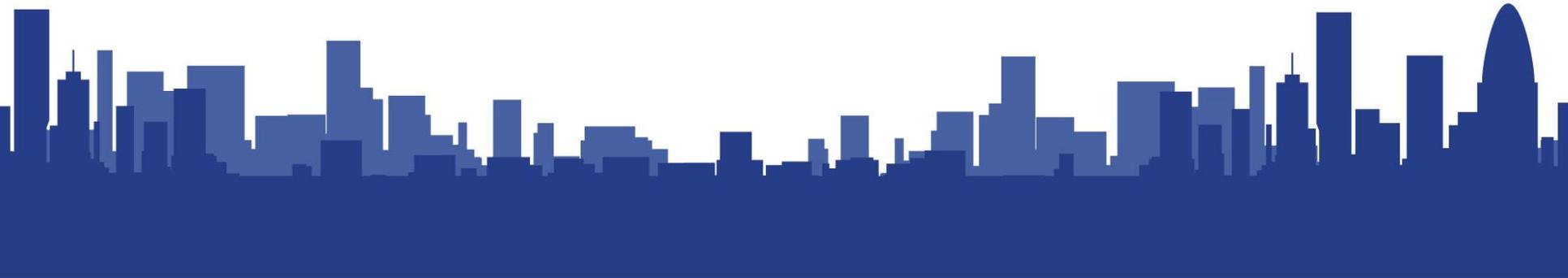




Advanced RTU Campaign Energy Savings Calculators

September 23, 2013

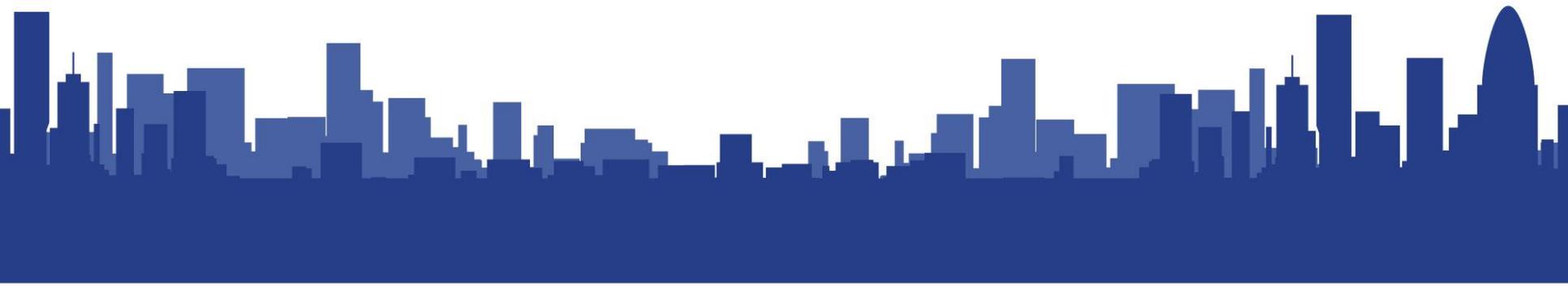


Agenda

- ▶ Overview of the Advanced RTU Campaign
- ▶ RTU Evaluation Methodology
- ▶ RTU Comparison Calculator
- ▶ 179D DOE Calculator

Overview of the Advanced RTU Campaign

Michael Deru, NREL



Advanced RTU Campaign (ARC) Overview

- ▶ National campaign for promotion and support of high-efficiency RTU replacements and retrofits
- ▶ Partnership between DOE, ASHRAE, RILA, and several supporting organizations
- ▶ Launched May 30, 2013 and runs through November 2014
- ▶ www.advancedrtu.org

The screenshot displays the 'Advanced RTU Campaign' website. At the top, there is a navigation menu with links for HOME, ABOUT, JOIN, TECHNICAL ASSISTANCE, FINANCIAL RESOURCES, AWARDS & RESULTS, and CONTACT US. A search bar is located in the top right corner. The main content area features a large blue banner on the left with the text 'Replace. Retrofit. Reap Rewards.' and a 'Join' button. To the right, the '179D DOE Calculator' interface is shown, including a progress bar with three steps: 'Building Eligibility Summary', 'Energy Savings Calculations', and 'Review Estimated Results'. Below the progress bar, there is a 'BUILDING ELIGIBILITY SUMMARY' section with a form for 'Enter Building and Location Details'. The form includes fields for 'Building Type', 'Building Name', 'Zip Code', 'Building Owner', 'Building Gross Area', and 'Building Address (Street, City, State)'. A 'Join Now & Save Money' button is also visible.

What is the Advanced RTU Campaign?

Older, inefficient commercial rooftop unit (RTU) air conditioning systems are common and can waste from \$1,000 to \$3,700 per unit annually, depending on the building size and type. By replacing or retrofitting them, you can save money, improve your energy efficiency, make your building more comfortable, and help the environment. The Advanced RTU Campaign (ARC) encourages commercial building owners and operators to replace their old RTUs with more efficient units or to retrofit their RTUs with advanced controls in order to take advantage of these benefits.

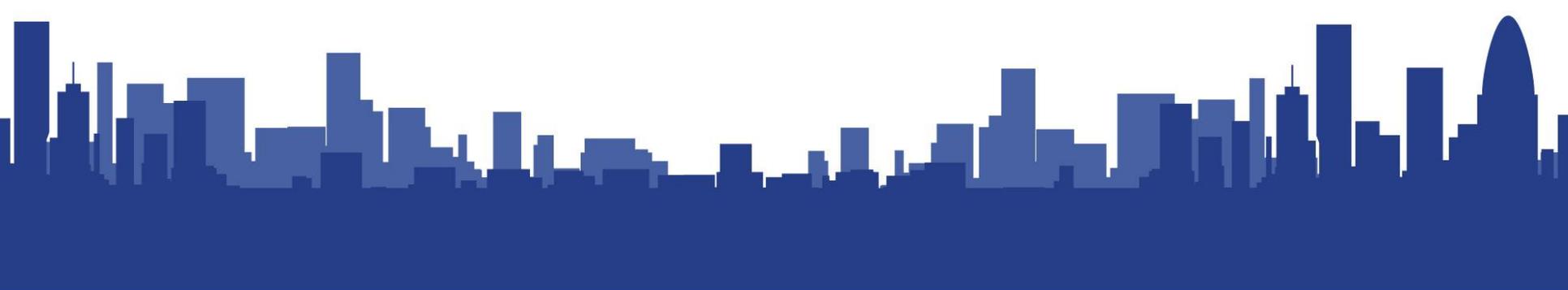
What are the benefits of joining?

ARC provides building owners and operators with access to information and expertise to lower facility operating costs while maintaining or improving building occupant comfort. Joining the campaign allows you to:



RTU Evaluation Methodology

Michael Deru, NREL



Decision Tree for Evaluating RTUs

Advanced RTU Campaign: RTU Evaluation Process

 **Resources**
<http://www.advancedrtu.org>

Preliminary Screening

What is the general condition, age, and size of each RTU?

Is the RTU a candidate for retrofit or replacement?

General Condition
Age
Size

**Fair-Good,
Under 10 years
Under 7 tons**

**Fair-Good,
Under 10 years
Over 7 tons**

**Fair-Good,
Over 10 years**

Poor



Initial Inventory

Building name	Manufacturer
Space type	Model
Age	General condition
Size	Maintenance history

RTU Inventory Spreadsheet

Evaluation and Analysis

What is the result of the field evaluation?

Can a replacement be combined with other energy efficiency measures?

Is the RTU properly sized?

What is the predicted energy savings and ROI for retrofit and replacement and does it meet your requirements?



Detailed Inventory

Controls, Usage, Features



Field Evaluation



Retrofit Analysis



Replacement Analysis

no action

yes

no action

yes

RTU Inventory Spreadsheet
 RTU Field Evaluation Checklist
 RTU Comparison Calculator
 179D DOE Calculator
 RTU Incentives Database
 RTU Sizing Guidance
 Case Studies

Planning and Procurement

Do you need to hire engineering support or a service company?

Which are the best RTUs for your applications?

What is the predicted energy savings and payback?

Do you need to include measurement and verification?



