

Selecting Energy Efficiency Packages For Small Office Buildings

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Laboratory Snapshot

Only National Laboratory Dedicated Solely to Energy Efficiency and Renewable Energy

- Leading clean-energy innovation for 37 years
- 1740 employees with world-class facilities
- Campus is a living model of sustainable energy
- Owned by the Department of Energy
- Operated by the Alliance for Sustainable Energy



Scope of Mission



Energy Efficiency

Residential Buildings

Commercial Buildings

Personal and Commercial Vehicles



Renewable Energy

Solar

Wind and Water

Biomass

Hydrogen

Geothermal



Systems Integration

Grid Infrastructure

Distributed Energy

Interconnection

Battery and Thermal Storage

Transportation



Market Focus

Private Industry

Federal Agencies

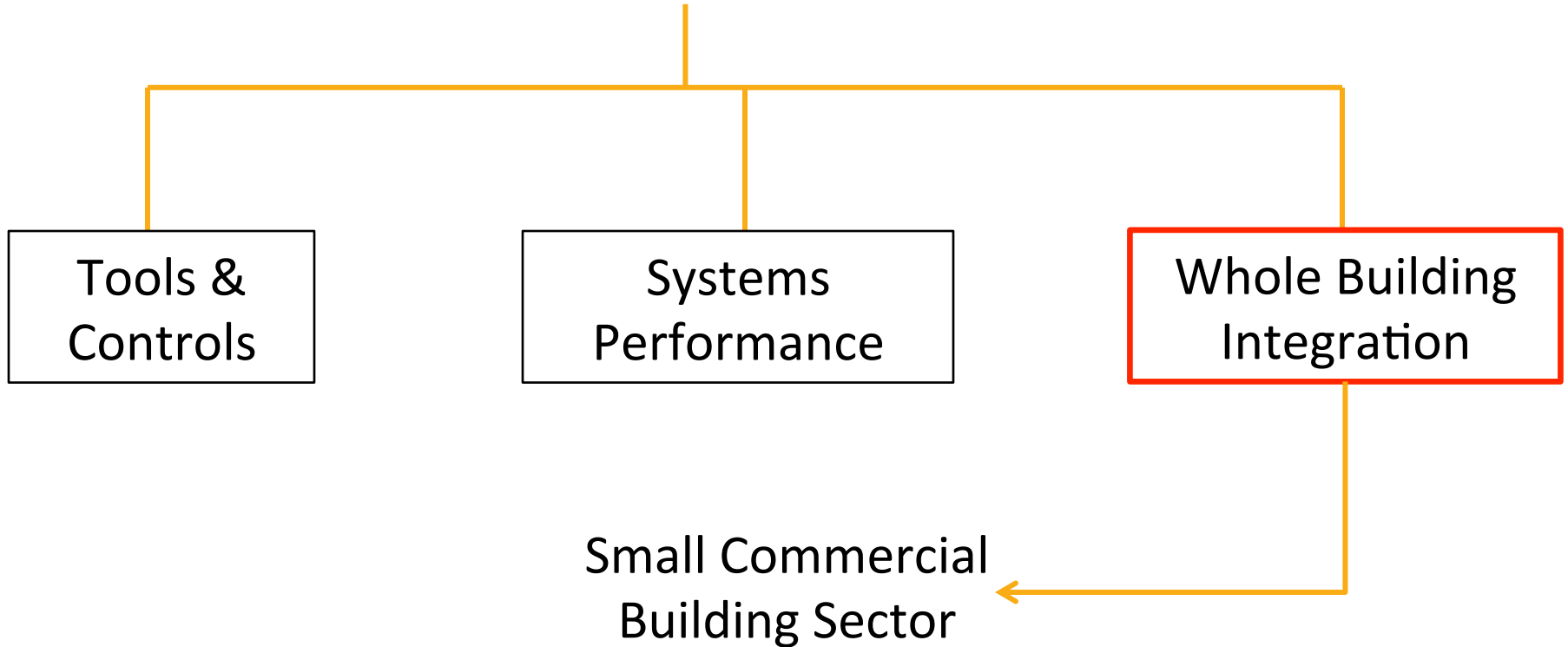
Defense Dept.

State/Local Govt.

