



Announcing New Resources to Help You Evaluate Technologies and Design Options

Larry Brackney, *NREL*

Tyler Dillavou, *Bonneville Power
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Jennifer Elling, *Xcel Energy*

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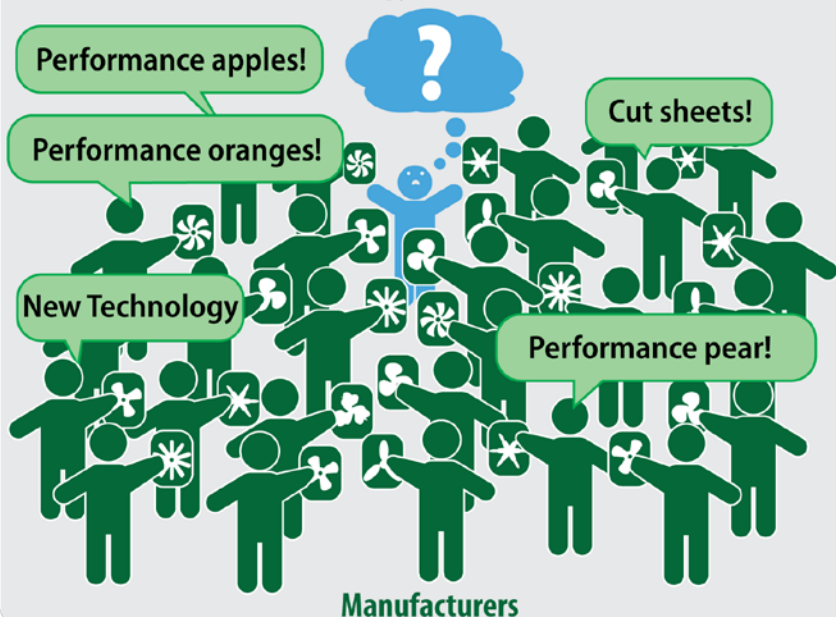
Introduction to the Technology Performance Exchange™ (TPEX™)

Daniel Studer, NREL

TPEx: The Current State

PROBLEM: How do building owners/operators, utilities, and technology demonstrators make informed decisions on energy saving technologies?

Building Owners/Operators, Utilities,
and Technology Demonstrators



PROBLEM: How do manufacturers/distributors reach potential customers and provide them with the information they need?

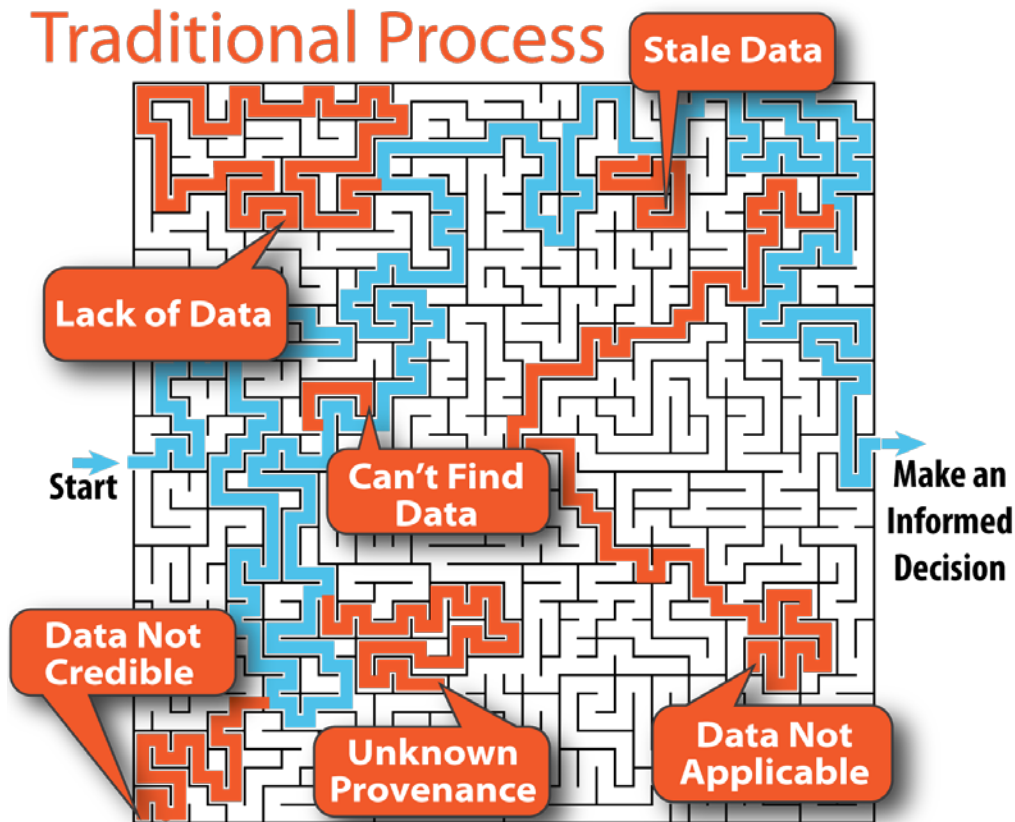


- Define the characteristics necessary to credibly predict performance
- Create the infrastructure necessary to find, share, and leverage data
- Provide data transparency via metadata

TPEx: The Vision

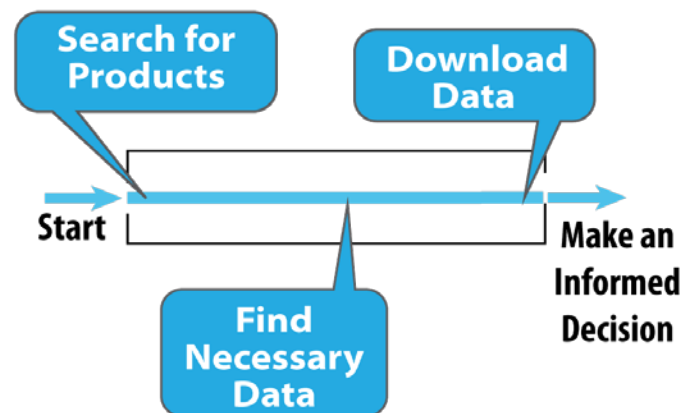
- Necessary energy performance data are easily accessible
 - Reduce investment risk
 - Drive uptake of cost-effective efficiency measures

Traditional Process



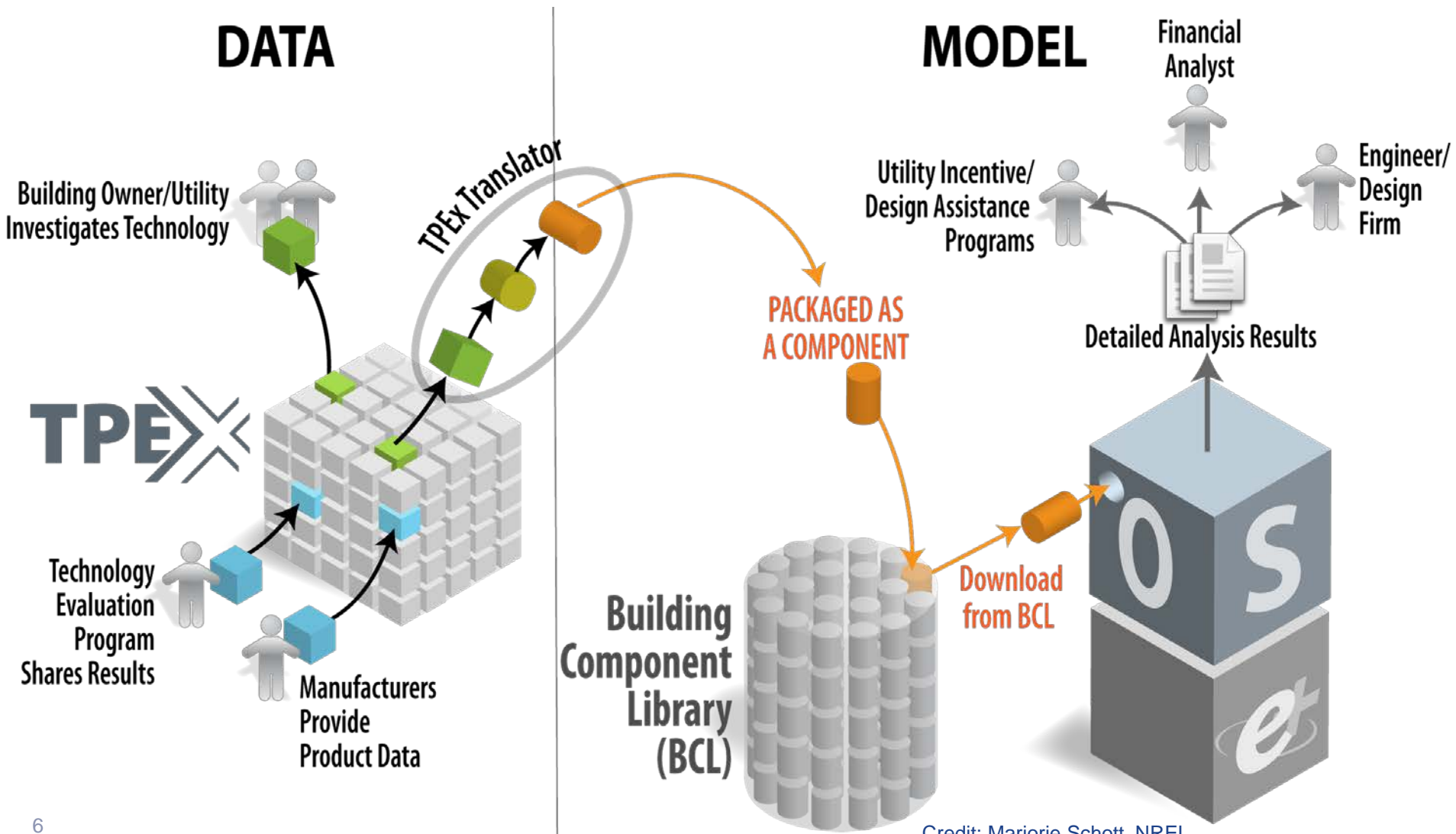
credit: <http://www.mazegenerator.net/>

TPEx Process

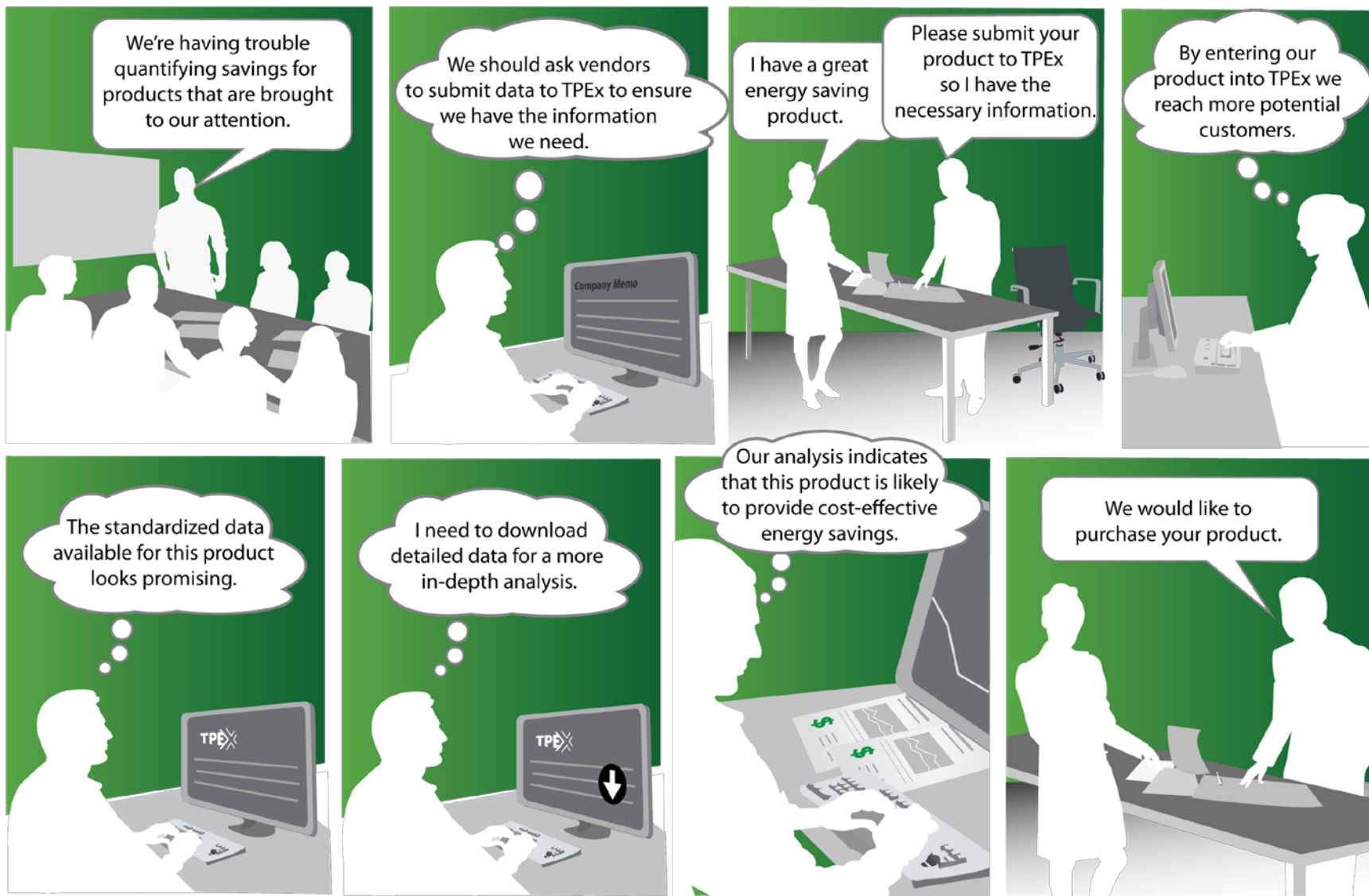


Credit: Marjorie Schott, NREL

TPEX: An Integrated Ecosystem



TPEX: The Data Value Proposition



TPEx.org

TPEX User Perspective: Building Owners

Scott Williams, Target
Jim McClendon, Walmart

TPEX User Perspective: Manufacturers

Kevin McNamara, LG Electronics USA

LG Sees Value In DOE's TPEX

LG is happy to support DOE in this endeavor, and others, as we believe the Agency's actions will help grow the energy efficiency sector on the whole.

