceeding 50% savings. They also make net-zero energy buildings more achievable by substantially reducing energy demand, which makes it easier and more cost-effective to meet remaining energy needs with renewable energy.

Why do a deep energy retrofit?

- To reduce GHG emissions and support the President's Climate Action Plan
- Maximize the value of Federal appropriations
- To replace aging infrastructure and improve a building system's reliability
- To reduce operating costs and hedge against risks such as rising energy costs
- To improve occupant satisfaction, wellness, and productivity
- To maintain access to additional cost-effective upgrades and infrastructure renewal in the future

Brought to you by GSA's Office of Federal High-Performance Green Buildings

Deep retrofits can be implemented across a wide spectrum of buildings and conditions:

What is not (necessarily) required for deep energy savings: high energy prices, high energy consumption or advanced energy conservation measures.

What is required for deep savings: buildings in need of an energy retrofit, agency support, a thorough audit process to identify measures, and an integrative design approach.

Step 1: GO DEEP AT THE RIGHT TIME AND IN THE RIGHT ORDER

Piggyback on upcoming projects and conduct the right steps in the right order.

- The following are some events that may trigger a cost-effective deep energy retrofit:
  - » Planned building renovation
  - » Major system replacement
  - » Disaster recovery
  - » Envelope replacement
  - » Code upgrades
  - » New owner/refinancing
  - » New use/occupancy type
  - » Building greening
- When a deep retrofit opportunity surfaces, have an initial conversation with GSA Headquarters or with your ESCO to do a rough scoping. If there is any access to appropriated funds, use those to buy longer payback items (such as window replacements).
- Consider expanding the scope of work beyond a single building as a stand-alone system. Instead consider the portfolio of buildings as a whole to drive greater impact.

THE RIGHT ORDER: ALWAYS REDUCE ENERGY DEMAND FIRST.

Reduce loads: Reduce the amount of energy needed to heat, cool and light the building	Identify integrative bundles of measures	Select appropriate and efficient technologies	Optimize operations	Explore renewable energy

KING–BRICKELL FEDERAL BUILDINGS

As part of GSA's National Deep Energy Retrofit (NDER) Program, the King–Brickell Federal Buildings, located in Miami, Florida, anticipate a 40% reduction in energy use and more than $200,000 in annual energy cost savings over a 15-year contract period. The ESPC process, which was led by FPL Energy Services, Inc. (FPLES), incorporated several unique characteristics that enabled this significant energy use and cost savings projection to be achieved. FPLES used an established project management process, including the engagement of a diverse group of stakeholders early and throughout the process and they analyzed and implemented a variety of ECMs to achieve the projects conservation goals. Additionally, Option C was selected for measurement and verification (M&V) to evaluate the success of the project.