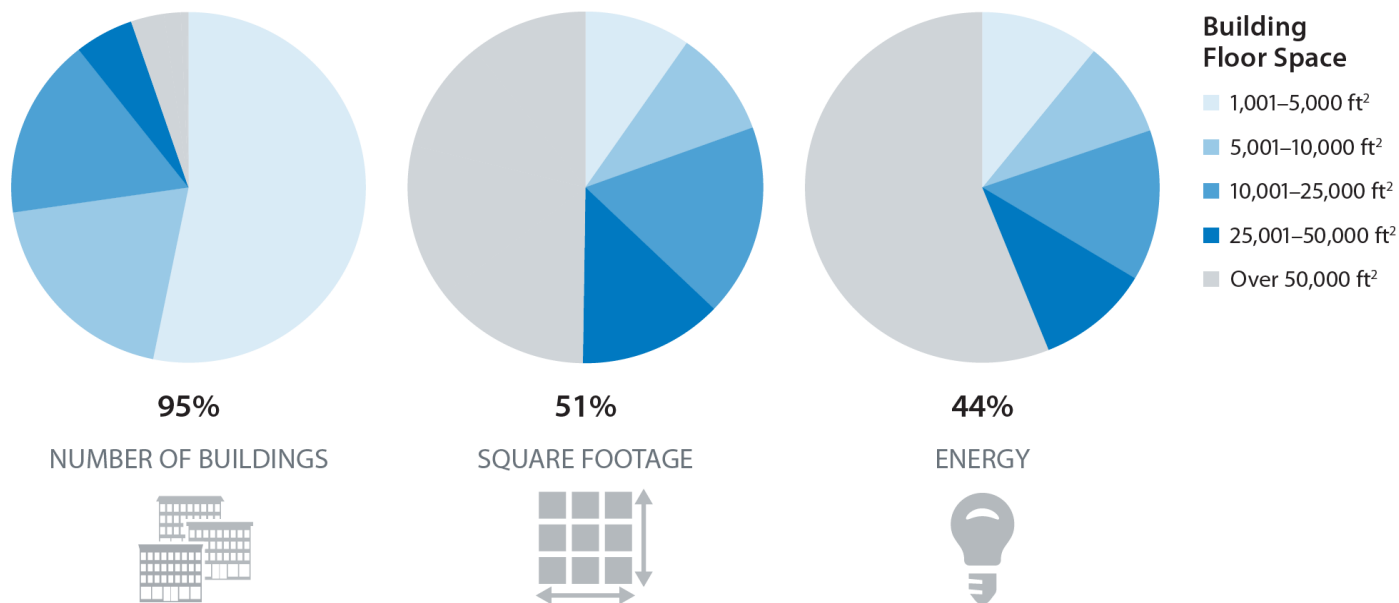
International

Commercial Buildings Research Group

Commercial



Small Commercial Buildings



**Defined as buildings <50,000 ft²,
most are <8,000 ft²**

Initial Research Findings

The largest reported barriers inhibiting small building owners from adopting energy efficiency solutions:

- Limited capital
- Higher transaction costs relative to energy cost savings
- Lack of time to research and implement energy efficiency solutions
- Split incentive obstacles between owners and tenants
- Lack of available sector-specific resources and technologies

Industry Research and Recommendations for Small Buildings and Small Portfolios:
<http://www.nrel.gov/docs/fy14osti/57776.pdf>

Small Building Research

- DOE \$10M award for 6 projects to help small commercial buildings save money by saving energy:
 - National Trust for Historic Preservation: provide low-cost energy efficiency services to small businesses leveraging the Trust's National Main Street Center
- Tools to Help Overcome Financial Barriers:
 - Reducing Transaction Costs for Energy Efficiency Investments
 - Analysis of Economic Risk Associated with Building Performance Uncertainties
- Leveraging SBA Loan Programs to Finance Energy Efficiency Solutions for Small Businesses

A Technical Solution

GOAL Encourage Investments in Energy Efficiency by Providing a Quick and Easy Process while Managing Risk



NREL PIX #19986

- Reducing energy costs helps to increase bottom lines
- Pilot focused on small office buildings
- 11 low-risk energy efficiency measures (EEMs) were analyzed for small office buildings
- Michigan Saves' financing offer for EEMs was factored into the study results

A Technical Solution

END RESULT NREL Determined Numerous EEM Packages that are Expected to Achieve 15% or More Energy Savings *Cost Effectively*



NREL PIX #19448

- Packages are based on answers to a few basic questions about the building
- *Cost effective* is defined as positive cash flow
- Michigan Saves will pre-approve EEM packages for financing
 - Customer will still need to go through a credit approval process