- LG is committed to energy efficiency and sustainability, both through its actions and its products, making support of the TPEX a “no brainer” for the company.

LG values the opportunity to create more awareness of its highly efficient VRF systems in the US market in a technically robust way.

- LG always wants to supply as much information as possible to its customers so they can make informed decisions – and get the best energy savings results!
- We appreciate that DOE/NREL has identified the types of information necessary for building owners to make informed decisions .
 - Especially in cases where the technology might not be well known in a market (ie VRF in the US), it is helpful to have a third party like DOE/NREL tell customers that they are informed enough to make the right choice.

Entering the performance attributes of our VRF systems into the TPEX database provides a great sales resource to LG.

- LG is excited about the opportunity to enable more professionals to model the impact our Multi V system would have on their building through the non-proprietary EnergyPlus platform and the Building Component Library that are administered by DOE.
 - LG already provides product info for use in proprietary modeling software like Trane Trace, eQUEST, and Energy Pro.
 - LG looks forward to empowering even more engineers and procurement specialists, via the TPEX, as they work towards increasing the energy efficiency of their properties.

Savings by VRF system

VRF systems are marketed as offering extraordinary improvements in energy efficiency, including savings of between 30% and 60% in HVAC energy usage compared to a range of other HVAC systems. This is based on improved efficiency in all three areas of the HVAC system energy usage.

- Cooling efficiency. AHRI product certifications include VRF products with IEER ratings in the 20 to 30 IEER range (2014).
- Heating efficiency. AHRI product certifications include air-source VRF units with COP values that are typically 3.5 to 4.0 (2014).
- VRF fans operate at 50% or lower power most of the time in part-load fan speed operation and should be able to achieve significant fan savings.

Office Building Energy Model Results (HVAC Energy Only)

HVAC System Type	California	Northwest	Midwest/ Northeast	Southeast	Average Savings
RTU with economizer (kBtu/ft ²)	13.5	12	21	17	–
VRF with heat recovery (kBtu/ft ²)	9.5	7.5	10	10.5	–
Percent savings	30%	38%	52%	38%	39%
RTU with economizer (\$/ft ²)	\$0.54	\$0.18	\$0.59	\$0.51	–
VRF with heat recovery (\$/ft ²)	\$0.39	\$0.14	\$0.44	\$0.33	–
Savings (\$/ft ²)	\$0.15	\$0.04	\$0.15	\$0.18	–
Percent savings	28%	23%	26%	35%	29%

*U.S. General Services Administration(GSA)/Pacific Northwest National Laboratory(PNNL) (2013)

TPEX User Perspective: Gas & Electric Utilities

Tyler Dillavou, Bonneville Power Administration

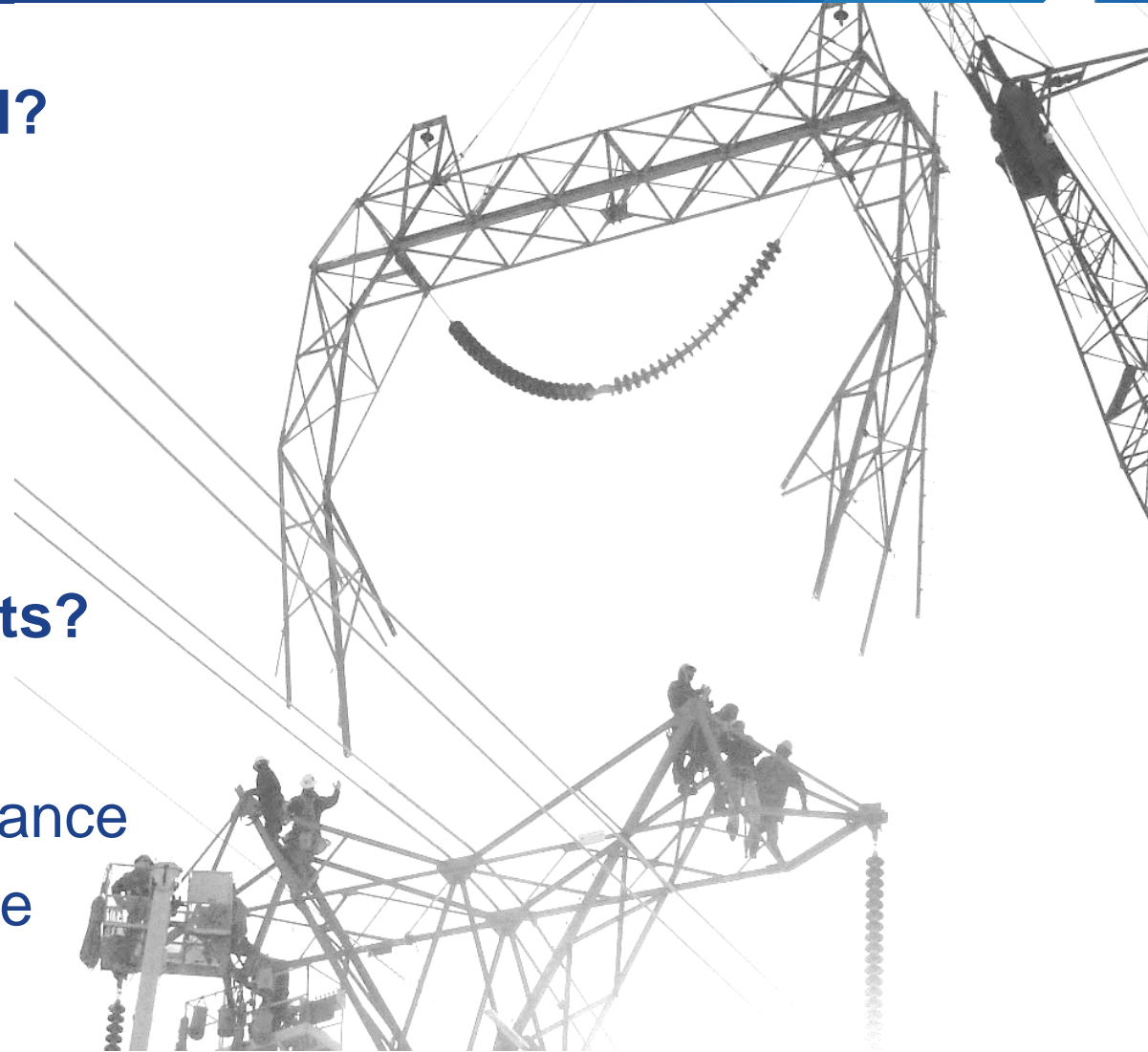
Utilities are a stakeholder in building design and use.

How is energy used?

- Base load
- Peak demand
- Power quality
- Long-term trends

What are the impacts?

- Rate design
- Regulatory compliance
- Capital expenditure

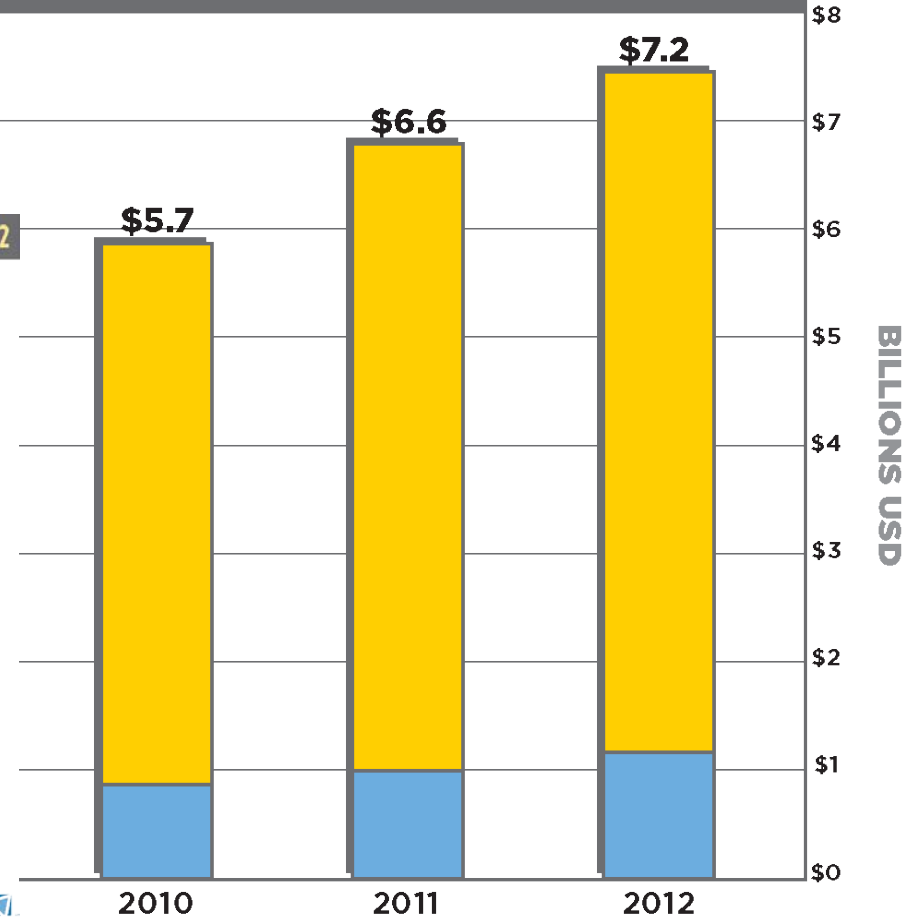


In 2012, U.S. utilities spent more than \$7 billion in markets for energy-using products.