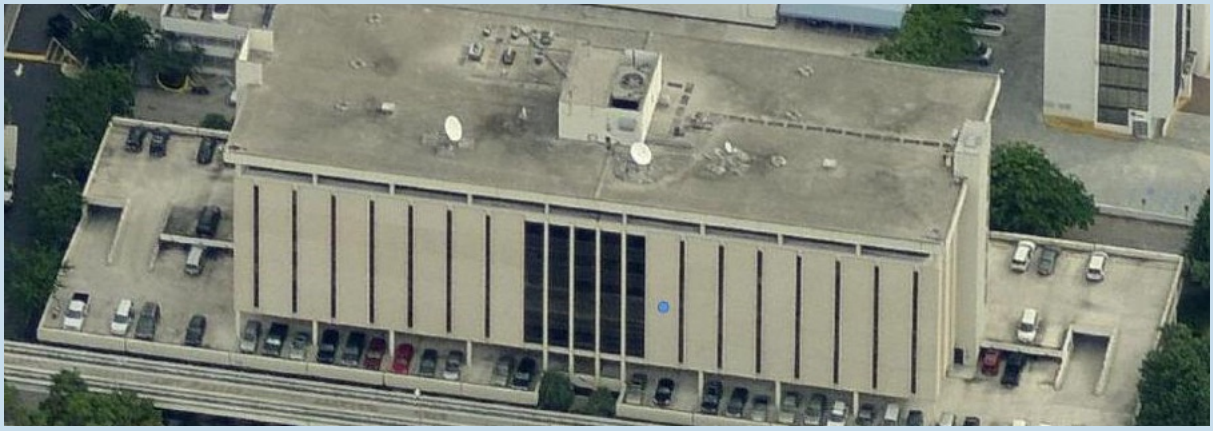


Image courtesy of FPL Energy Services, Inc. (FPLES).

Step 2: ENGAGE DIVERSE STAKEHOLDERS

Engage the entire decision-making chain early and check in throughout the process.

- Involve all stakeholders from the owner decision making team: Occupants, facility management team, legal, financial and procurement.
- Engage with those that bring different perspectives on energy savings like security, janitorial, landscaping and grounds staff, maintenance service providers, and local utility representatives.
- Make the project a priority.
- Involve a project coordinator to help oversee the ESCO and contractors.
- Engage building occupants early and often to educate, train, and foster support.
- Clarify contractor roles and liabilities at the onset. Identify contractor design responsibilities for each aspect of a project.
- See your Contracting Officer as both an advocate and an advisor. The Contracting Officer should push both the ESCO and the agency to go deeper.

KOHL'S

Kohl's acheived deeper energy savings by establishing a multi-disciplinary energy team. Kohl's previously executed several "low-hanging fruit" efficiency projects that provided cost savings but it remained difficult to get funding for more and deeper energy efficiency projects until Kohl's embedded a member of its finance department within the energy team. The results improved communication and transparency between the energy team and finance department and expedited approval processes.

Energy Team Structure

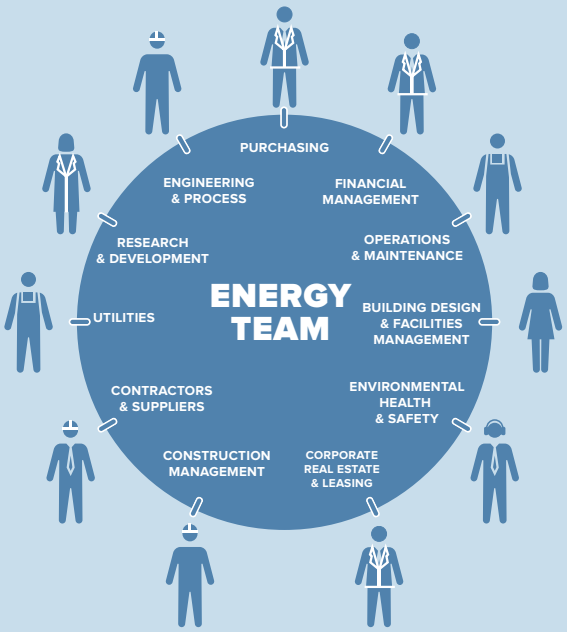


Figure courtesy of World Business Council for Sustainable Development (WBCSD).

Image courtesy of Joe Seer / Shutterstock.com.