Project Planning



Spec Retrofit



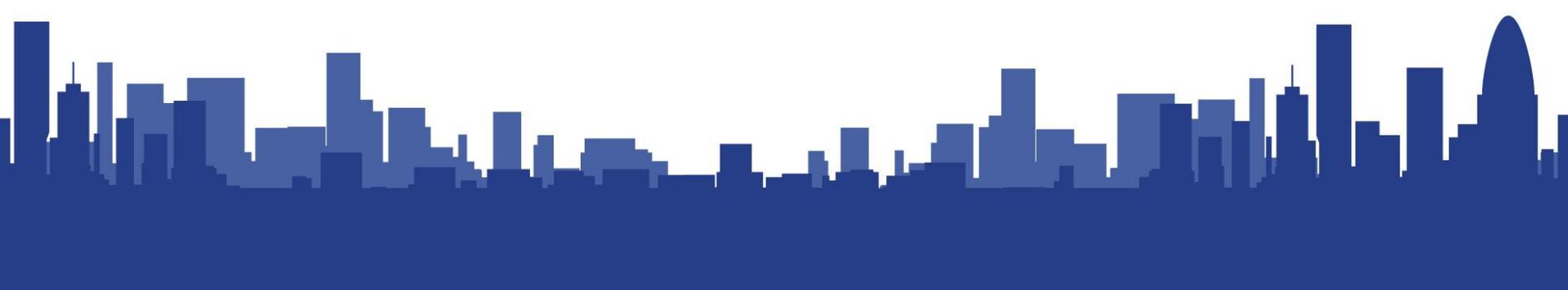
Spec Replacement

RTU Sizing Guidance
 RTU Incentives Database
 Procurement Spec
 M&V Guidance
 Case Studies

RTU Comparison Calculator

Ed Smyth, KEMA

Anne Wagner, PNNL



Rooftop Unit Comparison Calculator

- ▶ **Why use it?**
- ▶ What is it?
- ▶ Who can use it?
- ▶ Where is it and what does it look like?
- ▶ What results does it provide?
- ▶ How do learn how to use it?

Why create a calculator?

Situation:

- ▶ High efficiency rooftop units best serve building owners.

Condition:

- ▶ Building owners encounter difficulty justifying the selection and procurement of high efficiency rooftop units.

Question > **How can we reduce this difficulty?**

Solution:

- ▶ The RTU Calculator makes for easy comparison between two rooftop units to provide better justifications for choosing a high efficiency unit.

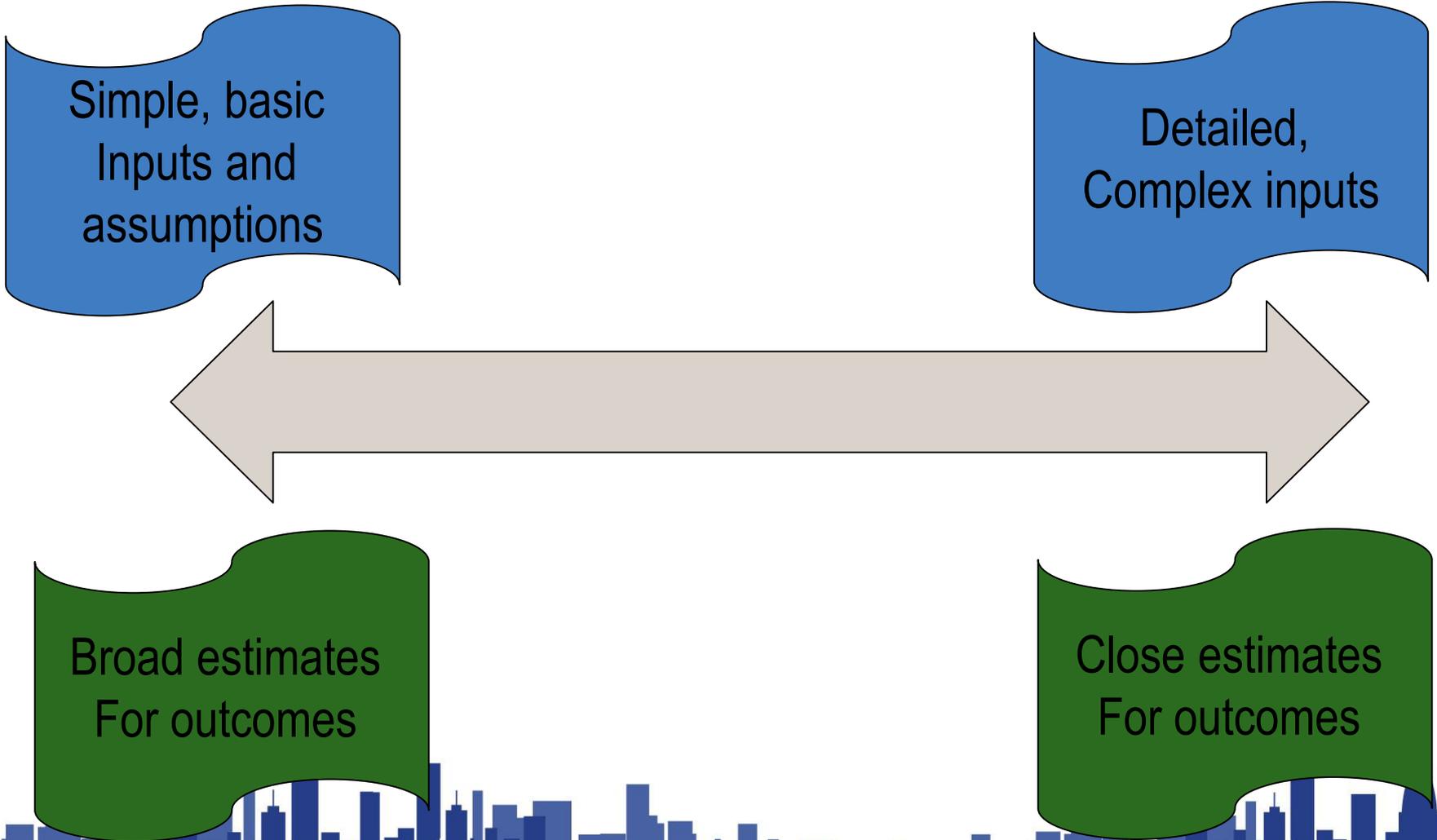
Key Features

- ▶ Compares RTUs lifetime energy cost savings at various efficiency levels
- ▶ Fully web-based and menu-driven format
- ▶ Quickly estimates life cycle cost, simple payback, return on investment, and savings-to-investment ratio
- ▶ Simulates operation under
 - specific climate conditions at one of 237 U.S. locations
 - user-specified AC requirements and building-use patterns
- ▶ Download results as graphic files and tables for further analysis and presentation

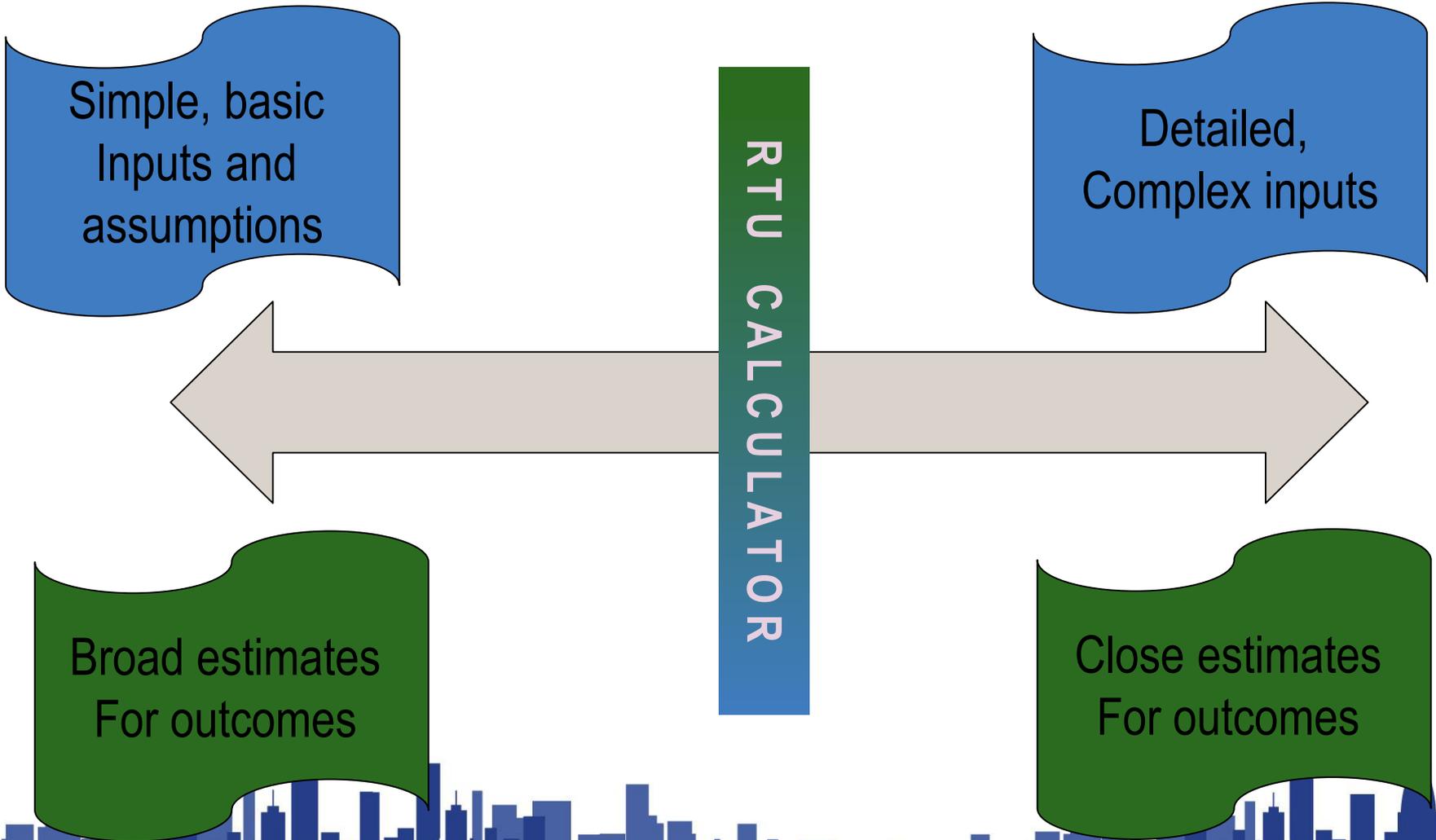
Rooftop Unit Comparison Calculator

- ▶ Why use it?
- ▶ **What is it?**
- ▶ **Who can use it?**
- ▶ Where is it and what does it look like?
- ▶ What results does it provide?
- ▶ How do learn how to use it?