A Technical Solution

EEM Selection & Cost Evaluation Tool **Small Office**

- Energy and cost savings predictions for more than 30,000 EEM/baseline combinations
- For projects undergoing a major renovation:
 - More than 1,500 EEM package options that are expected to achieve 20% energy savings cost effectively
- For projects that are not planning for a major renovation:
 - 30 EEM package options that achieve greater than 15% energy savings cost effectively
 - More than 150 EEM package options that achieve greater than 10% energy savings cost effectively



Tool Snapshot

2013_12_02_PreliminaryEEMPackages_Tool_SmOffice

File Home Insert Page Layout Formulas Data Review View Developer

Clipboard Font Alignment Number Conditional Formatting Format as Table

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EEM Selection & Cost Evaluation Tool Small Office
Developed by the National Renewable Energy Laboratory
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Input Building Data:		Roof Insulation	Window Type	Infiltration	Lighting Power Density
Vintage	Pre 1980 Construction				
Square Footage	5,500 SF				
HVAC System Type	Packaged Air Conditioner				
Boundary Conditions	Above Ground, 1 Side Attached				
Major Renovation Planned?	Yes				
Roof Replacement Planned?	No				
HVAC Replacement Planned?	No				
Energy Savings Threshold	20%				

Run Clear

Run the macro,
or clear results

Screening questions
to filter results

Results: EEM
package options

Tool Snapshot

Additional Data - Update as Necessary		
Efficiency Measure Costs		
Increase Roof Insulation (\$/ft² of Roof Area)		
Incremental Cost:	\$	3.00
Full Cost:	\$	12.15
O&M Cost:	\$	-
Replace Windows (\$/ft² of Window Area)		
Incremental Cost:	\$	7.18
Full Cost:	\$	43.00
O&M Cost:	\$	-
Reduce Building Leakage (\$/ft² of Exterior Wall Area)		
Incremental Cost:	\$	0.43
Full Cost:	\$	0.43
O&M Cost:	\$	-
LPD Reduction: Retrofit from T12s to T8s, 40fc (\$/ft²)		
Incremental Cost:	\$	0.66
Full Cost:	\$	2.06
O&M Cost:	\$	(0.12)
LPD Reduction: Retrofit to T8s and Change Design, 25fc (\$/ft²)		
Incremental Cost:	\$	0.79
Full Cost:	\$	11.15
O&M Cost:	\$	(0.19)
Daylighting Controls Added to Perimeter Zones (\$/ft²)		
Incremental Cost:	\$	0.55
Full Cost:	\$	3.41
O&M Cost:	\$	-
Occupancy Sensors Applied to Entire Office Building (\$/ft²)		
Incremental Cost:	\$	0.36
Full Cost:	\$	0.36
O&M Cost:	\$	-
Advanced Power Strips (\$/ft²)		
Incremental Cost:	\$	0.15
Full Cost:	\$	0.15
O&M Cost:	\$	-
Replace HVAC Equipment PSZ-AC: Rooftop Unit with Gas Furnace (\$/ft²)		
Incremental Cost:	\$	0.41
Full Cost:	\$	6.09
O&M Cost:	\$	-
Replace HVAC Equipment - PTAC: Split System Air-Conditioner with Gas Furnace (\$/ft²)		
Incremental Cost:	\$	0.66
Full Cost:	\$	2.85
O&M Cost:	\$	-
Replace HVAC Equipment - PTHP: Heat Pump (\$/ft²)		
Incremental Cost:	\$	1.53
Full Cost:	\$	3.30
O&M Cost:	\$	-



User can update EEM cost information, as well as utility costs, loan term, and interest rate



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Utility Costs		
Electricity (\$/kWh):	\$	0.10
Gas (\$/1000 ft ³):	\$	9.14

Loan Information		
Interest Rate:		5.90%
Loan Term (yrs):		5

Tool Snapshot

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EEM Selection & Cost Evaluation Tool Small Office