US DSM Expenditures—Gas and Electric Combined

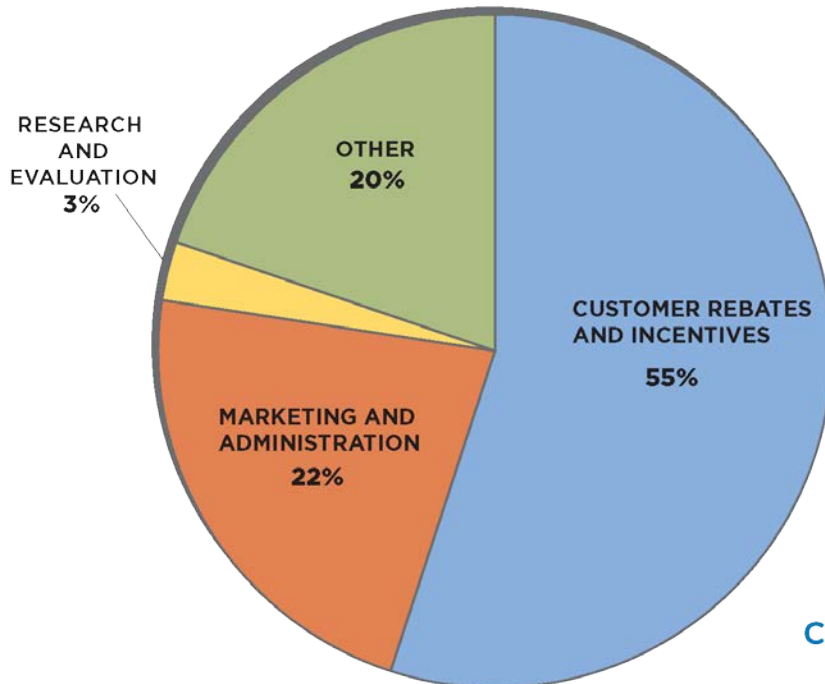
2008–2012

■ ELECTRIC
■ GAS



US Electric Energy Efficiency Expenditures by Category

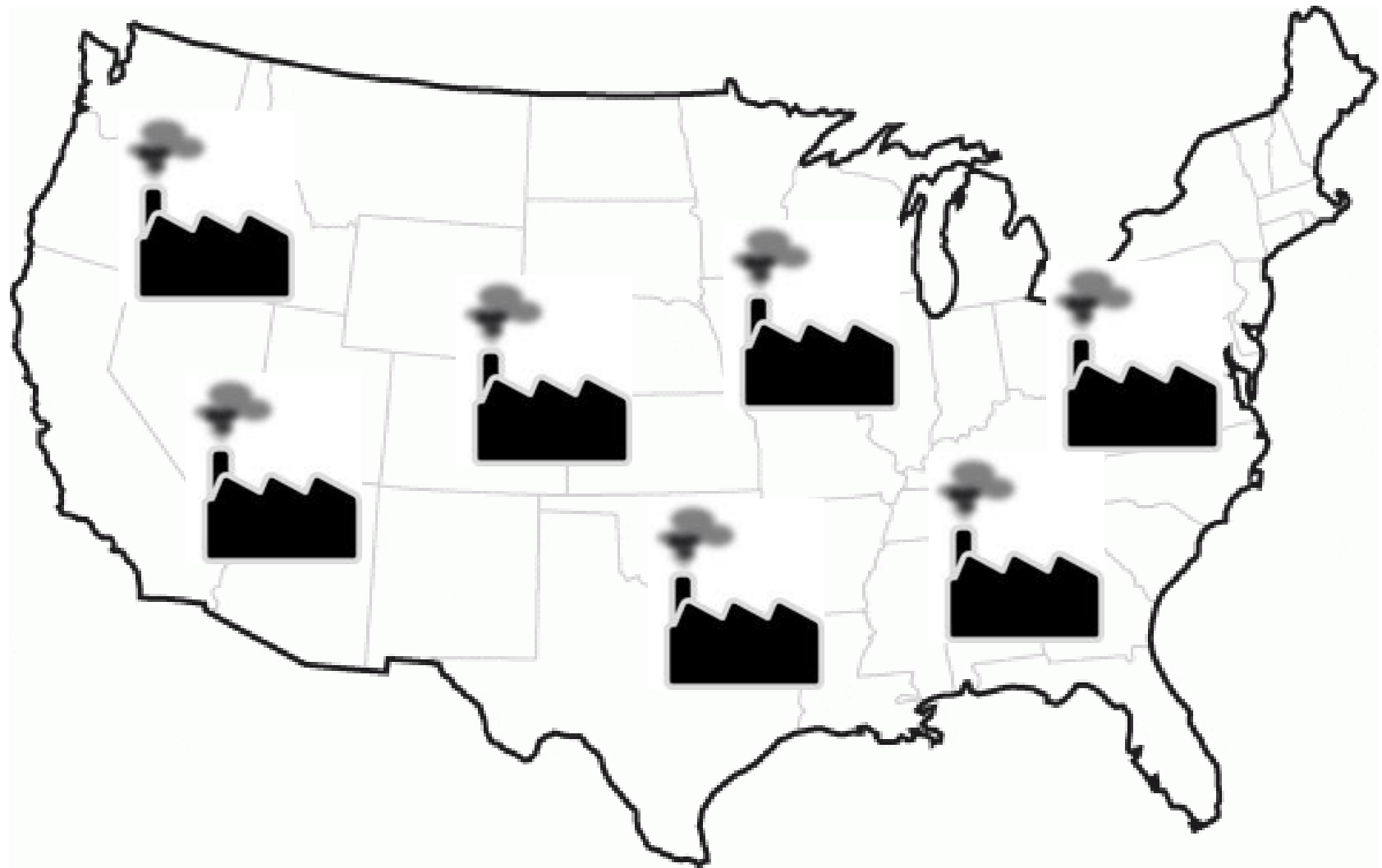
2012



CEE

CEE

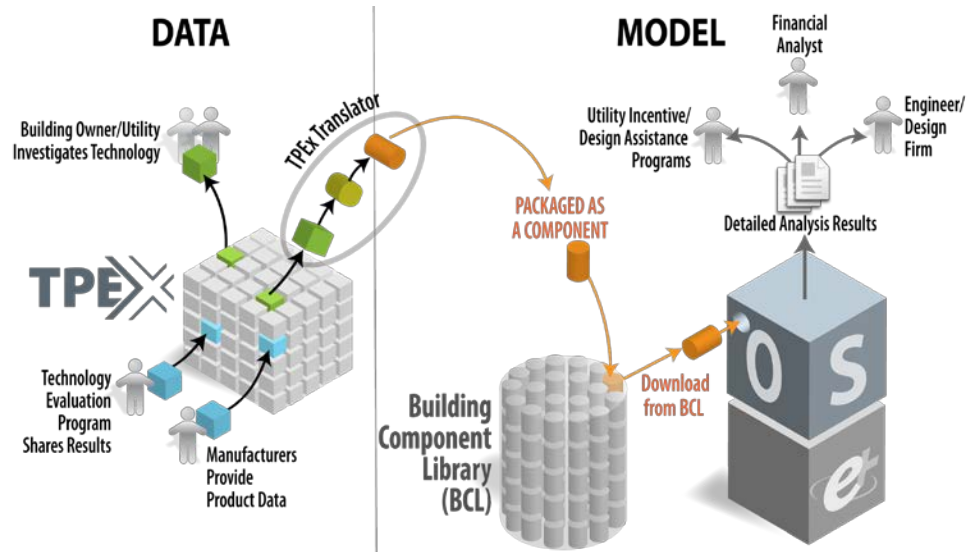
\$6 billion of that was spent by electric utilities,
to conserve seven Rosenfelds of energy...



...using this.



Better data may reduce the time and cost to develop new investment opportunities.



Current method

- In situ field test
- \$10,000-\$20,000 per site
- 30-100+ sites
- 18 months to complete

Preferred method

- Map performance in lab
- Survey field characteristics
- Simulate across applications
- Verify with limited field tests

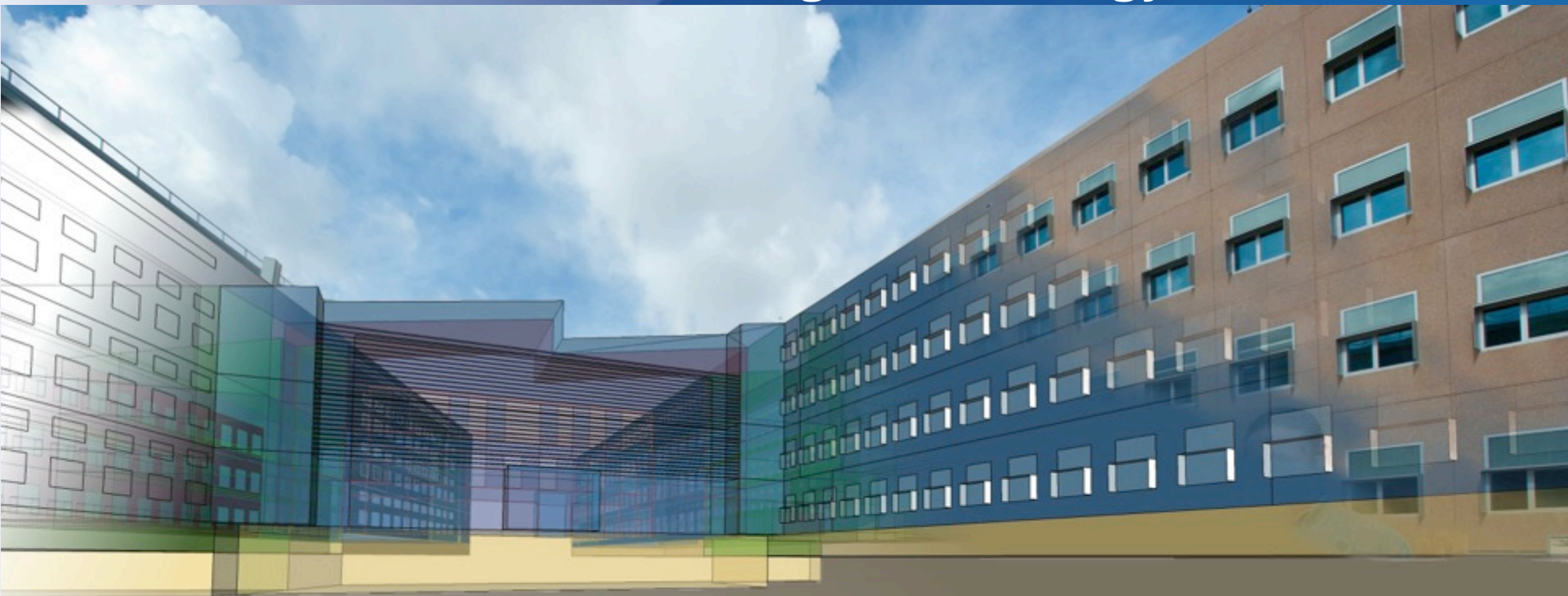
Data required by utility engineers are detailed in standard forms, by product category.

Table 2-7 Heating Operation Performance Map for DHP Outdoor Units

CR	Outdoor Air Dry-Bulb/Wet-Bulb Temperature	Indoor Air Dry-Bulb Temperature																									
		15.0°C			16.1°C			17.8°C			19.4°C			21.1°C			22.8°C			24.4°C			26.7°C				
		HC	CP	FP	HC	CP	FP	HC	CP	FP	HC	CP	FP	HC	CP	FP	HC	CP	FP	HC	CP	FP	HC	CP	FP		
50%–130%	–20.0°C/–20.2°C																										
	–17.8°C/–18.0°C																										
	–15.0°C/–15.3°C																										
	–12.2°C/–12.8°C																										
	–9.4°C/–10.0°C																										
	–6.7°C/–7.2°C																										
	–3.9°C/–5.0°C																										
	–1.1°C/–2.2°C																										
	1.7°C/0.0°C																										
	4.4°C/2.2°C																										
	7.2°C/5.0°C																										
	8.3°C/6.1°C																										
	10.0°C/7.8°C																										
	12.8°C/10.6°C																										
15.6°C/13.3°C																											

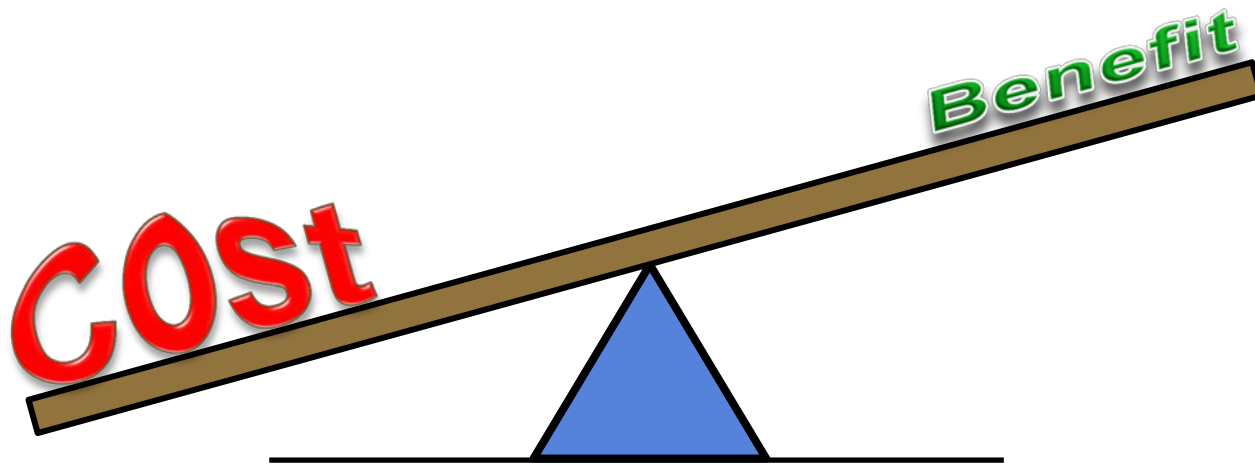
Introduction to OpenStudio and Energy Design Assistance Program Tracker (EDAPT)

Dr. Larry Brackney, NREL
Jennifer Elling, Xcel Energy



- Provide background on OpenStudio
- Provide background on EDAPT
- Discuss DOE plans for replication