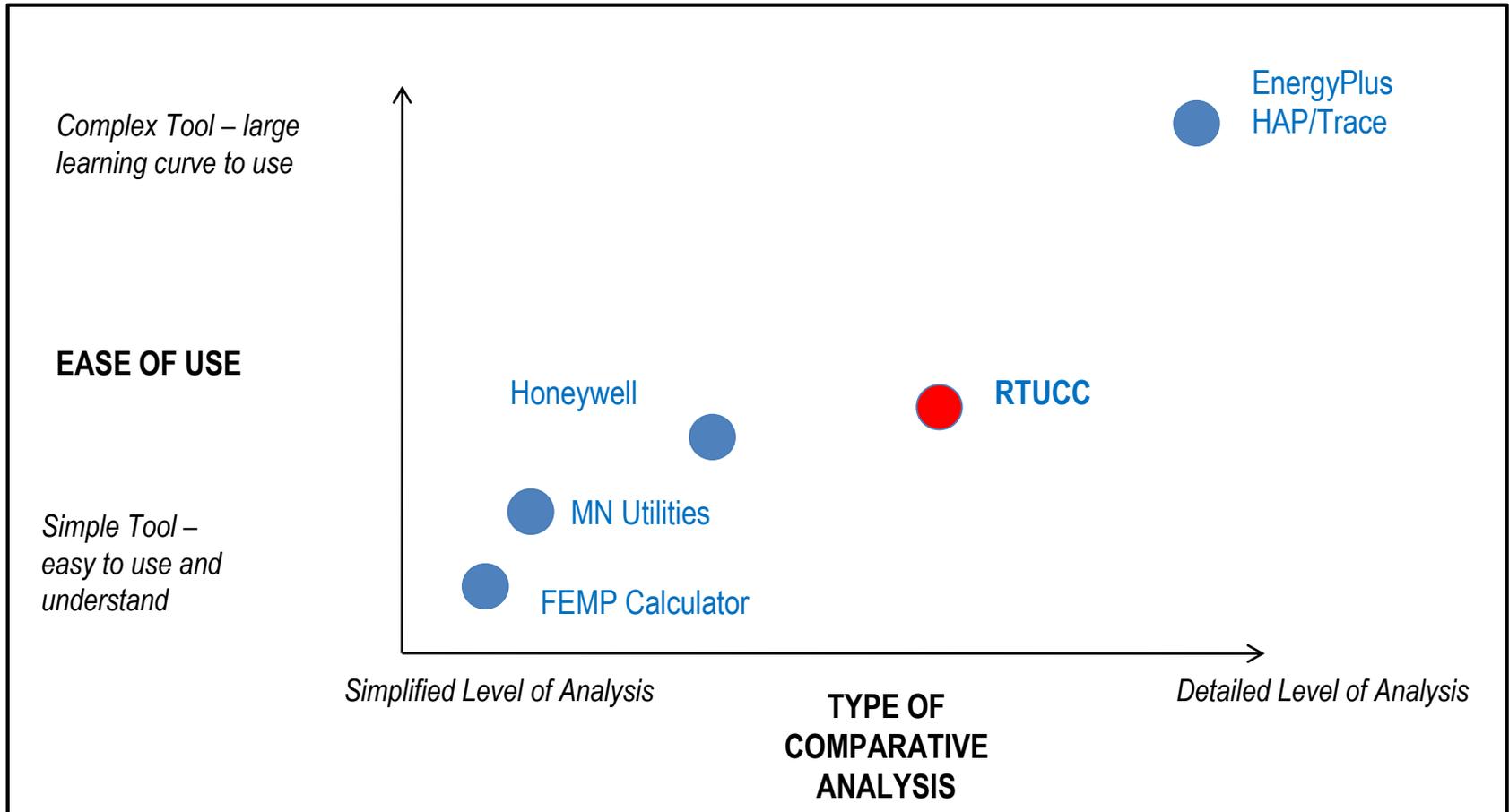
Tool's Intent



Tool's Intent



Comparison of Other Tools



Multiple Tiers

*Two-tiered system of inputs:
simple queries and sophisticated comparisons*

Default interface for quick investigations of high efficiency units by:

- ▶ Building Type, Location (City)
- ▶ Occupancy Schedule
- ▶ Building Temperature Settings
- ▶ Equipment size and efficiency
- ▶ Economizer Use
- ▶ Equipment Lifetime and Number of Units
- ▶ Electric Rates and Discount Rates

Advanced controls so that users can also manipulate (use defaults otherwise):

- ▶ Interior Humidity Conditions
- ▶ Fraction of Load that is Solar and Internal Gains
- ▶ Ventilation Rate
- ▶ Power split between fan, compressor, and auxiliaries
- ▶ Inputs for Spreadsheet Data
- ▶ Equipment Degradation Factor and Ratio of Sensible to Total Capacity

Rooftop Unit Comparison Calculator

- ▶ Why use it?
- ▶ What is it?
- ▶ Who can use it?
- ▶ **Where is it and what does it look like?**
- ▶ What results does it provide?
- ▶ How do learn how to use it?

Rooftop Unit Comparison Calculator

<http://www.pnnl.gov/uac/>

Opening page describes use and purposes

The screenshot displays the website for the Rooftop Unit Comparison Calculator. At the top left is the Pacific Northwest National Laboratory logo, featuring an orange stylized bird or wing design above the text "Pacific Northwest NATIONAL LABORATORY" and "Proudly Operated by **Battelle** Since 1965". To the right is the U.S. Department of Energy logo. A navigation menu includes links for "PNNL Home", "About", "Research", "Publications", "Jobs", "News", and "Contacts". A search bar labeled "Search PNNL" with a right-pointing arrow is also present.

The main content area features a large banner with a green-tinted image of a calculator on the left and a photograph of a rooftop air conditioning unit on the right. The text "Rooftop Unit COMPARISON CALCULATOR" is centered in white over a blue grid background.

Below the banner, on the left, is a dark grey box titled "Rooftop Air Conditioner" containing a list of links: "Home" (highlighted in orange), "RTU Comparison Calculator", "RTUCC Methods", and "RTUCC Revision History".

To the right of this list is a section titled "About the Comparison Calculator" in orange text. The text below reads: "The Rooftop Unit [Comparison Calculator](#) (RTUCC) compares high-efficiency rooftop air conditioners to standard equipment in terms of life cycle cost. This web application provides an alternative to complicated building simulation models, while offering more detail than simplified estimating tools that are commonly available. While simplified tools are typically based on full-load efficiencies and full-load equivalent operating hours, the RTUCC accounts for local climate and partial-load, as well as full-load efficiencies."

On the far right of the page is an orange "Contact Us" box containing an email icon and the address "uac@pnl.gov".

Rooftop Unit Comparison Calculator

- ▶ Why use it?
- ▶ What is it?
- ▶ Who can use it?
- ▶ Where is it and what does it look like?
- ▶ **What results does it provide?**
- ▶ How do learn how to use it?

Drop Down Choices

Rooftop Unit Comparison Calculator

RTU Comparison Calculator (BETA)	Home	Submit	Restore	Power ?		
<p>Welcome to the Rooftop Unit Comparison Calculator (RTUCC).</p> <p>This calculator simulates the energy usage of both a high efficiency and a standard efficiency air conditioner. It then compares their energy and economic performance.</p> <p>The RTUCC displays best in Mozilla Firefox. Good second choices for a web browser are Microsoft Internet Explorer and Google Chrome.</p> <p>To run the RTUCC, characterize the two systems and their environment using the controls on this page. Then click the 'submit' button. Use your browser 'back' button to return from the results page to this control page or click on the "Return to Controls Page" link.</p>	Advanced Controls ?	<input checked="" type="checkbox"/>	Hidden			
	Show bin calculations ?	<input checked="" type="checkbox"/>	Hide bin calcs			
	Lock load line ?	<input type="checkbox"/>	Automatically adjust			
	Building Type ?	Office-Medium	Office-Medium			
	State / City ?		MO	Kansas City		
	Schedule ?		M-Fri, 7a.m. to 7p.m.			
	Indoor Temperature ?	Office-Medium	Off	°F	75 °F	Condenser Off
	Inside Rel. Humidity (%) ?		Auto			
	S&I Fraction ?		0.527			
	Total Capacity ?		84 kBtuh	in 2 Stages		
Oversizing F...		0%				