Developed by the National Renewable Energy Laboratory
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Roof Insulation	Window Type	Infiltration	Lighting Power Density	Daylight Sensors	Occ Sensors	Plug Loads	HVAC Efficiency	Energy Savings	Energy Cost Savings	Net Initial Cost
Baseline Roof Insulation	Replace Windows	Reduce Infiltration	Reduce Lighting Levels to 25	Install Daylighting Sensors	Install Occupancy Sensors	Install Plug Load Control	Install High Efficiency HVAC Equipment	24.3%	\$3,913.45	\$17,223.1
Baseline Roof Insulation	Replace Windows	Reduce Infiltration	Reduce Lighting Levels to 25	Install Daylighting Sensors	Install Occupancy Sensors	Install Plug Load Control	Baseline HVAC Equipment	23.6%	\$3,803.17	\$14,968.1
Baseline Roof Insulation	Replace Windows	Reduce Infiltration	Reduce Lighting Levels to 25	Install Daylighting Sensors	No Occupancy Sensors	Install Plug Load Control	Install High Efficiency HVAC Equipment	23.6%	\$3,672.76	\$15,243.1
Baseline Roof Insulation	Replace Windows	Reduce Infiltration	Reduce Lighting Levels to 40	Install Daylighting Sensors	Install Occupancy Sensors	Install Plug Load Control	Install High Efficiency HVAC Equipment	23.5%	\$3,649.34	\$16,508.1
Baseline Roof Insulation	Baseline Windows	Reduce Infiltration	Reduce Lighting Levels to 25	Install Daylighting Sensors	Install Occupancy Sensors	Install Plug Load Control	Install High Efficiency HVAC Equipment	23.2%	\$3,764.83	\$13,472.1
Baseline Roof Insulation	Replace Windows	Reduce Infiltration	Reduce Lighting Levels to 25	Install Daylighting Sensors	No Occupancy Sensors	Install Plug Load Control	Baseline HVAC Equipment	22.8%	\$3,556.64	\$12,988.1
Baseline Roof Insulation	Replace Windows	Reduce Infiltration	Reduce Lighting Levels to 40	Install Daylighting Sensors	Install Occupancy Sensors	Install Plug Load Control	Baseline HVAC Equipment	22.7%	\$3,532.67	\$14,253.1
Baseline Roof Insulation	Replace Windows	Reduce Infiltration	Reduce Lighting Levels to 25	No Daylighting Sensors	Install Occupancy Sensors	Install Plug Load Control	Install High Efficiency HVAC Equipment	22.7%	\$3,440.24	\$14,198.1
Baseline Roof Insulation	Replace Windows	Reduce Infiltration	Reduce Lighting Levels to 40	Install Daylighting Sensors	No Occupancy Sensors	Install Plug Load Control	Install High Efficiency HVAC Equipment	22.4%	\$3,333.73	\$14,528.1
Baseline Roof Insulation	Baseline Windows	Reduce Infiltration	Reduce Lighting Levels to 25	Install Daylighting Sensors	Install Occupancy Sensors	Install Plug Load Control	Baseline HVAC Equipment	22.4%	\$3,644.54	\$11,217.1
Baseline Roof Insulation	Baseline Windows	Reduce Infiltration	Reduce Lighting Levels to 25	Install Daylighting Sensors	No Occupancy Sensors	Install Plug Load Control	Install High Efficiency HVAC Equipment	22.4%	\$3,518.95	\$11,432.1
Baseline Roof Insulation	Baseline Windows	Reduce Infiltration	Reduce Lighting Levels to 40	Install Daylighting Sensors	Install Occupancy Sensors	Install Plug Load Control	Install High Efficiency HVAC Equipment	22.3%	\$3,495.19	\$12,757.1
Baseline Roof Insulation	Replace Windows	Reduce Infiltration	Baseline Lighting Levels	Install Daylighting Sensors	Install Occupancy Sensors	Install Plug Load Control	Install High Efficiency HVAC Equipment	22.3%	\$3,278.14	\$12,878.1
Baseline Roof Insulation	Replace Windows	Reduce Infiltration	Reduce Lighting Levels to 25	Install Daylighting Sensors	Install Occupancy Sensors	No Plug Load Control	Install High Efficiency HVAC Equipment	22.0%	\$3,188.75	\$16,398.1
Baseline Roof Insulation	Replace Windows	Reduce Infiltration	Reduce Lighting Levels to 25	No Daylighting Sensors	Install Occupancy Sensors	Install Plug Load Control	Baseline HVAC Equipment	21.9%	\$3,317.73	\$11,943.1

Description of cost effective EEM package options that meet an energy savings threshold

Energy savings for each EEM package (sorted highest to lowest)

Cost information for each EEM package

Energy Efficiency Measures



NREL PIX #19911

- **Building Envelope:**
 - Increased roof insulation
 - Window replacement
 - Reduced building leakage

- **Lighting:**
 - Lighting retrofits
 - Daylighting controls
 - Occupancy controls



NREL PIX #29518

- **Plug loads:**
 - Install plug load controls, such as advanced power strips

- **HVAC Efficiency:**
 - Improved efficiency for heating and cooling



Thank You!

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