The Problem with Energy Modeling

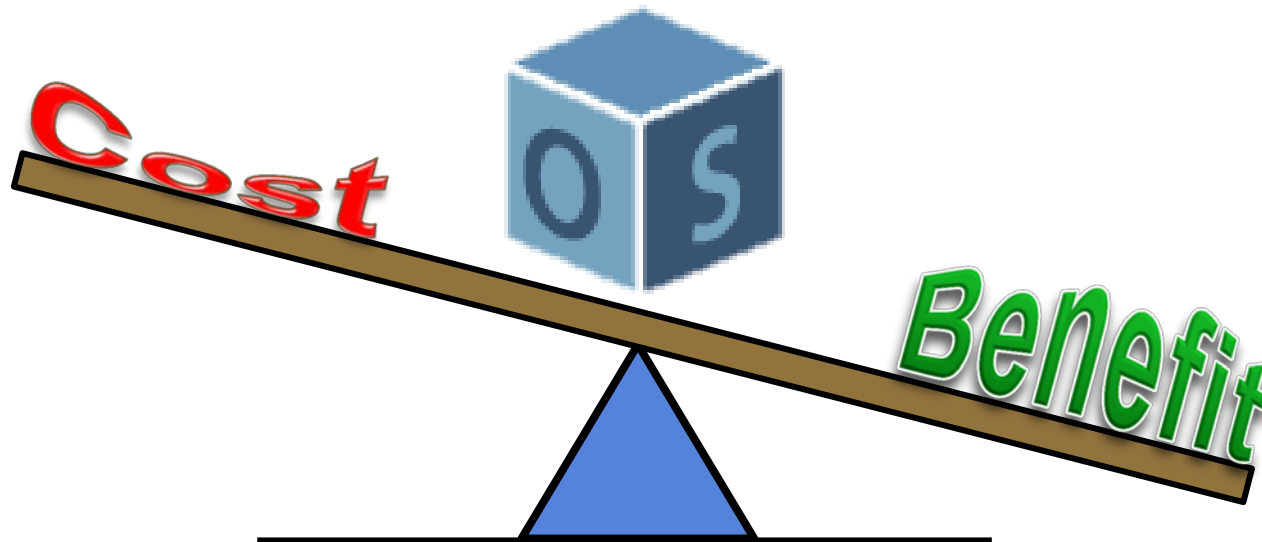


- Highly specialized skillset
- Tools are too hard to use
- Every building is different

Outcomes:

- Model only for certification
- Take prescriptive incentives
- Mediocre energy performance

Meeting the Challenge with DOE's OpenStudio Platform



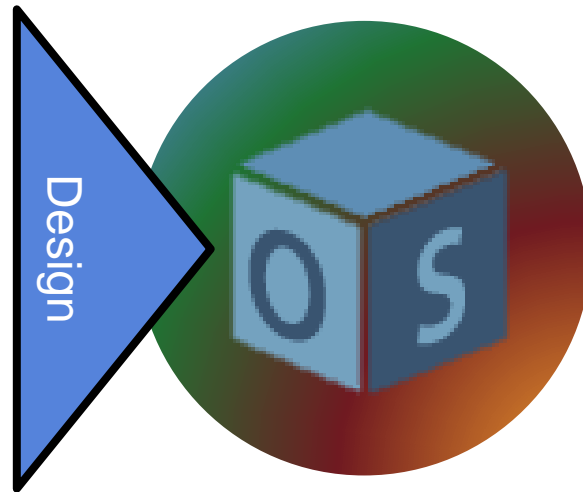
- Smarter tools save time:
 - “Drag-and-Drop Easy”
 - Standardized inputs
 - Automated quality checking
- Pre-packaged modeling solutions are online and only a click away

Outcomes:

- Performance optimized for cost-effectiveness and energy savings
- Maximum incentive opportunity
- Oh, and certifications too!

A&E Firms

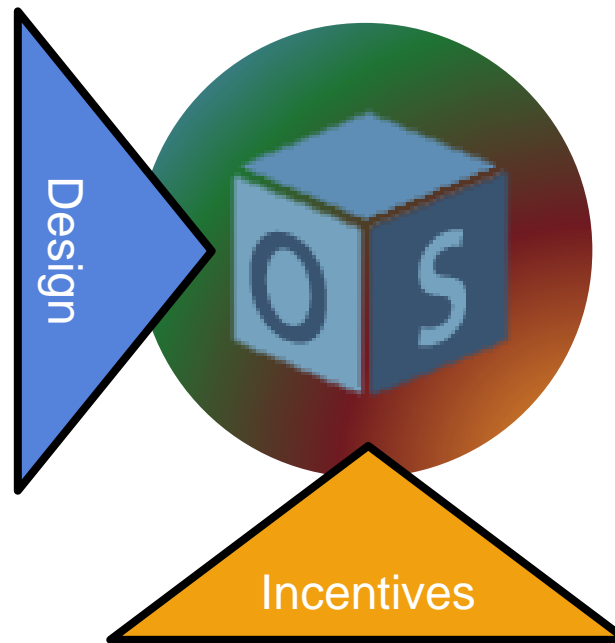
- More projects
- Reduced costs
- Greater workforce engagement



OpenStudio: A Platform That Supports All Stakeholders

A&E Firms

- More projects
- Reduced costs
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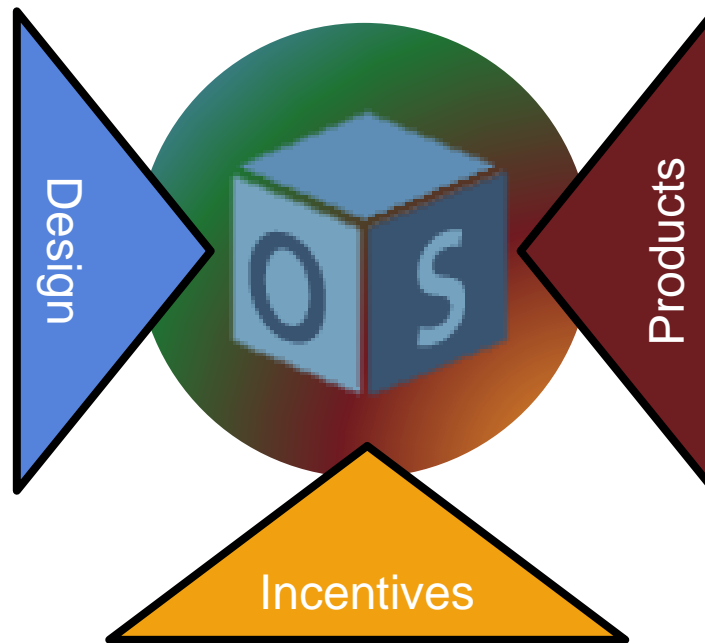
Utilities

- Reduced costs
- Reduced risk
- Greater realization rates

OpenStudio: A Platform That Supports All Stakeholders

A&E Firms

- More projects
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Manufacturers

- New sales channels
- Put product specs in front of design teams early in process
- Identify value as part of integrated design

Utilities

- Reduced costs
- Reduced risk
- Greater realization rates

OpenStudio: A Platform That Supports All Stakeholders

Owners

- Optimal cost-effective design
- Maximize incentive opportunity
- Certifications

Efficient
Buildings

A&E Firms

- More projects
- Reduced costs
- Greater workforce engagement

Design

Manufacturers

- New sales channels
- Put product specs in front of design teams early in process
- Identify value as part of integrated design