Drop Down Menu

Selecting Advanced Features

Rooftop Unit Comparison Calculator

BETA)		Home	Submit	Restore
Comparison	Advanced Controls	<input type="checkbox"/>	Hidden	
	Show bin calculations	<input type="checkbox"/>	Hide bin calcs	
Energy usage Standard Comparison ance. Use Firefox. Browser are ogle	Building Type	<input type="text" value="Office-Small"/>	Office-Medium	
	State / City	<input type="text" value="MO"/> <input type="text" value="Kansas City"/>	MO	Kansas City
	Schedule	<input type="text" value="M-Fri, 7 a.m. to 7 p.m."/>	M-Fri, 7a.m. to 7p.m.	
	Indoor Temperature	<input type="text" value="75"/> °F Setback <input type="text" value="Cond. Off"/> °F	75 °F	Condenser Off

Setting Building Use

Rooftop Unit Comparison Calculator

BETA)	<input type="button" value="Home"/>	<input type="button" value="Submit"/>	<input type="button" value="Restore"/>	
parison	Advanced Controls	<input type="checkbox"/>	Hidden	
	Show bin calculations	<input type="checkbox"/>	Hide bin calcs	
gy usage				
idard	Building Type	Office-Small	Office-Medium	
mpares	State / City	MO Kansas City	MO	Kansas City
nance.	Schedule	M-Fri, 7 a.m. to 7 p.m.	M-Fri, 7a.m. to 7p.m.	
la Firefox.	Indoor Temperature	75 °F Setback Cond. Off °F	75 °F	Condenser Off
rowser are				
ngle				

Example – Rochester Medium Office Setting

Rooftop Unit Comparison Calculator

BETA)	<input type="button" value="Home"/>	<input type="button" value="Submit"/>	<input type="button" value="Restore"/>	
Comparison	Advanced Controls	<input type="checkbox"/>	Hidden	
	Show bin calculations	<input type="checkbox"/>	Hide bin calcs	
Energy usage standard compares performance.	Building Type	Office-Medium	Office-Medium	
	State / City	NY Rochester	MO	Kansas City
Install in Mozilla Firefox. Internet browser are required to use Google	Schedule	M-Fri, 7 a.m. to 7 p.m.	M-Fri, 7a.m. to 7p.m.	
	Indoor Temperature	71 °F Setback 4 °F	75 °F	Condenser Off

Setting Unit Configurations

Total Capacity 	110  kBtuh in 2  stages	84 kBtuh	in 2 Stages	
Oversizing Factor 	0  %	0%		
Candidate Unit 	13 EER @ 4.5 k\$ 400 \$/yr	12 EER	\$4,500/unit	\$0/year
Enable Economizer 	<input checked="" type="checkbox"/>	Economizer enabled		
Standard Unit 	10 EER @ 4 k\$ 400 \$/yr	9 EER*	\$4,000/unit	\$0/year
Enable Economizer 	<input checked="" type="checkbox"/>	Economizer enabled		

Setting Utility Rate, Cost-of-Money, and Equipment Life

Electric Utility Rate 	<input type="text" value="0.12"/> \$/kWhrs	0.08 \$/kWhrs
Discount Rate 	<input type="text" value="7"/> %	7.0 %
Equipment Life 	<input type="text" value="15"/>  years	15 years
Number of Units 	<input type="text" value="1"/> units	1 unit
Chart discounted costs 	<input checked="" type="checkbox"/>	Chart present value
<input type="button" value="Home"/>	<input type="button" value="Submit"/>	<input type="button" value="Restore"/>

Enter "Submit" to do the Calculations

Electric Utility Rate 	<input type="text" value="0.12"/> \$/kWhrs	0.08 \$/kWhrs
Discount Rate 	<input type="text" value="7"/> %	7.0 %
Equipment Life 	<input type="text" value="15"/>  years	15 years
Number of Units 	<input type="text" value="1"/> units	1 unit
Chart discounted costs 	<input checked="" type="checkbox"/>	Chart present value
<input type="button" value="Home"/>	<input type="button" value="Submit"/>	<input type="button" value="Restore"/>

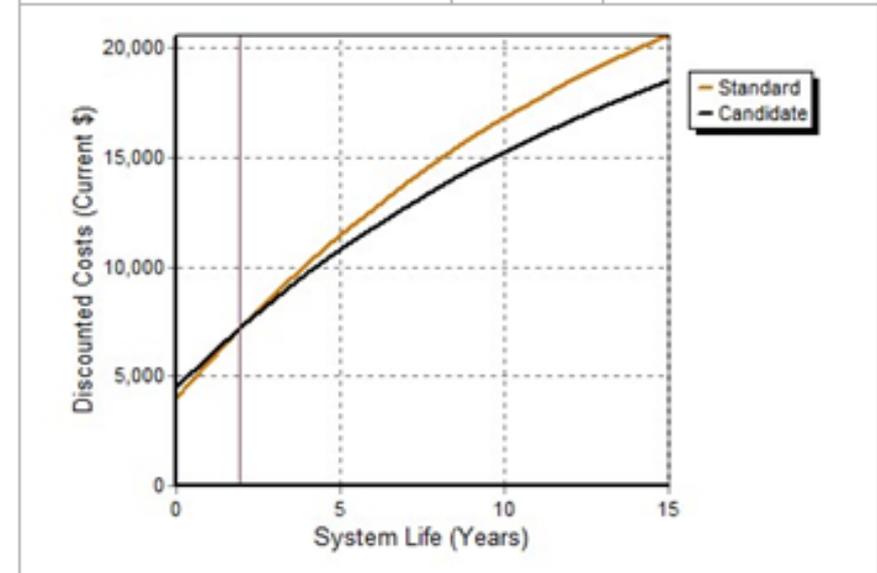


Output Results

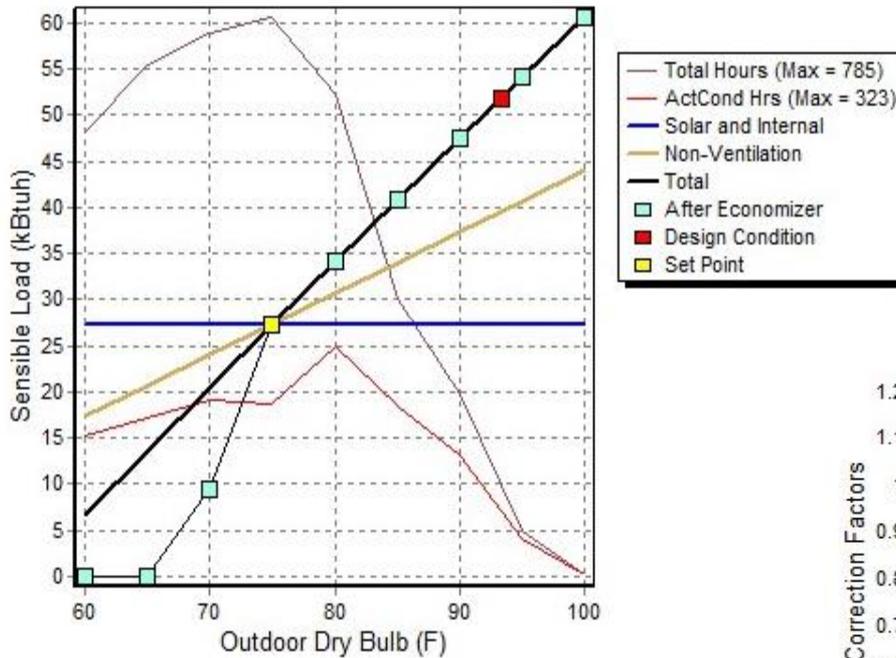
RESULTS

Results Table is the same with bin calculations hidden or shown

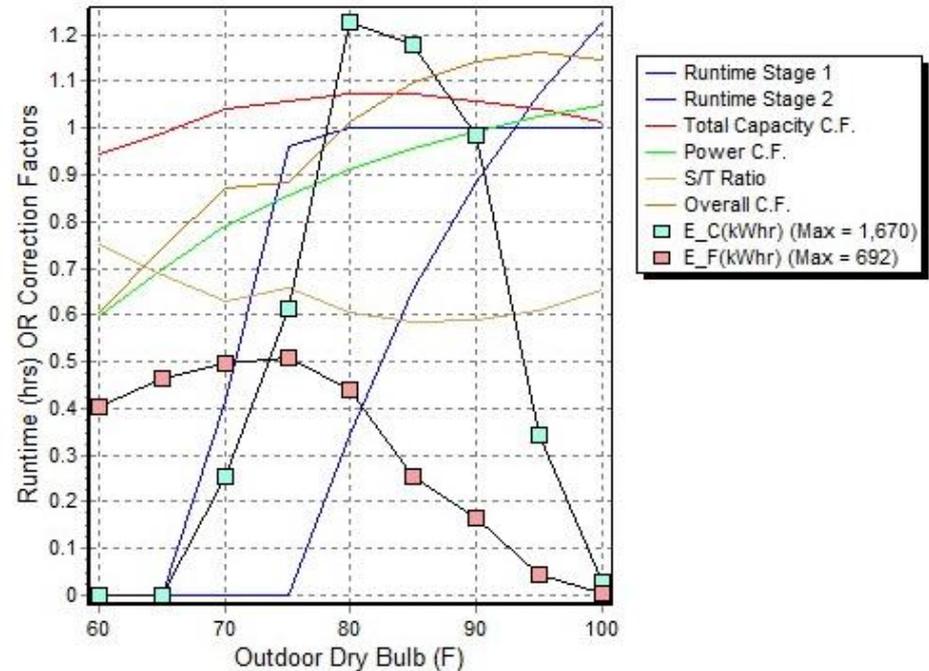
ALBANY, NY	Candidate	Standard	Savings
Annual Energy Consumption (kWhrs)	9,469	11,880	2,410
Annual Operating Cost (\$)	1,536	1,826	289
15 Year Life Cycle Cost (\$)	18,493	20,627	2,134
Annualized Cost (\$)	2,030	2,265	234
Net Present Value (\$)	2,134		
Payback (yrs)	1.9		
Rate of Return (%)	57.79		
Savings to Investment Ratio (SIR)	5.27		