Step 3: REQUEST A DEEP RETROFIT IN YOUR SOLICITATION

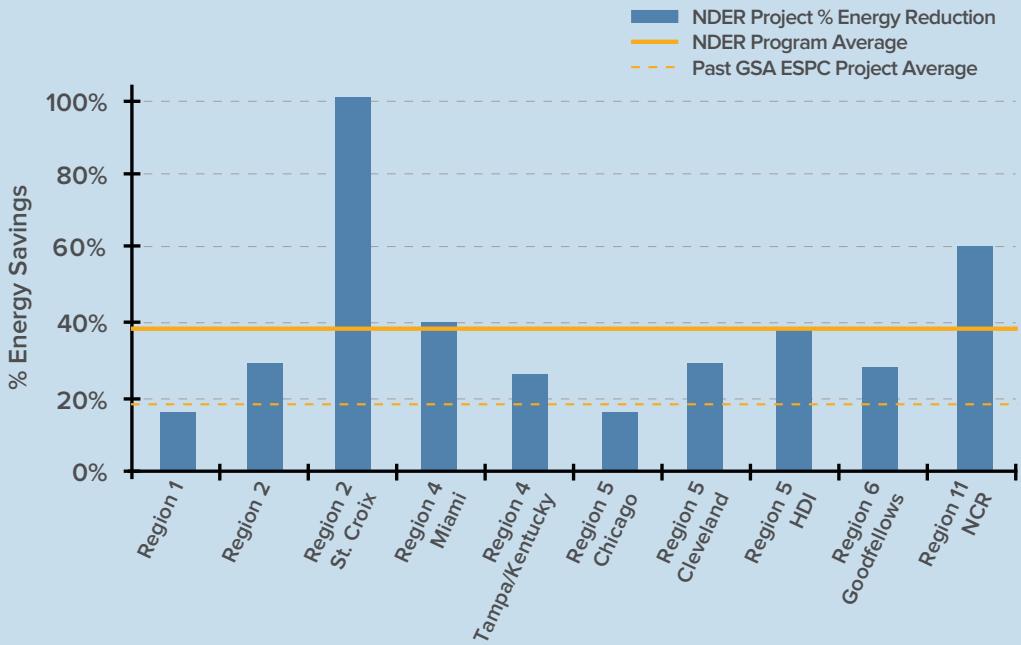
Ask for a deep retrofit, know what you're getting and how to make the most of it.

- In your request for proposals or notice of opportunity, state your intent to achieve deep levels of savings. Be prepared for what you are asking for, as it should entail a more rigorous audit process and a broader set of ECMs than a conventional retrofit. Continue to push for out of the box ideas over the course of the project.
- Consider adding capital to buy-down the project cost. Apply capital to the longer payback measures and ensure they are analyzed as part of the bundle of ECMs and implemented at the same time.
- Wherever possible, include operations and maintenance (O&M) in the contract. It could yield additional savings since the ESCO is more involved on a day-to-day basis and form a seamless integration between O&M and measurement and verification (M&V).
- Work with your ESCO, GSA, Contracting Officer, and occupants to incorporate occupant behavior savings into ECM bundles.

GSA'S NATIONAL DEEP ENERGY RETROFIT (NDER) PROGRAM

The GSA awarded ten ESPC projects under the NDER Program to demonstrate the use of innovative and renewable energy technologies and to move Federal buildings toward net-zero energy. The NDER projects have doubled energy savings from past GSA ESPC projects—boosting average energy savings from 18% to 38%—by emphasizing the need for deeper energy savings and by establishing a central Project Management Office (PMO) that provides authoritative contracting, technical, and pricing assistance.