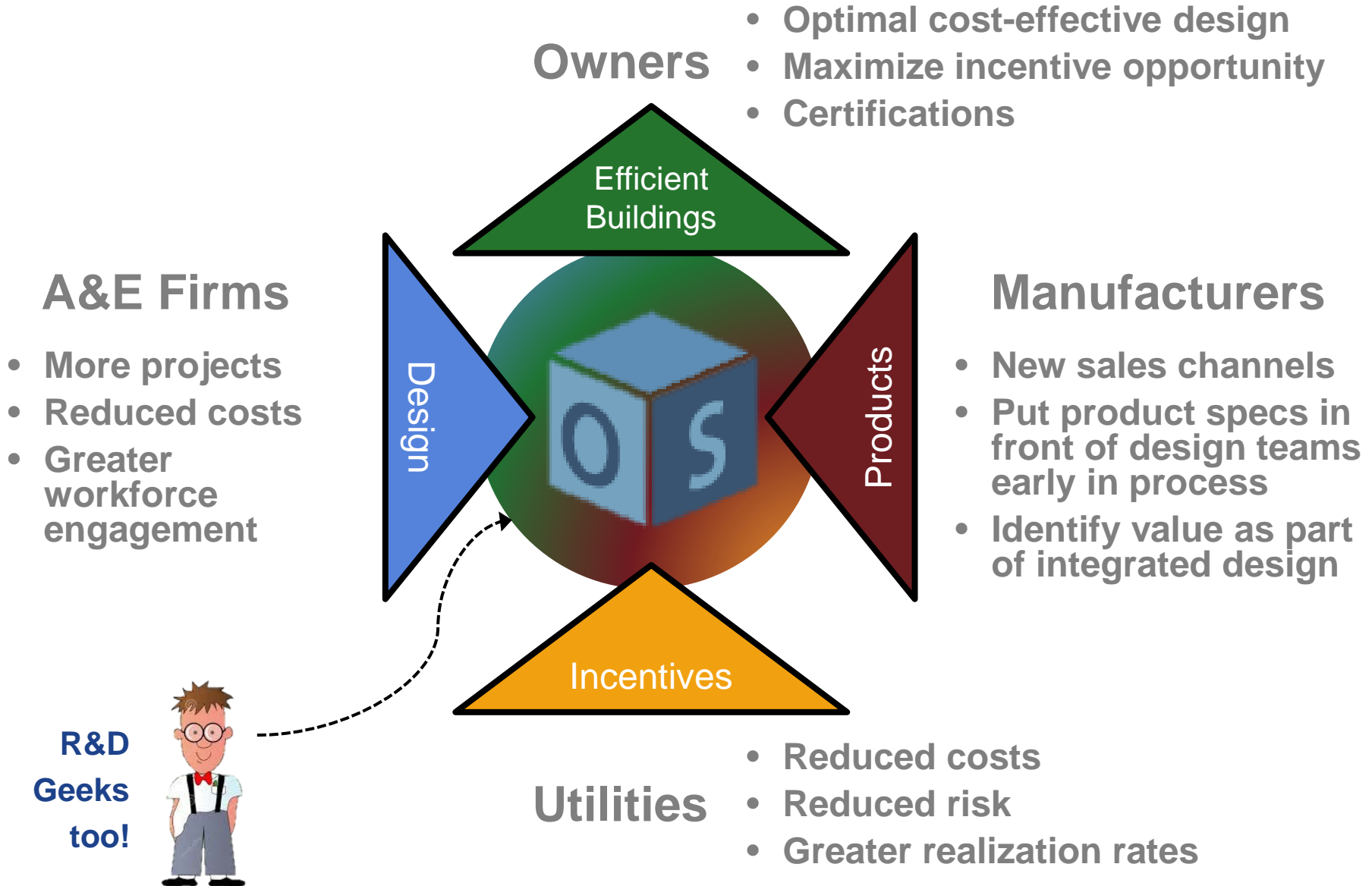
Products

Incentives

Utilities

- Reduced costs
- Reduced risk
- Greater realization rates

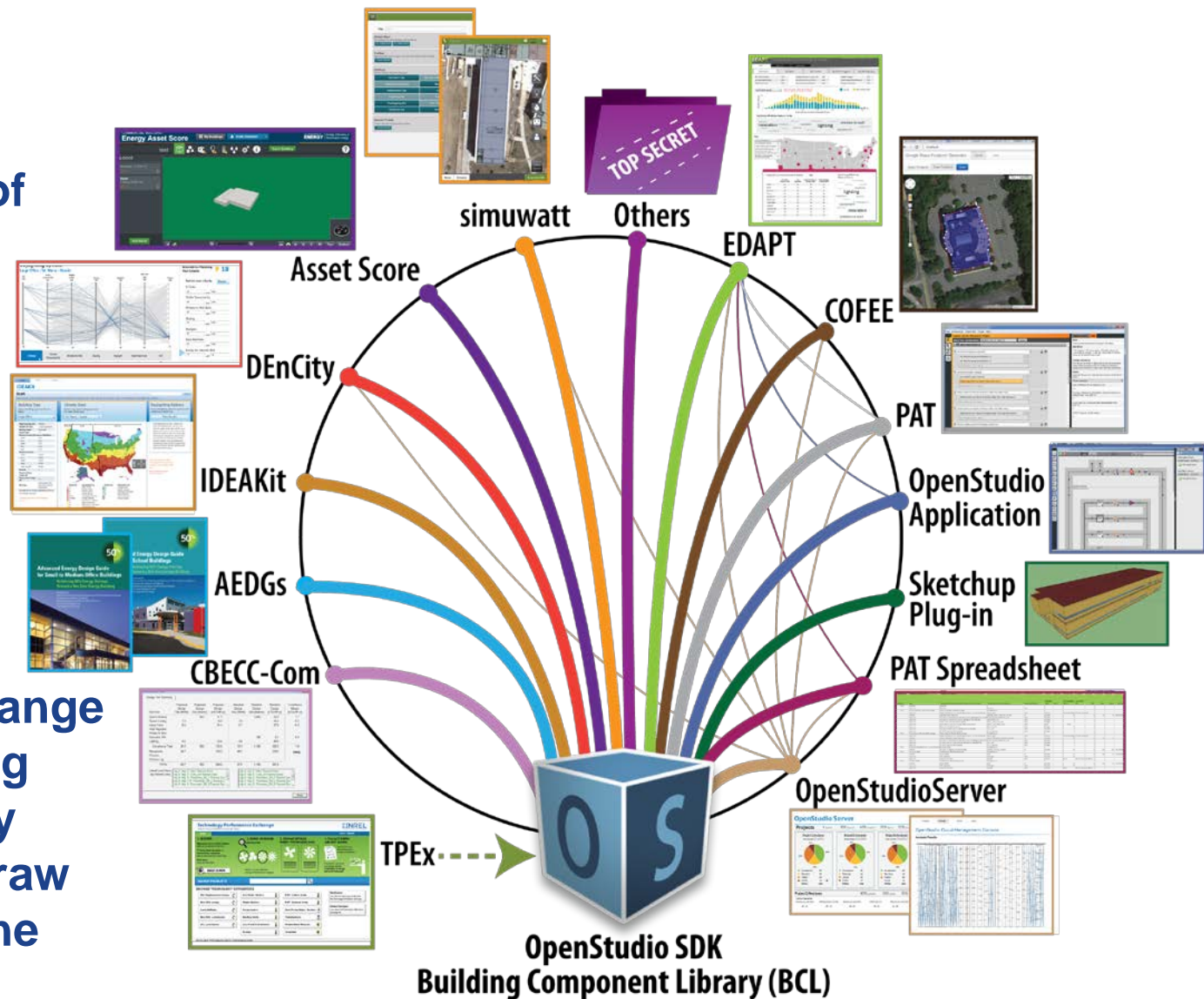
OpenStudio: A Platform That Supports All Stakeholders



OpenStudio – Not a Single Tool

OpenStudio is an enabling part of a larger ecosystem of public and private sector tools.

The Technology Performance Exchange (TPEX) and Building Component Library (BCL) provide the raw data that powers the ecosystem.



Credit: Marjorie Schott, NREL

The BCL: A Source for Reusable Input Data

Components are used to quickly build complete models

Building Component Library

Welcome, Guest! | Login | Register

Enter the terms you wish to search for. Search

- 1 Search for a component or energy conservation measure.
- 2 Filter results and download the specific file or files you need.
- 3 Add component data to your building energy model.
- 4 Run simulation and review results.

Building Component Library

The Building Component Library is a repository of building data used to create building energy models. The data are broken down into separate components that represent parts of a building: windows, walls, schedules, and weather information are a few examples.

Search for components by type or keyword and use the facets to narrow down your search. Once you find the components you need, download them and insert them in your energy model.

Components
Total Components: 28,652

The components are designed to provide data to the energy modeler and simplify the process of gathering inputs. The range of components goes from whole buildings to detailed files, like duct sealing components.

Search

Browse Components

Energy Conservation Measures
Total Measures: 1

Energy saving measures are packages that have been created to try one or a package of energy saving measures to your model. An example would be a measure that adds overhangs to all your windows.

Search

Browse Energy Conservation Measures

Developer Access

News view all

Initial Component Upload Complete

ASHRAE 90.1 Constructions Exterior Wall Steel-Framed



Click to view more images



Attributes	
Standard	ASHRAE 90.1 Constructions
Construction	Exterior Wall
Construction type	Steel-Framed
Effective r-value	0.4421 ft ² F h/Btu
Insulation minimum r-value	R ft ² F h/Btu
Film coefficients	false
OpenStudio Type	OS:Construction
Source	

The BCL: A Source for Reusable Input Data

Components are used to quickly build complete models

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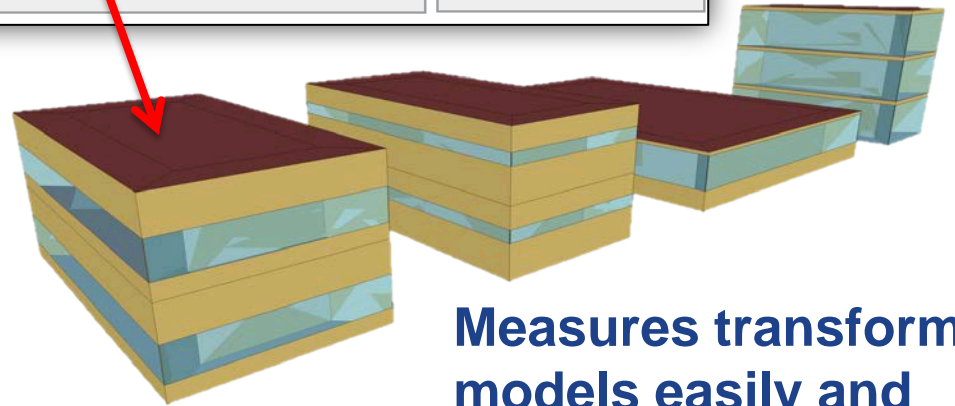
Click to view more images



Attributes

Standard	ASHRAE 90.1 Constructions
Construction	Exterior Wall
Construction type	Steel-Framed
Effective r-value	0.4421 ft ² F h/Btu
Insulation minimum r-value	R ft ² F h/Btu
Film coefficients	false
OpenStudio Type	OS:Construction

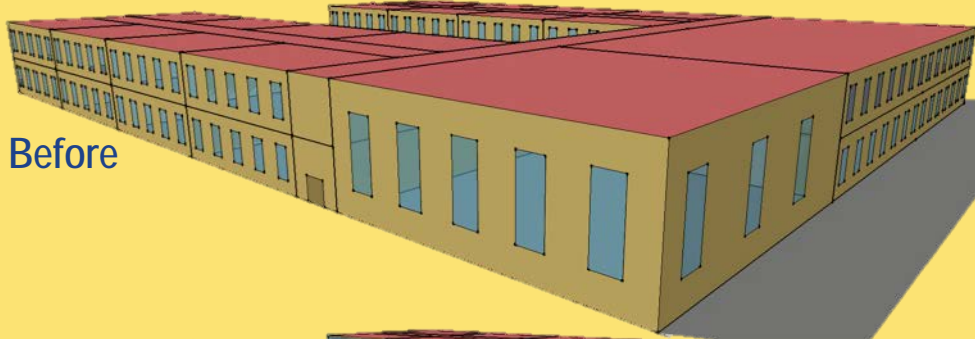
Source



Measures transform models easily and consistently

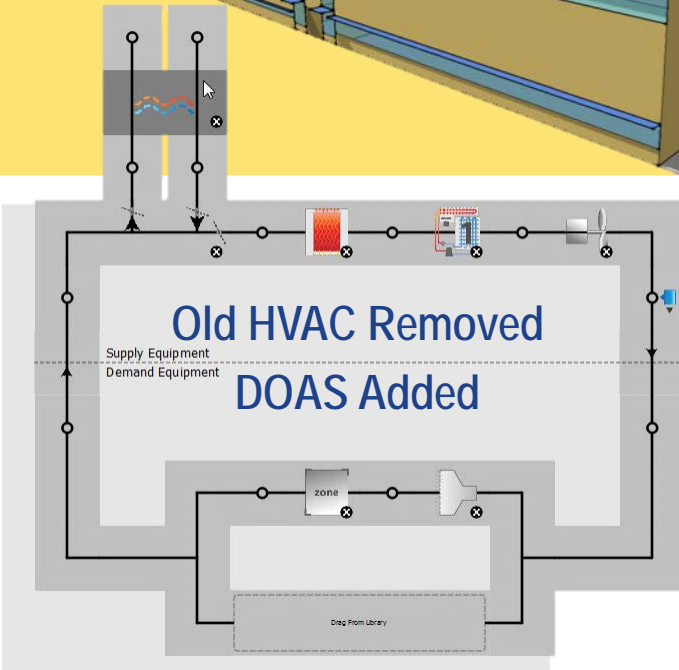
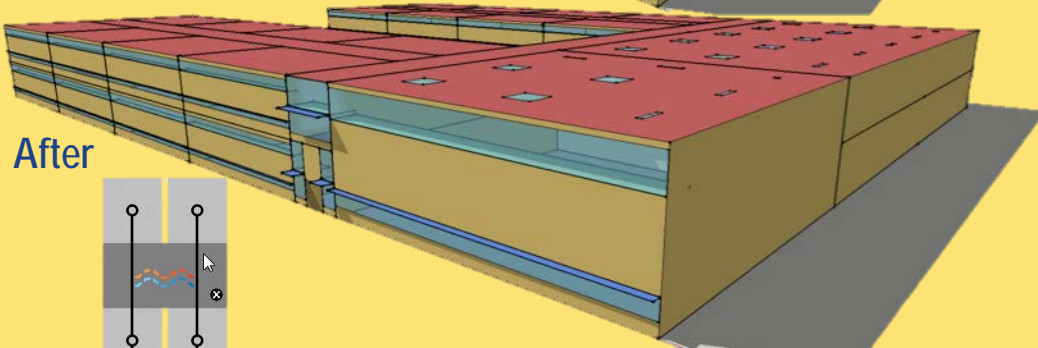
Sample Measures for Rapid Design

Before

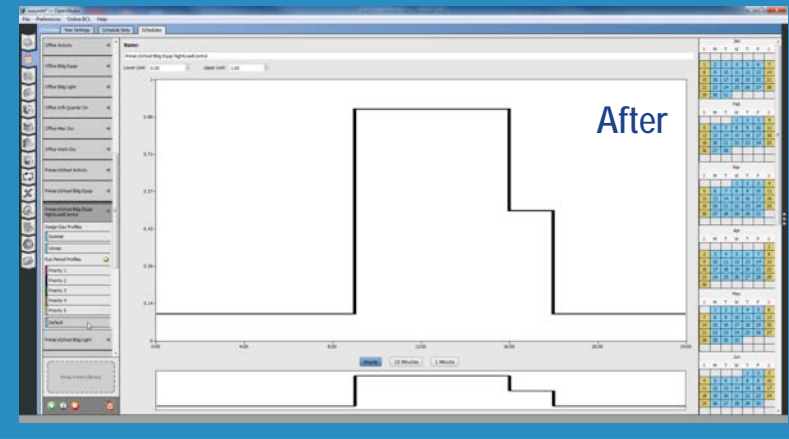
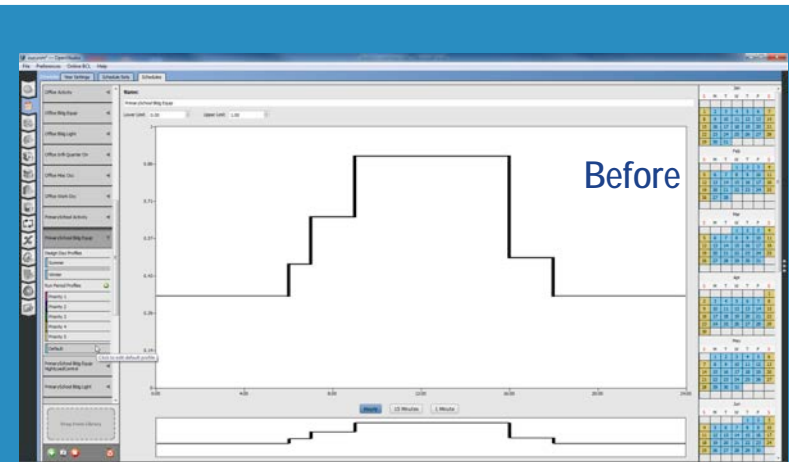