Output Results – Optional Bin Calculation Outputs



Bin Calcs: Equipment Performance – Standard Unit



Optional Bin Calculation Outputs

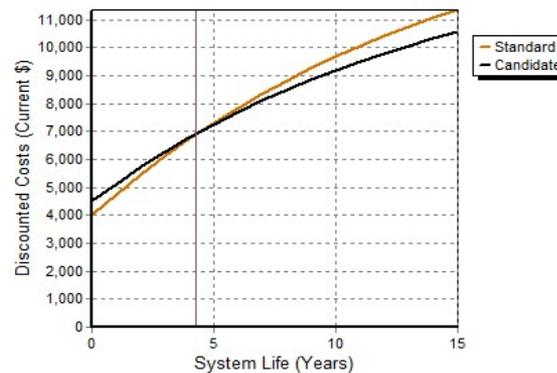
Rooftop Unit Comparison Calculator

[Return to Controls Page](#)

RESULTS

KANSAS CITY, MO	Candidate	Standard	Savings
Annual Energy Consumption (kWhrs)	8,342	10,082	1,740
Condenser Unit Energy (kWhrs)	4,565	6,306	1,740
Evaporator Fan Energy (kWhrs)	3,777	3,777	0
Aux Electronics Energy (kWhrs)	0	0	0
Annual Operating Cost (\$)	667	807	139
Demand Costs (\$)	0	0	0
15 Year Life Cycle Cost (\$)	10,578	11,346	768
Annualized Cost (\$)	1,161	1,246	84
Net Present Value (\$)	768		
Payback (yrs)	4.3		
Rate of Return (%)	27.08		
Savings to Investment Ratio (SIR)	2.54		

Added



Simple Assistance

Rooftop Unit Comparison Calculator

RTU Comparison Calculator (BETA) Welcome to the Rooftop Unit Comparison Calculator (RTUCC). This calculator simulates the energy usage of both a high efficiency and a standard efficiency air conditioner. It then compares their energy and economic performance. The RTUCC displays best in Mozilla Firefox. Good second choices for a web browser are Microsoft Internet Explorer and Google Chrome.	Home	Submit	Restore	Power ?	
	Advanced Controls ?	<input checked="" type="checkbox"/>	Hidden		
	Show bin calculations ?	<input checked="" type="checkbox"/>	Hide bin calcs		
	Lock load line ?	<input type="checkbox"/>	Automatically adjust		
	Building Type ?	Office-Medium	Office-Medium		
	State / City ?	MO	Kansas City		
Schedule ?	M-Fri, 7 a.m. to 7 p.m.	M-Fri, 7a.m. to 7p.m.			
Indoor Temperature ?	75 °F	Setback	Cond. Off	75 °F	Condenser Off

Building Type: Select the building type which best represents your building.

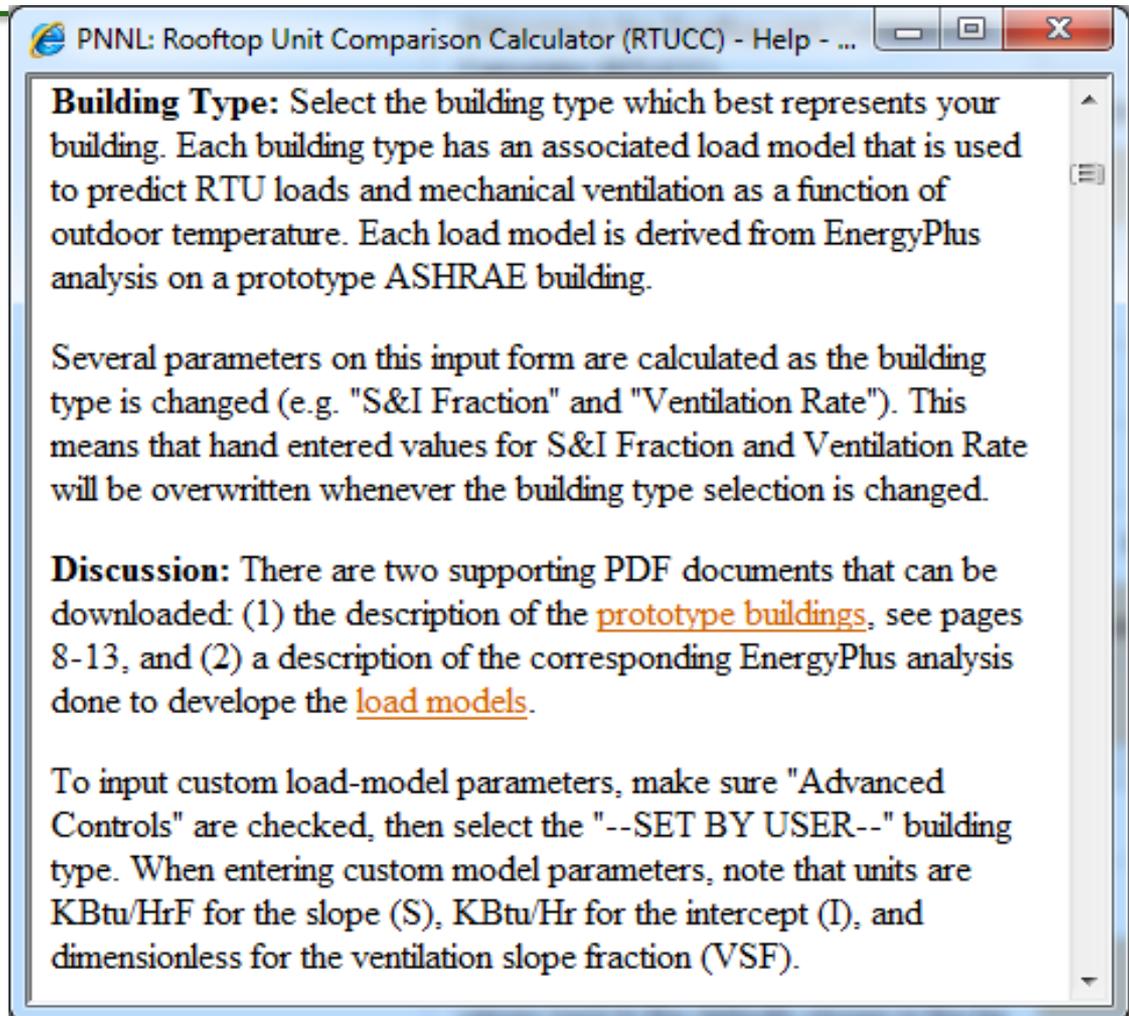
Move your cursor over a question mark near a controls name to display a help tip. Click on the question mark for more detailed information

Rooftop Unit Comparison Calculator

- ▶ Why use it?
- ▶ What is it?
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- ▶ What results does it provide?
- ▶ **How do learn how to use it?**

Detailed Help

Detailed information in
Controls Help



Additional Information

Rooftop Unit Comparison Calculator

RTU Comparison Calculator (BETA) Home Submit Restore Power

To run the RTUCC, characterize the two systems and their environment using the controls on this page. Then click the 'submit' button. Use your browser 'back' button to return from the results page to this control page or click on the "Return to Controls Page" link.

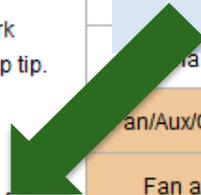
Use the 'restore' button to change all values back to the defaults shown in the far right column ([more on defaults](#)).

Move your cursor over a question mark near a controls name to display a help tip. Click on the question mark for more detailed information ([more on help](#)).

Visit the [engineering methods](#) pages for additional background information on the RTUCC. Click the version link (below) to view the revision history.