NDER Program ESPC Project Energy Savings



Step 4: BUNDLE ENERGY CONSERVATION MEASURES

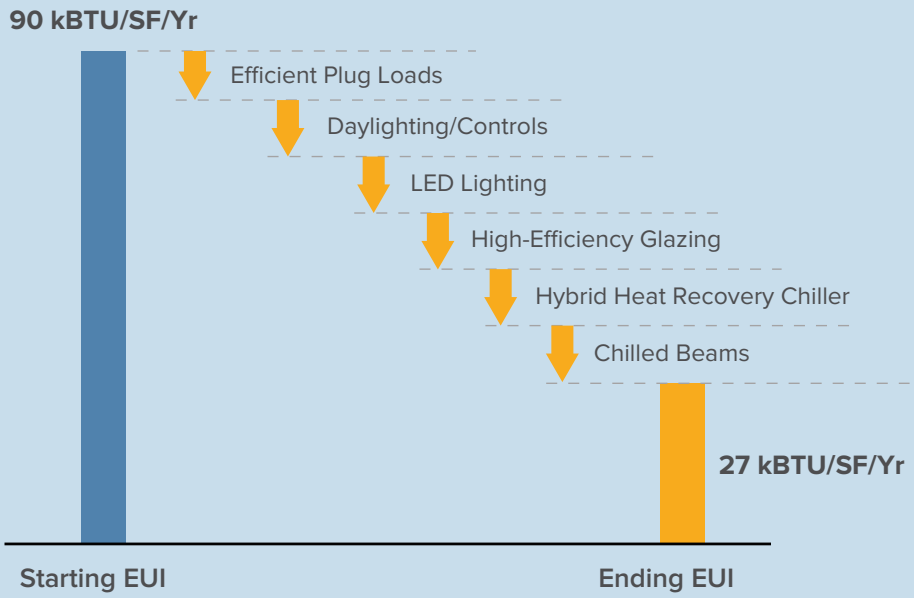
Reinforce the importance of bundling energy conservation measures. Bundling—or grouping measures to consider the total savings rather than the individual savings from each measure—provides interactive effects across different systems. For instance, highly insulating windows may reduce heating and cooling energy use and lead to downsized heating and cooling systems. This is not apparent unless you consider the bundle as a whole.

- Bundling measures combines long payback measures with short payback measures, creating an acceptable return and much higher value.
- Combining several buildings into a single ESPC contract (and associated financing) may reduce overhead, implementation, and financing costs.
- When reviewing the proposed measures in audit reports, keep the bundles intact and resist removing individual measures. Bundles of ECMs create greater value for owners than the sum of the individual measures.

BYRON G. ROGERS FEDERAL OFFICE BUILDING

GSA's 494,156 square-foot Byron G. Rogers Federal Office Building in Denver, Colorado—home to eleven federal agencies—underwent a deep energy retrofit to make it one of the most energy-efficient buildings in the U.S. The retrofit is expected to reduce energy use by 60–70% and lower Energy Use Intensity (EUI) to 28–38 kBtu/sf-year. Bundling ECMs was the driving force behind the significant energy performance improvements to the building. Updates to daylighting, controls, lighting, glazing, and plug loads significantly reduced energy loads. Active chilled beams were integrated with a heat recovery and thermal storage system to meet the loads more efficiently.

Bundle ECMs to maximize energy performance



Step 5: PRESENT THE FULL SUITE OF BENEFITS

Communicate all the potential benefits of a deep energy retrofit to stakeholders.

- Build a stronger case for deep energy retrofits by considering their value beyond energy cost savings and how different stakeholders benefit.

POTENTIAL VALUE BEYOND ENERGY COST SAVINGS

Maintenance Costs Pacific Northwest National Laboratory (2008); Leonardo Academy (2008); Aberdeen Group (2010)	↓ 9.0-14%
Occupant Satisfaction GSA (2011)	↑ 27-76%
Rental Premium Eicholtz, Kok & Quigley (2010); Wiley et al. (2010); Fuerst & McAllister (2011); Eicholtz, Kok, et al. (2011); Newell, Kok, et al. (2011); Miller, Morris & Kok (2011); Pogue et al. (2011); McGraw Hill/Siemens (2012)	↑ 2.1-17%
Occupancy Premium Wiley et al. (2010); Pogue et al. (2011); McGraw Hill/ Siemens (2012)	↑ 3.14-18%
Property Sale Price Premium Eicholtz, Kok & Quigley (2010); Fuerst & McAllister (2011); Eicholtz, Kok, et al. (2011); Newell, Kok, et al. (2011)	↑ 11.1-26%
Employee Productivity Lawrence Berkeley National Laboratory	↑ 1.0-10%
Employee Sick Days Miller, Pogue, Gough & Davis (2009); Cushman & Wakefield et al. (2009); Dunckley (2007); City of Seattle (2005); Romm & Browning (1995)	↓ 0-40%

* Information courtesy of Rocky Mountain Institute's Deep Retrofit Value Practice Guide.