Daylighting Measure Package Applied

After



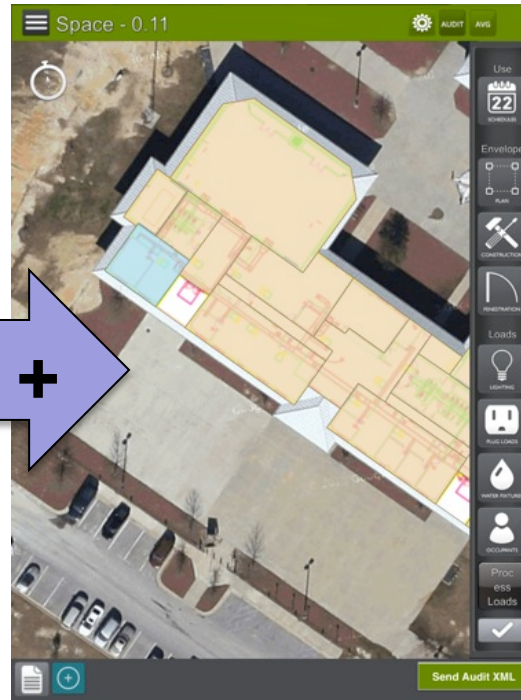
Night Setback Schedule Applied



simuwatt: OpenStudio-Based Low-Cost Auditing Tool



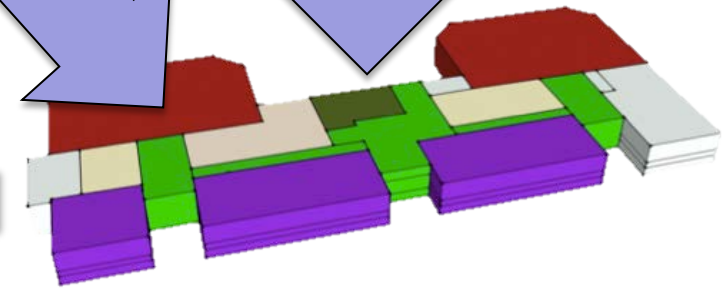
Photo of on-site evacuation plan



Google Maps satellite imagery



BCL Components

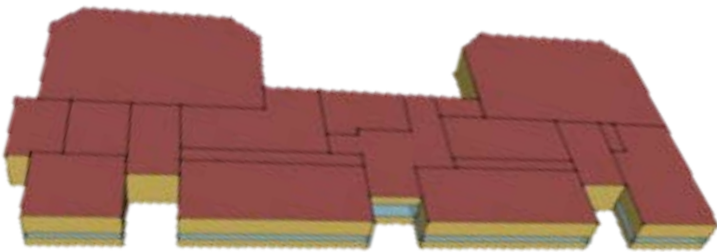


- OpenStudio automatically generates a detailed energy model ready for measure analysis

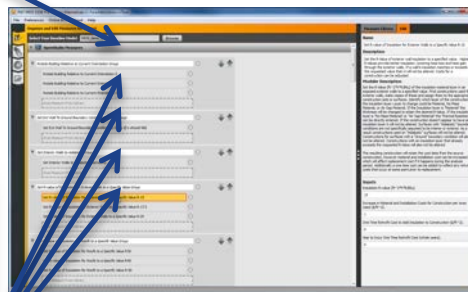


Ft. Jackson Bldg 10400

EEM Analysis with simuwatt



Baseline Model



EEM Comparison Tool



BCL Measures

Design Alternative Name	Energy Use Intensity (kBtu/112 sq ft)	Peak Electric Demand (kW)	Electricity Consumption (kBtu)	Natural Gas Consumption (Million Btu)	District Cooling Consumption (Million Btu)	District Heating Consumption (Million Btu)	First Year Capital Cost (\$)	Annual Utility Cost (\$)	Total LCC (\$)
Baseline	31	23	81,000	1,200	1	1	2,800,000	88,000	4,304,000
Single General Controlled Ventilation Alternative (1)	28	22	71,000	227	1	1	1,200	1,200	16,000
Single General Controlled Ventilation Alternative (2)	28	22	71,000	227	1	1	1,200	1,200	16,000
Single General Controlled Ventilation Alternative (3)	28	22	71,000	227	1	1	1,200	1,200	16,000
Single General Controlled Ventilation Alternative (4)	28	22	71,000	227	1	1	1,200	1,200	16,000
Single General Controlled Ventilation Alternative (5)	28	22	71,000	227	1	1	1,200	1,200	16,000
Single General Controlled Ventilation Alternative (6)	28	22	71,000	227	1	1	1,200	1,200	16,000
Single General Controlled Ventilation Alternative (7)	28	22	71,000	227	1	1	1,200	1,200	16,000
Single General Controlled Ventilation Alternative (8)	28	22	71,000	227	1	1	1,200	1,200	16,000
Single General Controlled Ventilation Alternative (9)	28	22	71,000	227	1	1	1,200	1,200	16,000
Single General Controlled Ventilation Alternative (10)	28	22	71,000	227	1	1	1,200	1,200	16,000
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Ft. Jackson Bldg 10400

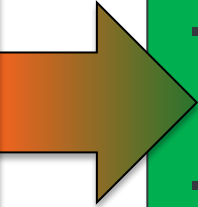
- Life cycle analysis identifies cost-effective energy efficiency measures (EEMs)

Utility programs that incentivize energy performance beyond code

Primary tool for utilities to influence efficiency for beyond code new construction

Example: Xcel Energy's Energy Design Assistance (EDA) Program

EDA program
viability is
jeopardized as
codes rise



How to Address Challenges?

- Lower administrative costs
- Reduce modeling time and cost
- Maintain quality and consistency
- Find deeper savings

1. EDAProjectTracker web service - Lower admin costs

- Automate tracking and approvals
- Streamline communications
- Manages data and communications in one place
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Xcel Energy's Solution

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- Prepackaged modeling solutions (templates and EEMs)
- Quickly assess many EEMs (drag-and-drop, cloud-based)
- Automated QAQC
- Analysis results flow directly into EDAPT
- Automated report generation
- Free, publicly available tools

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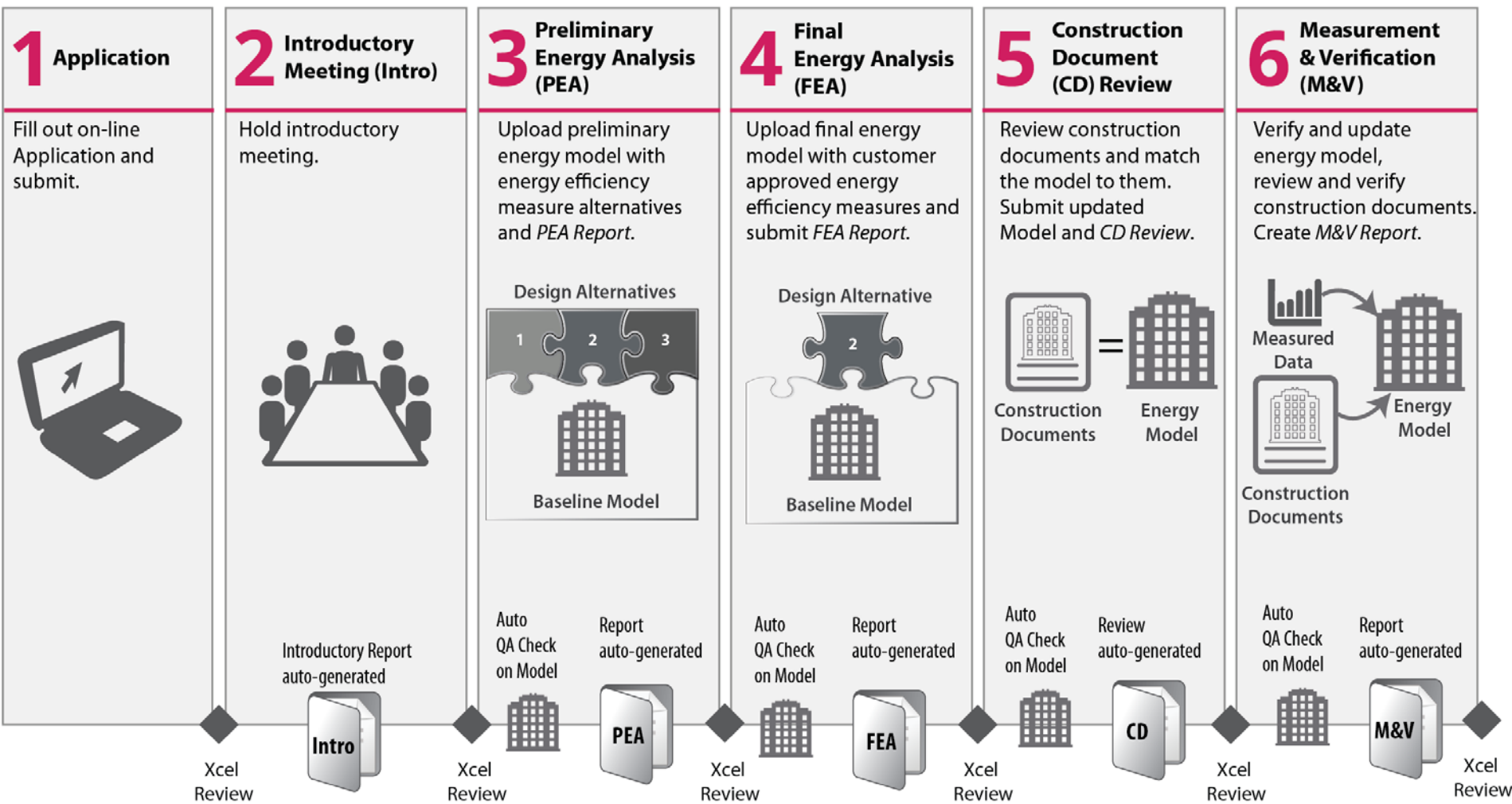
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3. OpenStudio & EnergyPlus - Find deeper savings

- Accurately models high performance technologies and interactive effects
- Expanding library of EEMs to model advanced tech quickly
- Influence design as early as possible
- DOE continues to support and add new technologies

Overview of EDAPT Workflow



Credit: Marjorie Schott, NREL

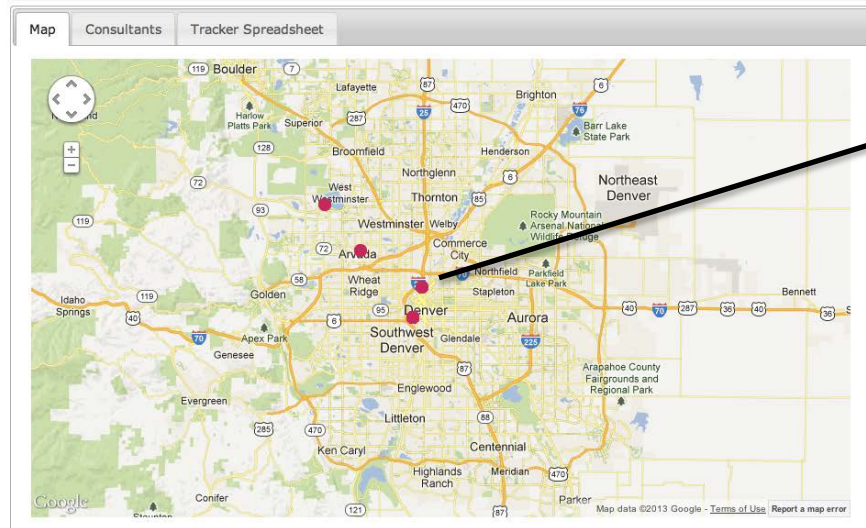
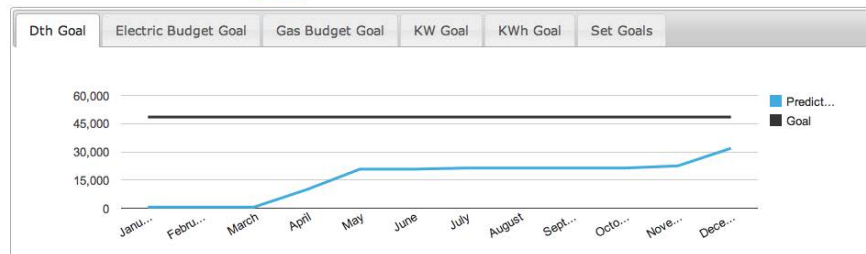
EDAPT Web Service



Summary Projects Application Resources Logout

Summary

Current Projects	31	1 APPLY	2 INTRO	3 PEA	4 FEA	5 CD REVIEW	6 M&V
Waiting on Xcel - PM	12	EC	EC	EC	EC	MV	MV
Waiting on Xcel - MA	0	10	2	10	1	2	1
Waiting on Xcel - EEE	0						3
Waiting on Energy Consultant	17						
Waiting on Measurement & Verification Company (MVC)	0						
Waiting on Measurement & Verification Energy Modeler (MVEM)	0						
Completed Projects	2						



- Tracks projects
- Manages data and communications
- Reports program-wide outcomes
- Integrates with analysis tools

Huron St Residential

1 APPLICATION 2 INTRO MEETING 3 PRELIMINARY ENERGY ANALYSIS 4 FINAL ENERGY ANALYSIS 5 CONSTRUCTION DOCUMENT REVIEW 6 MEASUREMENT & VERIFICATION

PRELIMINARY ENERGY ANALYSIS

PRELIMINARY ENERGY ANALYSIS MODEL

After the model has been completed in OpenStudio, the EC should upload results. The modeled baseline and measures will be listed and graphically displayed below.