Inside Rel. Humidity (%)	Auto	Auto
S&I Fraction	0.527	0.527
Total Capacity	084 kBtuh in 2 stages	84 kBtuh in 2 Stages
Oversizing Factor	0 %	0%
Ventilation Rate	24 % of Fan Cap.	24 of Fan Cap
Variable Economizer	<input checked="" type="checkbox"/>	Economizer enabled
Fan/Aux/Condenser (kW)	0.881 BFn 0 Aux 6.120 Cond	0.881 0.000 6.120
Fan and Compressor	1-Spd: Always ON	1-Spd: Always ON
S/T Ratio	0.72	0.72
Degradation Factor	25	25
Spreadsheet data		blank

Visit the engineering methods pages for additional background information on the RTUCC.



Supporting Documentation

Rooftop Unit Comparison Calculator

Rooftop Air Conditioner

Home

RTU Comparison Calculator

RTUCC Methods

RTUCC Revision History

Related Links

RTUCC: *Methods*

This [series of pages](#) describes the engineering methods behind the Rooftop Unit [Comparison Calculator](#) (RTUCC). Each page starts with an outline and is followed by discussion.

- Establishing Loads
 - [Sensible Load Lines](#)
 - [An Example: schedule and load data](#)
- Corrections to Tested Performance
 - [System Power Draw](#)
 - [Sensible Capacity](#)
 - [Specific Manufacturer Data](#)

Detailed Explanations

Rooftop Unit Comparison Calculator

[Home](#) | [Next >>](#)

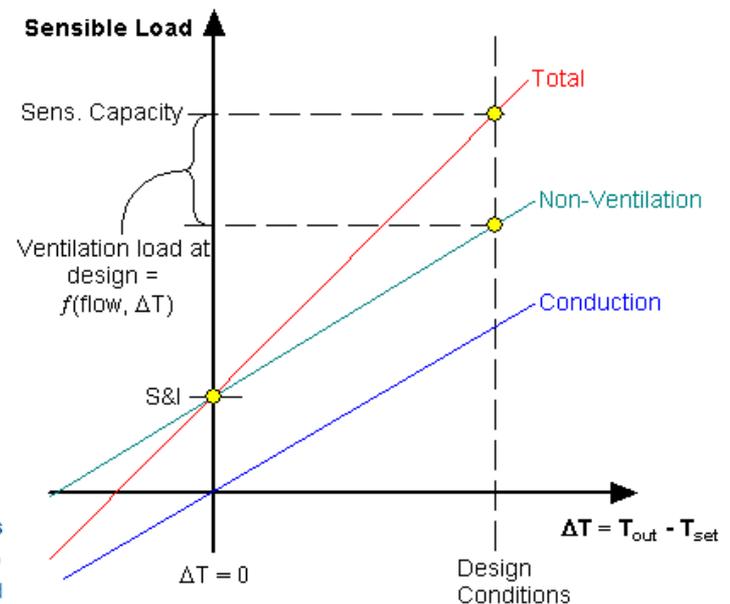
Establishing Loads: *Sensible Load Lines*

- Establish high point of the total sensible load line
 - Total **sensible load** = Total **sensible capacity** @ design conditions
 - Use rated sensible capacity **corrected** to design conditions
- Establish two points for the non-ventilation line
 - Subtract off **Sensible Ventilation Load** at design conditions
 - $SVL = f(\text{ventilation mass flow, } t_{out} - t_{in})$
 - Solar and internal gains (S&I) point
 - Value is calculated based on users selection of building type and location. Calculation is based on EnergyPlus load models for ASHRAE building types.
 - Daily average S&I load is assumed constant throughout the cooling season.

Discussion

The RTU Comparison Calculator uses weather data to conduct a binned energy analysis for the rooftop unit in cities across the United States. Weather tape data (outdoor dry bulb and coincident wet bulb) was binned in 5 degree increments and filtered by the selected occupancy schedule. The result is a database of hours (in each bin) and coincident wet bulb temperatures, for each city and schedule combination.

The first step in the binned analysis is to determine the conditioning load for each weather bin. Since building characteristics are not explicitly entered for the RTU Comparison Calculator, building loads must be inferred by assuming the unit would be installed in a building suitable for its specified capacity. Load behaviors for this hypothetical building are established via a "Total" sensible load line and the "Non-ventilation" sensible load line. These load lines are defined by the yellow line markers in the figure to the right. Assumptions behind these points are in the outline above.



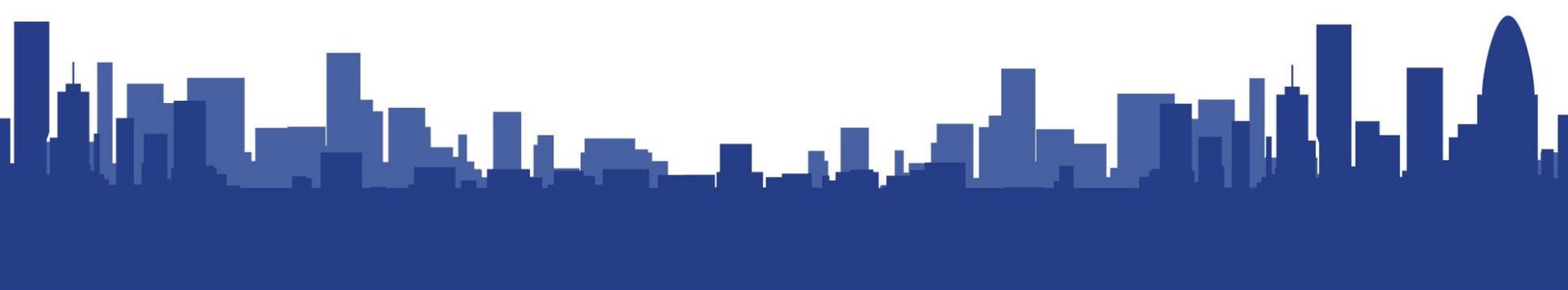
Where S&I are the SOLAR and INTERNAL gains

Next Steps

- ▶ Use the tool for a **sales presentation**, or have your customer use the tool to satisfy their need to justify costs.
- ▶ Discuss **proper sizing** and **installation** – use the ASHRAE/ACCA Quality Installation Standard 5 as a reference.
- ▶ Discuss proper **maintenance cycle** and **steps** – use the ASHRAE/ACCA Quality Maintenance Standard 180 as a reference.

179D DOE Calculator

Michael Deru, NREL



179D Federal Tax Deduction

- ▶ Federal tax deduction for energy efficient commercial building properties
- ▶ Based on energy and power cost savings from envelope, lighting, HVAC, and hot water improvements over 90.1-2001

179D DOE Calculator

	Fully Qualifying Property	Partially Qualifying Properties			Interim Lighting Rule
		Envelope	HVAC and SWH	Lighting	
Savings Requirements	50%	10%	20%	20%	25%-40% lower LPD (50% for warehouses)
	50%	10%	15%	25%	
Tax Deduction	\$1.80/ft ²	\$0.60/ft ²	\$0.60/ft ²	\$0.60/ft ²	\$0.60/ft ² Times applicable percentage

Require hourly energy simulations

No simulations

What is the 179D DOE Calculator?

- ▶ Web-based tool for quick estimates of energy and power cost savings for partial qualifying properties for envelope, lighting, or HVAC
- ▶ Regression models of 250,000 pre-simulated runs
- ▶ 12 building types from the DOE Reference Building Models
- ▶ 16 locations to represent all 15 climate zones plus southern California coast mapped to zip codes

The screenshot shows the top of the 179D DOE Calculator website. At the top left is the U.S. Department of Energy logo and the text "Energy Efficiency & Renewable Energy". At the top right are links for "EERE Home | Programs & Offices | Consumer Information". Below this is a green header with the text "179D DOE Calculator". Underneath is a navigation bar with "EERE > Building Technologies Office > 179D DOE Calculator" on the left and "Printable Version" and "SHRE" on the right. The main content area has three sections: "What is the 179D federal tax deduction?", "What is the 179D DOE Calculator?", and "Is my building eligible to use the 179D DOE Calculator?". The first section explains the tax deduction under Section 179D. The second section describes the calculator as a DOE approved tool for determining eligibility. The third section lists building types and provides a link to a modeling tool. Below this is a section titled "What are the different compliance pathways for qualification for the 179D tax deduction?" which lists three pathways. At the bottom is a "To Determine Eligibility" section with a "START YOUR ESTIMATE" button and a three-step process: 1. Building Eligibility Summary, 2. Energy Savings Calculations, and 3. Review Estimated Results. Each step has a brief description of what the user will do.

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

EERE Home | Programs & Offices | Consumer Information

179D DOE Calculator

EERE > Building Technologies Office > 179D DOE Calculator

Printable Version SHRE

What is the 179D federal tax deduction?

Section 179D of the Federal Tax Code provides a tax deduction for energy efficiency improvements to commercial buildings. A building may qualify for a tax deduction under Section 179D not to exceed \$1.80/ft² for whole building performance or \$0.60/ft² for a partially qualifying property for envelope, heating, ventilating, and air conditioning (HVAC), or lighting improvements. In addition, a building may qualify with a reduced installed lighting power under the interim lighting rule. Energy simulations are required to show compliance with the energy and power cost savings requirements. [View more detailed information.](#)

What is the 179D DOE Calculator?

The 179D DOE Calculator is a DOE approved tool that provides calculations to determine eligibility for the 179D federal tax deduction as a substitute for other modeling software. The 179D DOE Calculator provides pre-simulated results to determine qualification for both the partial and interim compliance pathways.