AT&T

AT&T is integrating the multiple benefits of energy efficiency into decision-making. At&T builds support for its energy management program by engaging stakeholders across different departments—including human resources, operations, and maintanence—about how energy efficiency investments would benefit each of them. The effective communication of these benefits to stakeholders established broad internal support for AT&T to make large investments in its energy management program. These investments provided $191 million in annual energy cost savings between 2010 and 2013.

Step 6: MEASURE AND VERIFY FOR SUCCESS

Measurement and Verification (M&V) is essential for evaluating and improving a building's energy performance.

- Consider using International Performance Measurement and Verification Protocol (IPMVP) Option C—which provides a whole building approach—during the first year or two and then transition to measuring only key parameters of retrofits in isolation later.
- Share project successes and lessons learned through case studies.
- Build a long-term energy management plan for the building. Note the age of equipment and envelope components and plan ahead for when they will need replacement.
- Continually engage occupants and facility staff to maximize benefits and minimize future maintenance.

Image courtesy of Schneider Electric.

GSA'S ALMERIC CHRISTIAN FEDERAL BUILDING

Through its participation in GSA's National Deep Energy Retrofit (NDER) Program, the Almeric Christian Federal Building in St. Croix, U.S. Virgin Islands anticipates 100% energy use reductions—thereby achieving net-zero energy status—and nearly $510,000 in annual energy cost savings over a 19-year contract. Schneider Electric is overseeing the ESPC process. Best practices included the following: doing the right steps in the right order by reducing loads before adding on-site solar energy, engaging a diverse group of stakeholders early and throughout the process, combining ECMs into bundles and taking a whole building approach to measurement and verification of savings by using Option C.

Step 7: ACHIEVE NET-ZERO ENERGY

When pursuing net-zero energy, the decision-making paradigm changes from asking 'what measures are cost effective within a given timeframe?' to 'what measures are more cost effective than purchasing renewable energy?'.

- Deep energy retrofits are critical for making net-zero energy buildings a practical, cost-effective option.
- The path to a net-zero energy building demands that the right steps are pursued in the right order. Reduce the building energy load first optimize equipment and controls (building and grid/micro-grid), and then supply the remaining energy needs with renewable energy.

GSA WAYNE ASPINALL FEDERAL BUILDING AND COURTHOUSE

Built in 1918 and the home of nine federal agencies, GSA's Wayne Aspinall Federal Building and Courthouse in Grand Junction, Colorado is the first net-zero energy building on the National Register of Historic Places. Designed to achieve LEED Platinum, the deep retrofit of this 41,562 sf building used many best practices to become 67% more energy-efficient than comparable code-compliant buildings. With 123 KW of rooftop photovoltaic (PV) system, the building is a net producer of energy on an annual basis while still preserving the building's historic character.

Image couresy of GSA.

RESOURCES

Deep Energy Retrofits:

- Rocky Mountain Institute (RMI): Deep Retrofit Value Practice Guide and Retrofit Depot
- ASHRAE: Advanced Energy Retrofit Guides
- GSA: Energy Savings from GSA's National Deep Energy Retrofit Program and Deep Energy Retrofits in GSA Buildings
- New Buildings Institute (NBI): Deep Energy Savings in Existing Buildings

Net-Zero Energy Buildings:

- GSA: Sustainable Facilities Tool (SFTool)
- Whole Building Design Guide (WBDG): Net Zero Energy Buildings
- New Buildings Institute (NBI): Zero Net Energy
- International Living Future Institute: Net Zero Energy Building Certification

Energy Savings Performance Contracting:

- Department of Energy, Federal Energy Management Program (FEMP) ESPCs
- Energy Service Coalition
- National Association of Energy Service Companies

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