OpenStudio File

PEA Results.zip (85.47 KB) Remove

MODEL ERRORS

SINGLE MODEL COMPARISONS (0)

Measures	Annual Energy Cost (\$)	Energy Cost (\$)	% Cost Savings	Electricity Use (kWh)	Electricity Savings (kWh)	Peak Electric Demand (kW)	Peak Electric Demand Reduction (kW)	% kW Demand Reduction	Natural Gas Use (Dtherms)	Natural Gas Savings (Dtherms)
Baseline: EDA Baseline	214,465	0	0	2,554,378	0	573	0	0.000	4,333	0
Wall Insulation	212,271	2,194	1	2,489,028	15,350	567	5	0.927	4,316	137
Roof Insulation 1	213,778	687	0	2,500,486	3,892	570	3	0.441	4,313	40
Roof Insulation 2	213,633	832	0	2,499,803	4,575	570	3	0.547	4,304	49
Non-Residential										
Stairwells/Curtainwall	212,736	1,729	1	2,485,217	18,161	566	9	1.533	4,368	-15
Non-Residential										
Stairwells/Curtainwall	212,357	2,108	1	2,481,886	22,822	562	10	1.801	4,368	15

Preliminary Energy Analysis

Xcel Review (PM)

Stage

YRG

Energy Consultant

Darryl Presley

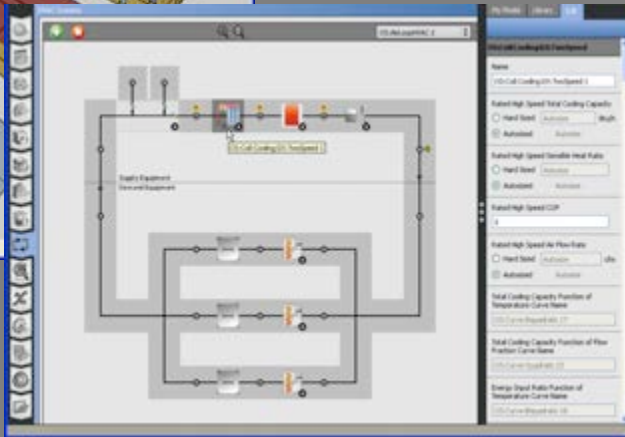
Account Manager

The intent of this step is to evaluate energy efficiency improvements, and assemble potential whole-building combinations for further analysis.

12-18-2013 14:58 - Project has been moved to the Intro Meeting stage by Steven.J.dilorenzo@xcelenergy.com. E-mails sent to: EC, AM, MA, EC, PM.

Analysis Tool – EDAPT Integration

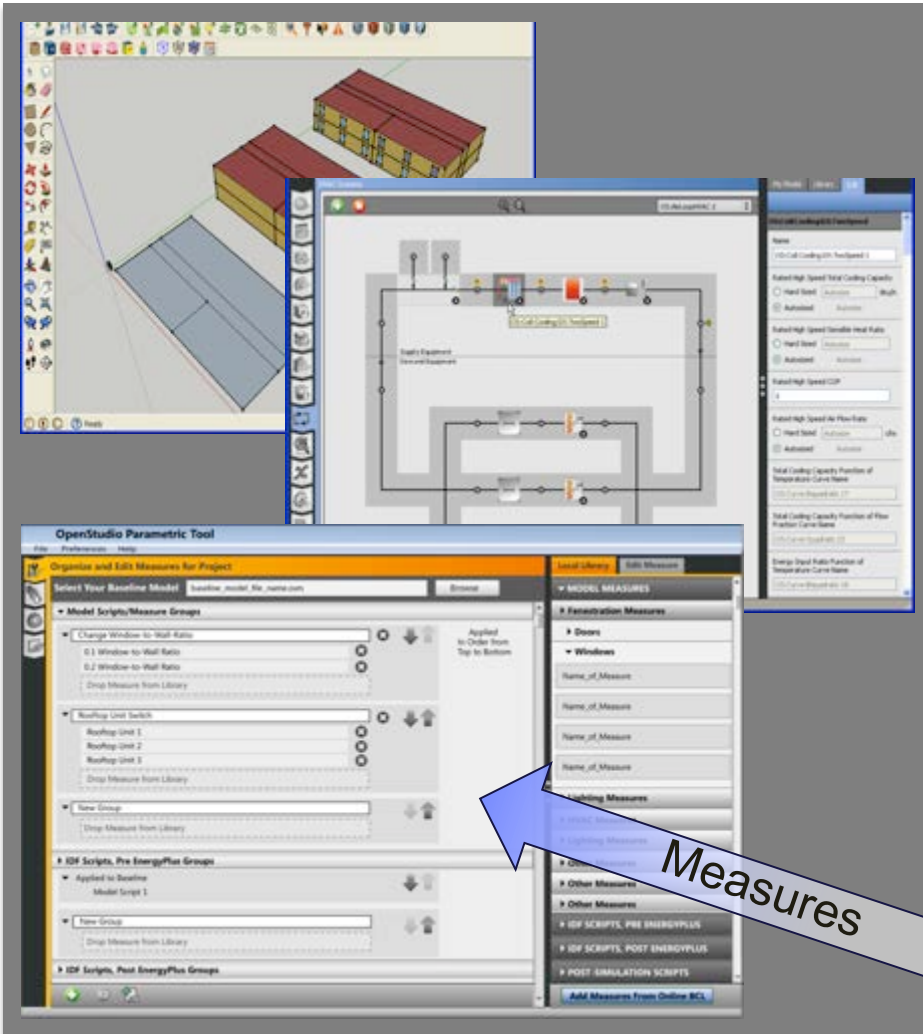
Easy-to-create
baseline models



- **EDAPT leverages open source tools and data sources**
 - EnergyPlus: DOE's flagship building energy simulation engine
 - Radiance: DOE's daylighting analysis engine
 - OpenStudio: Enables rapid tool development



Analysis Tool – EDAPT Integration



Drag-and-drop EEMs from the BCL make design alternative modeling rapid and repeatable

- EDAPT leverages open source tools and data sources
 - EnergyPlus: DOE's flagship building energy simulation engine
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Building Component Library

Welcome, Guest! | Login | Register

Enter the terms you wish to search for.

- 1 Search for a component or energy conservation measure.
- 2 Filter results and download the specific file or files you need.
- 3 Add component data to your building energy model.
- 4 Run simulation and review results.

Building Component Library

The Building Component Library is a repository of building data used to create building energy models. The data are broken down into separate components that represent parts of a building: windows, walls, schedules, and weather information are a few examples.

Search for components by type or keyword and use the facets to narrow down your search. Once you find the components you need, download them and insert them in your energy model.

Components
Total Components: 28,652

The components are designed to provide data to the energy modeler and simplify the process of gathering inputs. The range of components goes from whole buildings to detailed files, like duct sealing components.

Energy Conservation Measures
Total Measures: 1

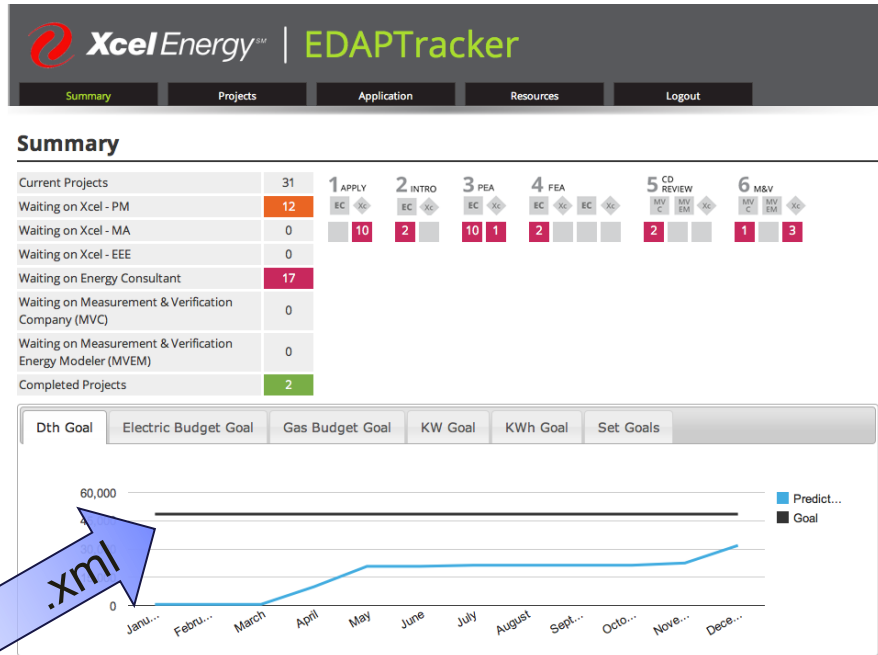
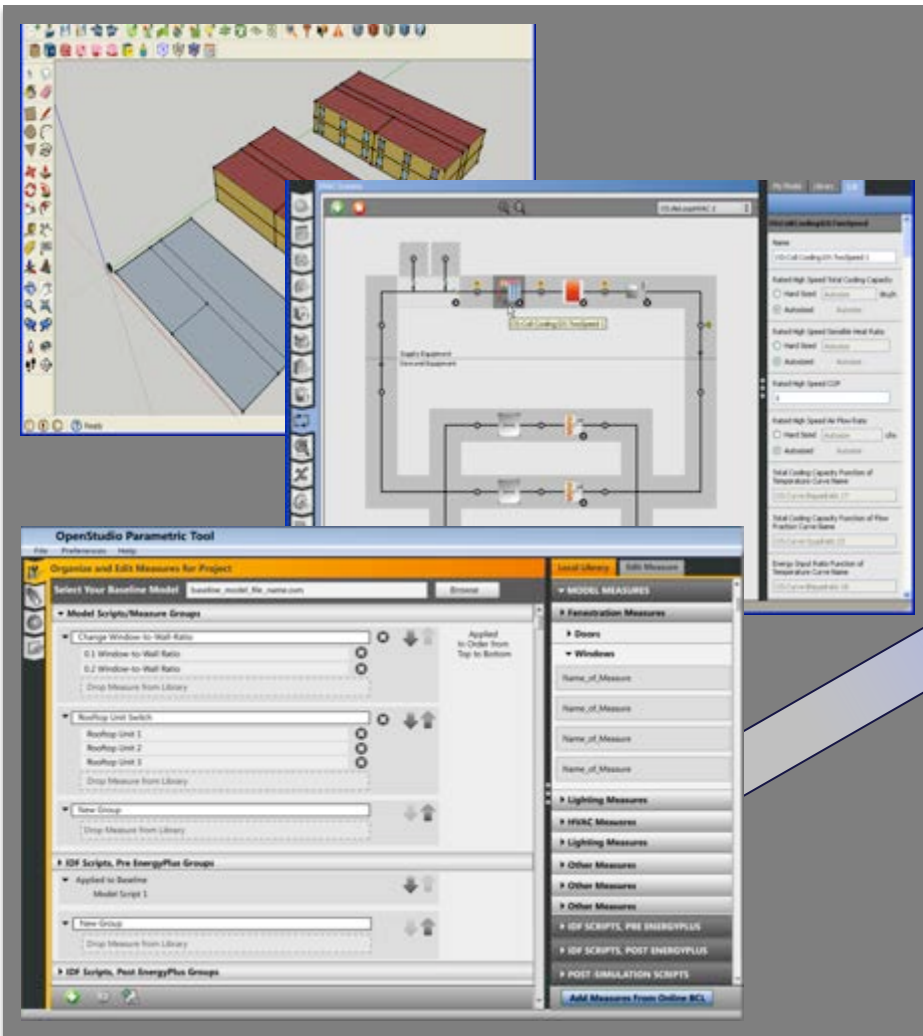
Energy saving measures are packages that have been created to try one or a package of energy saving measures to your model. An example would be a measure that adds overhangs to all your windows.