Is my building eligible to use the 179D DOE Calculator?

Although many common [building types](#) are included in this tool, some building types and configurations may not be eligible. By clicking on the "Start your Estimate" button below, you will enter the 179D DOE Calculator and be asked to enter six [building characteristics](#) to determine your eligibility. If a building is not eligible to use the 179D DOE Calculator, qualification for the 179D tax deduction can be determined with separate modeling using a different [modeling tool](#).

Eligible buildings can use the 179D DOE Calculator to determine qualification for lighting, envelope, and HVAC system. A 179D DOE Calculator Results Report will be provided as documentation of the qualification and eligibility status. The report does not preclude the need for a certification of the property performance from a qualified individual (a licensed contractor or engineer in the jurisdiction of the building location).

What are the different compliance pathways for qualification for the 179D tax deduction?

There are three [compliance pathways](#) to qualify for the 179D federal tax deduction:

1. Whole building qualification with 50% energy and power cost savings shown through energy simulation (not covered by this tool).
2. Partial qualification for envelope, HVAC and HW, and lighting with energy and power cost savings with threshold options:
 - a. 16 ²/₃% envelope, 16 ²/₃% HVAC, 16 ²/₃% lighting effective January 1, 2006 through December 31, 2008.
 - b. 10% envelope, 20% HVAC, 20% lighting effective January 1, 2006 through December 31, 2013.
 - c. 10% envelope, 15% HVAC, 25% lighting effective March 12, 2012 through December 31, 2013.
3. Partial qualification through the interim lighting rule based on reductions in installed lighting power.

To Determine Eligibility

START YOUR ESTIMATE

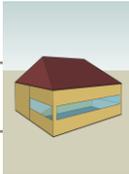
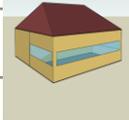
- 1 Building Eligibility Summary**

To start the process, select your building type from the list. You will see details for that building type based on the [U.S. Department of Energy reference buildings](#). You will also enter the zip code for its location.
- 2 Energy Savings Calculations**

The next step is to provide additional information on your energy efficiency upgrade including: lighting, building envelope; and heating, cooling, and hot water systems. Based on these inputs energy saving calculations will be performed to determine if the retrofit qualifies for the 179D deduction.
- 3 Review Estimated Results**

At the end, you will receive a 179D DOE Calculator Report that states your eligibility status to use the 179D DOE Calculator for tax qualification purposes, as well as any tax qualifications as a result of your retrofit. This report can be used as documentation to submit to the Internal Revenue Service when applying for the 179D tax deduction.

179D DOE Calculator Building Models

Sector	Building Activity	Area ft ²	Floors	Shape	% of Building Stock
Office	Small Office	5,500	1		4.5%
	Medium Office	53,630	3		4.8%
	Large Office	498,588	12		2.7%
School	Primary School	73,960	1		4.0%
Retail	Stand-alone Retail	24,962	1		12.2%
	Strip Mall	22,500	1		4.5%
	Supermarket	45,000	1		1.2%
Food service	Quick Service Restaurant	2,500	1		0.5%
	Full Service Restaurant	5,500	1		0.5%
Lodging	Small Hotel	43,200	4		1.4%
Residential	Midrise Apartment	33,740	4		5.9%
Storage	Warehouse	52,045	1		13.4%
Total					55.5%

179D DOE Calculator Capabilities

Can Model

- ▶ Envelope
 - U-values and solar reflectance
 - Window U-value and SHGC
- ▶ Lighting power reductions
- ▶ HVAC
 - Packaged HVAC efficiency
 - Central plant efficiency
 - Variable speed fans
 - Air source heat pump
- ▶ Hot water system efficiency

Cannot Model

- ▶ Envelope
 - Skylights
 - High window-to-wall ratios
- ▶ Lighting
 - Daylighting controls
- ▶ HVAC
 - Alternate HVAC systems or control strategies
- ▶ Combined savings for envelope, HVAC, and lighting EEMs
- ▶ Mixed use buildings

179D DOE Calculator

<http://apps1.eere.energy.gov/buildings/commercial/179d>

179D DOE Calculator

EERE » Building Technologies Office » 179D DOE Calculator

Printable Version SHARE

What is the 179D federal tax deduction?

Section 179D of the Federal Tax Code provides a tax deduction for energy efficiency improvements to commercial buildings. A building may qualify for a tax deduction under Section 179D not to exceed \$1.80/ft² for whole building performance or \$0.60/ft² for a partially qualifying property for envelope, heating, ventilating, and air conditioning (HVAC), or lighting improvements. In addition, a building may qualify with a reduced installed lighting power under the interim lighting rule. Energy simulations are required to show compliance with the energy and power cost savings requirements. [View more detailed information.](#)

What is the 179D DOE Calculator?

The 179D DOE Calculator is a DOE approved tool that provides calculations to determine eligibility for the 179D federal tax deduction as a substitute for other modeling software. The 179D DOE Calculator provides pre-simulated results to determine qualification for both the partial and interim compliance pathways.

Is my building eligible to use the 179D DOE Calculator?

Although many common [building types](#) are included in this tool, some building types and configurations may not be eligible. By clicking on the "Start your Estimate" button below, you will enter the 179D DOE Calculator and be asked to enter six [building characteristics](#) to determine your eligibility. If a building is not eligible to use the 179D DOE Calculator, qualification for the 179D tax deduction can be determined with separate modeling using a different [modeling tool](#).

Eligible buildings can use the 179D DOE Calculator to determine qualification for lighting, envelope, and HVAC system. A 179D DOE Calculator Results Report will be provided as documentation of the qualification and eligibility status. The report does not preclude the need for a certification of the property performance from a qualified individual (a licensed contractor or engineer in the jurisdiction of the building location).

What are the different compliance pathways for qualification for the 179D tax deduction?

There are three [compliance pathways](#) to qualify for the 179D federal tax deduction:

1. Whole building qualification with 50% energy and power cost savings shown through energy simulation (not covered by this tool).
2. Partial qualification for envelope, HVAC and HW, and lighting with energy and power cost savings with threshold options:
 - a. 16 2/3% envelope, 16 2/3% HVAC, 16 2/3% lighting effective January 1, 2006 through December 31, 2008.
 - b. 10% envelope, 20% HVAC, 20% lighting effective January 1, 2006 through December 31, 2013.
 - c. 10% envelope, 15% HVAC, 25% lighting effective March 12, 2012 through December 31, 2013.
3. Partial qualification through the interim lighting rule based on reductions in installed lighting power.

Click here to start using the calculator

To Determine Eligibility

START YOUR ESTIMATE

1



Building Eligibility Summary

To start the process, select your building type from the list. You will see details for that building type based on the [U.S. Department of Energy reference buildings](#). You will also

2



Energy Savings Calculations

The next step is to provide additional information on your energy efficiency upgrade including: lighting, building envelope, and heating, cooling, and hot water systems.

3



Review Estimated Results

At the end, you will receive a 179D DOE Calculator Report that states your eligibility status to use the 179D DOE Calculator for tax qualification purposes, as well as any tax qualifications as a result of your retrofit. This report can be used as documentation to submit to the Internal Revenue Service when applying for the 179D tax deduction.

179D DOE Calculator Example

179D DOE Calculator

EERE » Building Technologies Office » 179D DOE Calculator

SHARE

1



Building Eligibility Summary

2



Energy Savings Calculations

3



Review Estimated Results

BUILDING ELIGIBILITY SUMMARY

Enter Building and Location Details

* The following fields are required.

The following fields are optional. If provided, they will be printed on the results report.

Building Type*

Select a building type...

Building Name

Zip Code*

Building Owner

Building Gross Area*

ft² ?

Building Address

Determine Eligibility to use 179D DOE Calculator

This section will be populated when you select a building type, building gross area, and zip code.

Choose the System(s) to Estimate Potential Savings



LIGHTING

Buildings that have an installed lighting power of at least 25% less than ANSI/ASHRAE/IESNA Standard 90.1-2001 or buildings that save at least 16 ²/₃ % on annual energy costs through improvements to the building lighting may qualify for a tax deduction of up to \$0.60 per square foot.



ENVELOPE

Buildings that save at least 10% of their projected annual energy costs through improvements to the building envelope (insulation, windows, doors, and roof) may be eligible for a tax deduction of up to \$0.60 per square foot.



HVAC and HW

Buildings that save at least 15% of their projected annual energy costs through improvements to the heating, ventilating, and air conditioning (HVAC) and hot water systems may be eligible for a tax deduction of up to \$0.60 per square foot.

NEXT

- ▶ Retail building, 35,000 ft²
- ▶ 15 year old RTUs
- ▶ 2 20-ton and 2 15-ton RTUs
- ▶ Location: Baltimore, MD
- ▶ ZIP – 21230

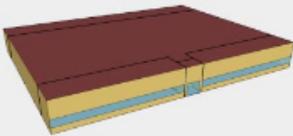
1. Select the building type
2. Enter ZIP code
3. Enter building area
4. Project information (optional)

179D DOE Calculator Example (page 2)

1 Building Eligibility Summary 2 Energy Savings Calculations 3 Review Estimated Results

BUILDING ELIGIBILITY SUMMARY

Enter Building and Location Details



Total Floor Area (ft²): 24,893
Number of Floors: 1
[View More Building Details](#)

* The following fields are required.