Developer Access

News

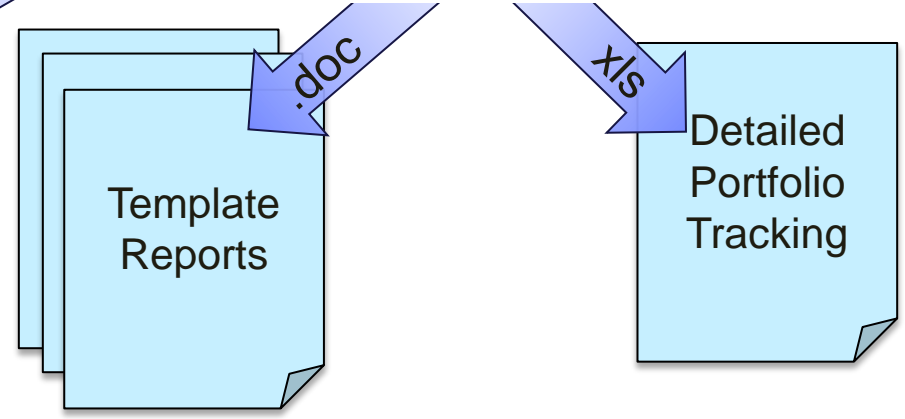
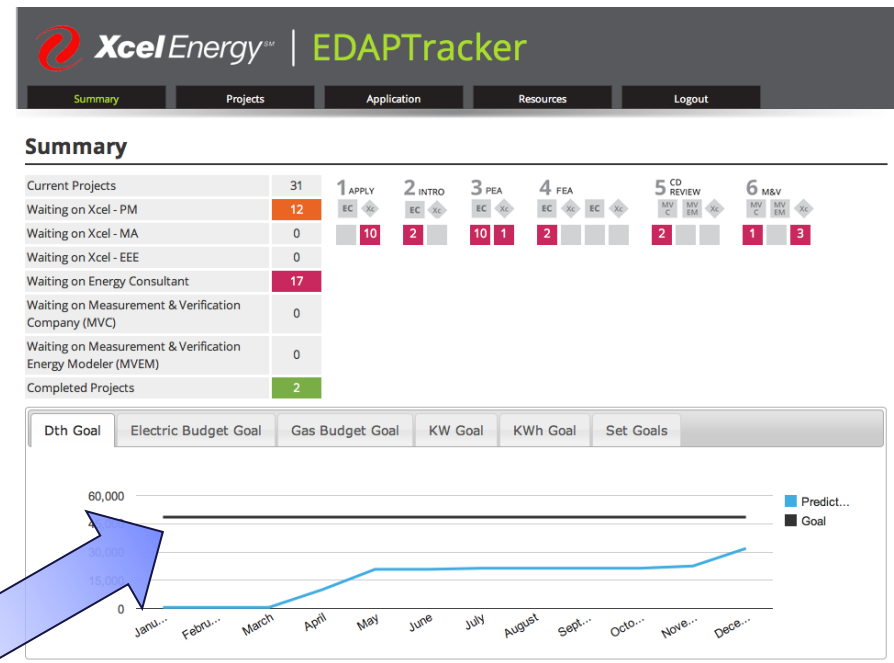
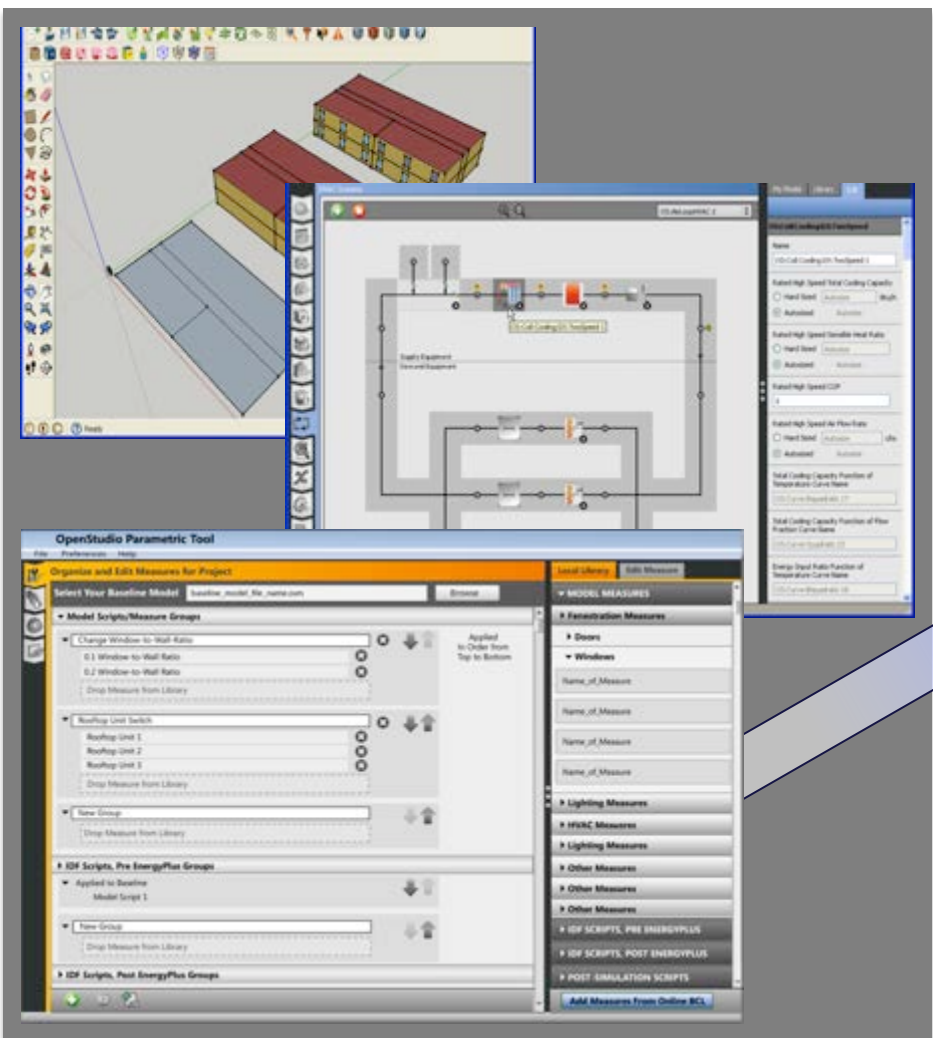
Initial Component Upload Complete

Analysis Tool – EDAPT Integration



- **OpenStudio packages results for upload**
 - Required simulation results for all design alternatives
 - Automated model quality checks
 - Automated EDA protocol checks

Analysis Tool – EDAPT Integration

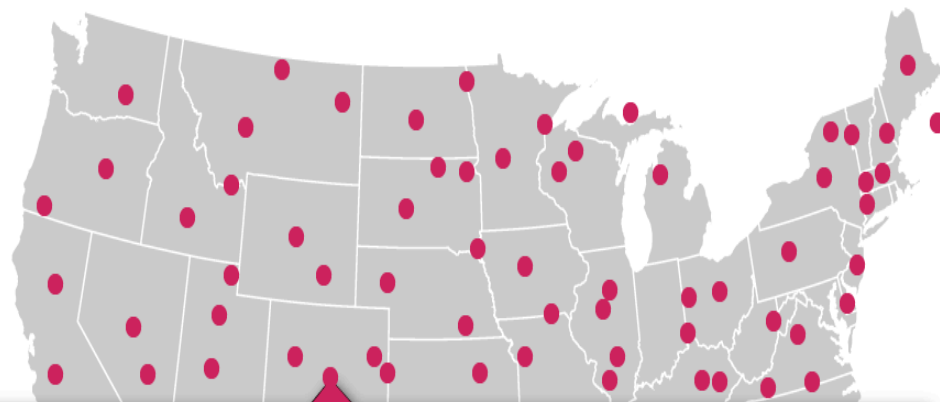


EDAPT project data + OpenStudio output = Generated documents

DOE's Goal – National Impact

EDAPT Benefits to Xcel Energy's new construction program:

- Administrative savings of \$500,000 per year
- Xcel's 2014 program savings goal of 40 GWH (up from 30 in 2013)
- 90 new projects (up from 70 in '13)
- 8 energy consultant firms (up from 2 in 2013)
- Anticipated 50% reduction in modeling time and cost from AEDG Measures



NREL is working with:

- Austin Energy
- Com-Ed
- CPS (San Antonio)
- Duke Energy
- National Grid and others

Toward:

- FY15 adoption of EDAPT for EDA and retrofit programs

Xcel Energy: Colorado Current Current Projects XXX
Participating since 2013

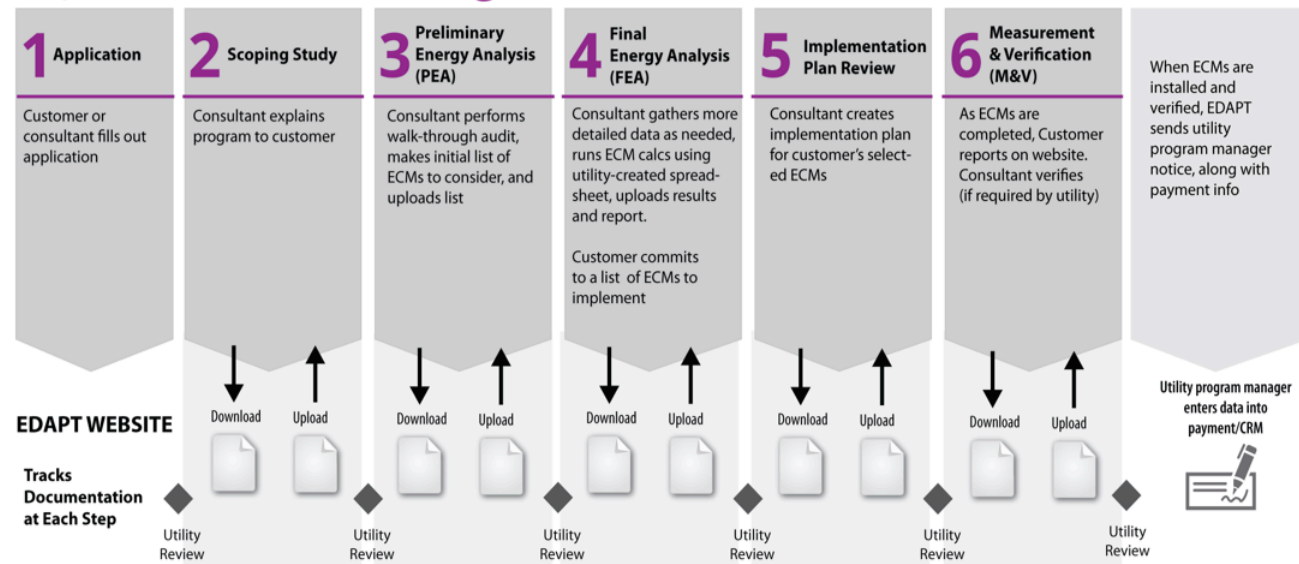
	# of New Constructions	# of Retrofits	Predicted Electric Savings (GW)	Predicted Gas Savings (Dth)
Office	XX	XX	XX	XX
Retail	XX	XX	XX	XX
Strip Mall	XX	XX	XX	XX
School	XX	XX	XX	XX
Restaurant	XX	XX	XX	XX
Warehouse	XX	XX	XX	XX
Hotel/Motel	XX	XX	XX	XX
Hospital	XX	XX	XX	XX
Supermarket	XX	XX	XX	XX
Apartment	XX	XX	XX	XX
Other	XX	XX	XX	XX

Top Energy Efficiency Measure Terms

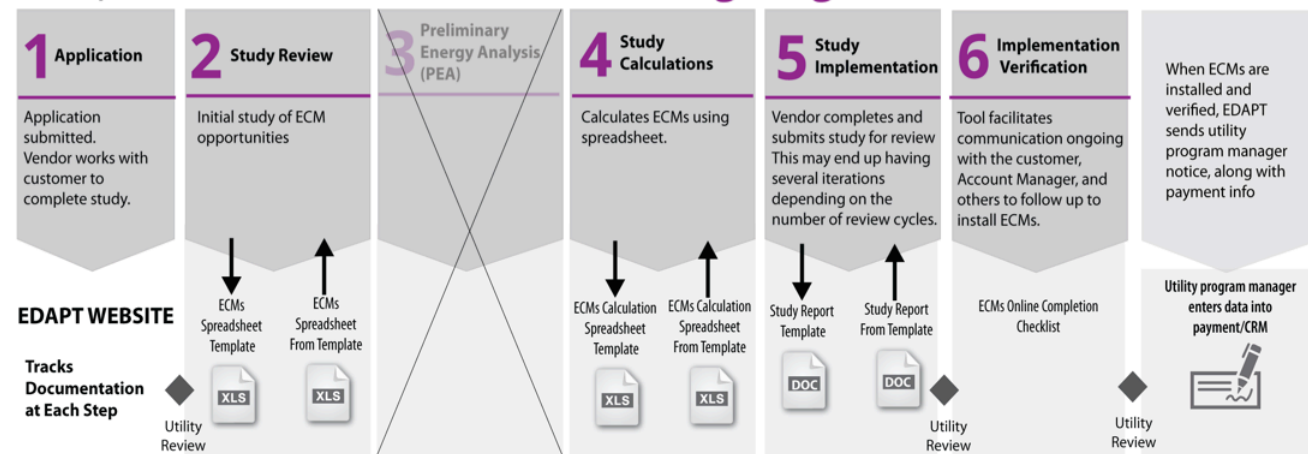
Word cloud terms: overhang, skylight, controls, lighting, glazing, insulation, window-to-wall, equipment, occupancy, vacancy, rotation, something, efficiency, furnace, occupancy, plugload.

Retrofit Extensions

Steps in EDAPT Retrofit Program Workflow



Example Workflow: Xcel Recommissioning Program Workflow



Credit: Marjorie Schott, NREL