Building Type*
Stand-Alone Retail

Zip Code*
21230

Climate Zone: 4A

Building Gross Area*
37000 ft² ?

The following fields are optional. If provided, they will be printed on the results report.

Building Name

Building Owner

Building Address (Street, City, State)

Determine Eligibility to use 179D DOE Calculator

Please answer the following questions to determine if your building is eligible to be analyzed with this calculator for tax deduction purposes. Each of the following responses must fall within the range of simulated parameters. If your building does not meet these requirements, you may still use the calculator to provide a quick estimate of potential energy savings. [View acceptable values for Eligibility.](#)

Number of floors: 1 ?

Aspect ratio: 1 ?

Window-to-wall ratio: .08 ?

Estimated plug load density (W/ft²): .75 ?

24 hour operations: No

Skylights: No

HVAC system type: Packaged A/C with gas fu

ELIGIBILITY

LIGHTING (interim rule): ✓

LIGHTING (partial qualifying rule): ✓

ENVELOPE: ✓

HVAC and HW: ✓

*You are eligible to use the 179D DOE Calculator for the following systems: Lighting (Interim Rule), Lighting (Partial Qualifying Rule), Envelope, HVAC.

Choose the System(s) to Estimate Potential Savings

LIGHTING
Buildings that have an installed lighting power of at least 25% less than ANSI/ASHRAE/IESNA Standard 90.1-2001 or buildings that save at least 16 2/3 % on annual energy costs through improvements to the building lighting may qualify for a tax deduction of up to \$0.60 per square foot.

ENVELOPE
Buildings that save at least 10% of their projected annual energy costs through improvements to the building envelope (insulation, windows, doors, and roof) may be eligible for a tax deduction of up to \$0.60 per square foot.

HVAC and HW
Buildings that save at least 15% of their projected annual energy costs through improvements to the heating, ventilating, and air conditioning (HVAC) and hot water systems may be eligible for a tax deduction of up to \$0.60 per square foot.

NEXT

5. Check eligibility of the 179D calculator for tax purposes based on basic building information (can always use the calculator for estimating savings)

6. Select system(s) to evaluate (can check 1 or all 3, but each system is treated separately)

179D DOE Calculator Example (page 3)

1 Building Eligibility Summary 2 Energy Calculations HVAC 3 Review Estimated Results

HVAC and HW Solution Explorer
Stand-alone retail Climate Zone 4A

Eligibility to use the 179D DOE Calculator for HVAC and HW
partial qualifying rule:

Change the values in the input boxes to match your building's HVAC parameters. The savings will be automatically calculated and displayed in the green area below the input boxes.

PARAMETER	90.1-2001	YOUR SELECTED VALUE	MOST EFFICIENT VALUE
System Type	Packaged single zone AC	Packaged single zone AC	Packaged single zone AC
Fan Speed Control	Constant Speed	Variable Speed	Variable Speed
IEER ([Btu/h] / W)	11.50	15	20.13
Heater Coil Thermal Efficiency (%)	79	79	95

Energy and Power Cost Savings*
[View HVAC and HW System Details](#)

QUALIFICATION FOR 179D TAX DEDUCTION:

15.4%
\$0.24 / ft²

Partial Qualifying Rule 15%
Threshold: Partial

Qualifying Rule 16 2/3%
Threshold:

Partial Qualifying Rule 20%
Threshold:

20.0%
\$0.31 / ft²

SUBMIT

Three solutions: baseline, your building, and most efficient

7. Enter your system data

Savings and eligibility for tax deduction

179D Reports

Approved by IRS as proof of qualification

Results Report for 179D Qualification

PRINT

ELIGIBILITY for use of 179D DOE Calculator

Lighting (interim rule): Lighting (partial qualifying rule):
 Envelope (partial qualifying rule): HVAC and HW (partial qualifying rule):

SUMMARY Log ID: 7918 September 13, 2013

Building Summary

Building Type: Stand-Alone Retail Building Name:
 Building Gross Area: 37,000 ft² Building Owner:
 Climate Zone: 4A Building Address:
 Zip Code: 21230

HVAC and HW

System Type: Packaged Single Zone Air Conditioner Efficiency Rating: IEER 15 [Btu/h]VW
 Heater Coil thermal efficiency: 79%
 Fan Speed Control: Variable Speed Fan

Estimated Results

Energy and Power Cost Savings*: 15.4% Tax Deduction: \$0.60/ft²
 Annual Energy Cost Savings*: \$0.24/ft²

Qualification Status*
 Partial Qualifying Rule:

Results Summary

System	179D DOE Calculator Eligibility	Installed Lighting Power (W)	Energy and Power Cost Savings* / Reduction in Lighting Power Density (%)	2008 Qualification Threshold (%) and Status††	2008 Qualification Threshold (%) and Status†††	2012 Qualification Threshold (%) and Status††††	Tax Deduction (\$/ft ² / Applicable Thresholds)
Lighting Interim Rule**	<input checked="" type="checkbox"/>			25 <input checked="" type="checkbox"/>	25 <input checked="" type="checkbox"/>	25 <input checked="" type="checkbox"/>	N/A
Lighting Partially Qualifying Rule	<input checked="" type="checkbox"/>			16 2/3 <input checked="" type="checkbox"/>	20 <input checked="" type="checkbox"/>	25 <input checked="" type="checkbox"/>	N/A
Building Envelope Partially Qualifying Rule	<input checked="" type="checkbox"/>	N/A		16 2/3 <input checked="" type="checkbox"/>	10 <input checked="" type="checkbox"/>	10 <input checked="" type="checkbox"/>	
HVAC and HW Partially Qualifying Rule	<input checked="" type="checkbox"/>	N/A	15.4	16 2/3 <input checked="" type="checkbox"/>	20 <input checked="" type="checkbox"/>	15 <input checked="" type="checkbox"/>	0.60
Total							0.60

Statements and Signatures

Qualified individual certifying compliance with section 179D requirements (as defined in section 5.05 of Notice 2006-52)

Name: _____

Address: _____

Phone: _____

Address of the building to which the certification applies: _____

Qualified individual must initial and complete one or more of the following statements:

____(1) Statement for full deduction for energy efficient commercial building property: The interior lighting systems, heating, cooling, ventilation and hot water systems, and building envelope that have been, or are planned to be, incorporated into the building will reduce the total annual energy and power costs with respect to combined usage of the building's heating, cooling, ventilation, hot water, and interior lighting systems by ____ percent as compared to a Reference Building that meets the minimum requirements of Standard 90.1-2001.

____(2) Statement for energy efficient lighting property under the Partially Qualifying Rule: The interior lighting systems that have been, or are planned to be, incorporated into the building will reduce the total annual energy and power costs with respect to combined usage of the building's heating, cooling, ventilation, hot water, and interior lighting systems by ____ percent as compared to a Reference Building that meets the minimum requirements of Standard 90.1-2001.

____(3) Statement for energy efficient lighting property under the Interim Lighting Rule: The interior lighting systems that have been, or are planned to be, incorporated into the building will result in a lighting power density reduction of ____ percent below ASHRAE Standard 90.1.2001.

____(4) Statement for energy efficient heating, cooling, ventilation, and hot water property under the Partially Qualifying Rule: The heating, cooling, ventilation, and hot water systems that have been, or are planned to be, incorporated into the building will reduce the total annual energy and power costs with respect to combined usage of the building's heating, cooling, ventilation, hot water, and interior lighting systems by ____ percent as compared to a Reference Building that meets the minimum requirements of Standard 90.1-2001.

____(5) Statement for energy efficient building envelope property under the Partially Qualifying Rule: The building envelope that has been, or is planned to be, incorporated into the building will reduce the total annual energy and power costs with respect to combined usage of the building's heating, cooling, ventilation, hot water, and interior lighting systems by ____ percent as compared to a Reference Building that meets the minimum requirements of Standard 90.1-2001.

Qualified individual must initial each of the following statements:

____(1) I have determined the reduction in energy and power costs or lighting power density using the rules of Notice 2006-52, Notice 2008-40 and Notice 2012-26.

____(2)(a) Certifications using the Partially Qualifying Rule: I performed field inspections of the building after the property was placed in service and I have confirmed that the building has met, or will meet, the energy-saving targets contained in the design plans and specifications, and that such field inspections were performed in accordance with any inspection and testing procedures that (1) have been prescribed by the National Renewable Energy Laboratory (NREL) as Energy Savings Modeling and Inspection Guidelines for Commercial Building Federal Tax Deductions and (2) are in effect at the time the certification is given.

OR

Contacts

ARC web site: www.advancedrtu.org

RTU Comparison Calculator: <http://www.pnnl.gov/uac/>

179D DOE Calculator: <http://apps1.eere.energy.gov/buildings/commercial/179d/>

ARC:

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