Better Buildings
U.S. DEPARTMENT OF ENERGY

Announcing New Resources to Help You Evaluate Technologies and Design Options

Larry Brackney, *NREL*
Tyler Dillavou, *Bonneville Power Administration*
Jennifer Elling, *Xcel Energy*
Daniel Studer, *NREL*

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Introduction to the Technology Performance Exchange™ (TPEx™)

Daniel Studer, NREL

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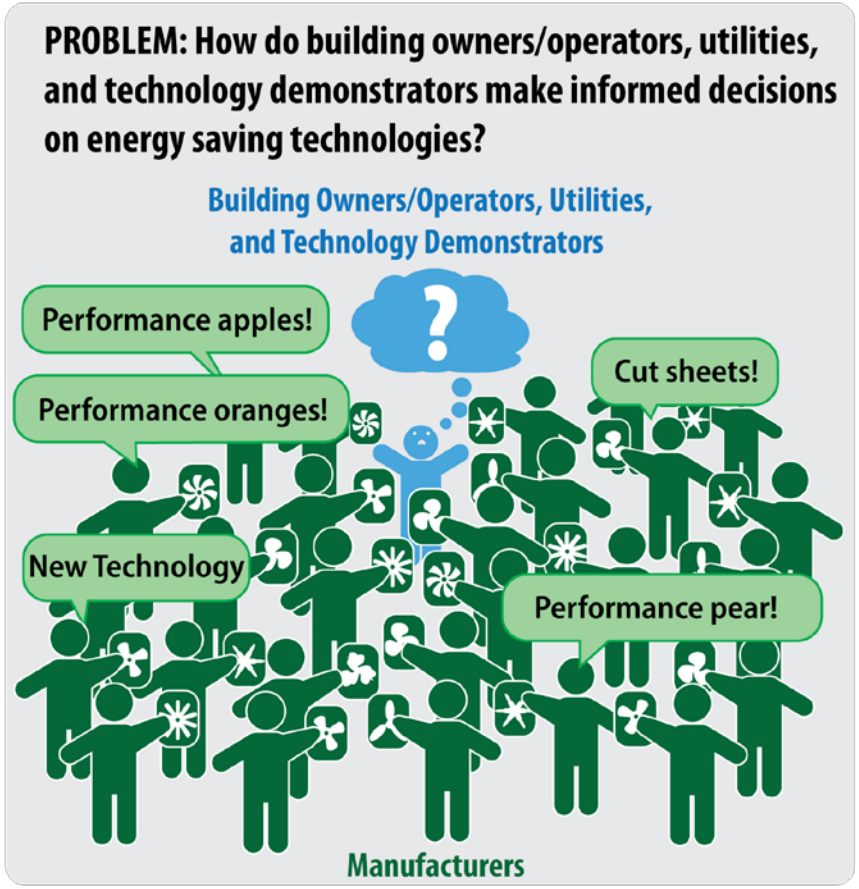
TPEx: The Current State



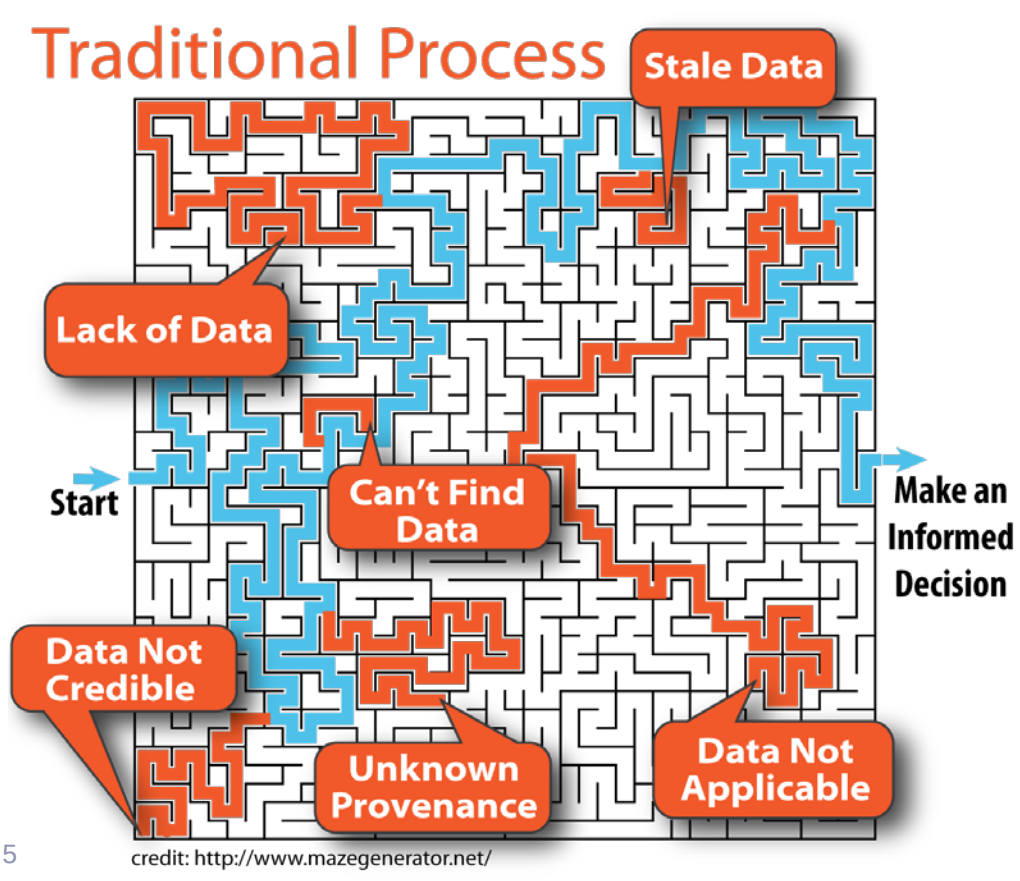
Credit: Marjorie Schott, NREL

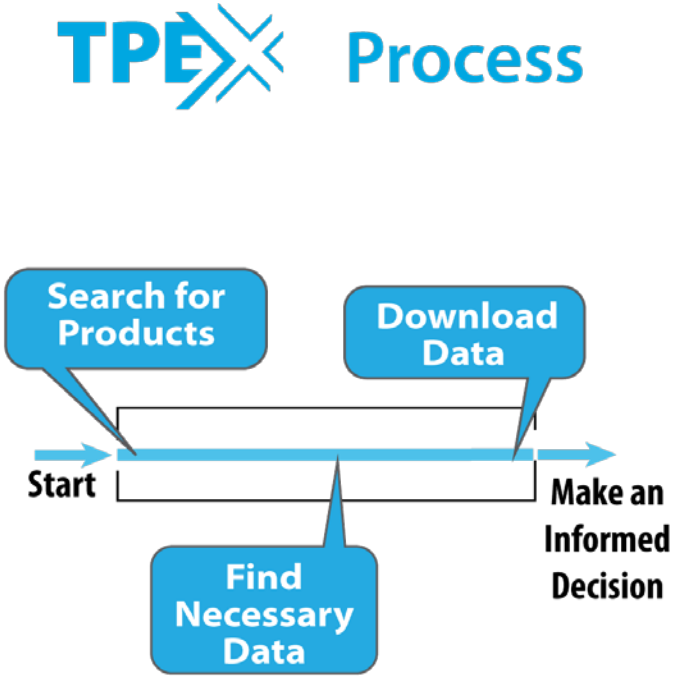
TPEx: The Approach

- 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

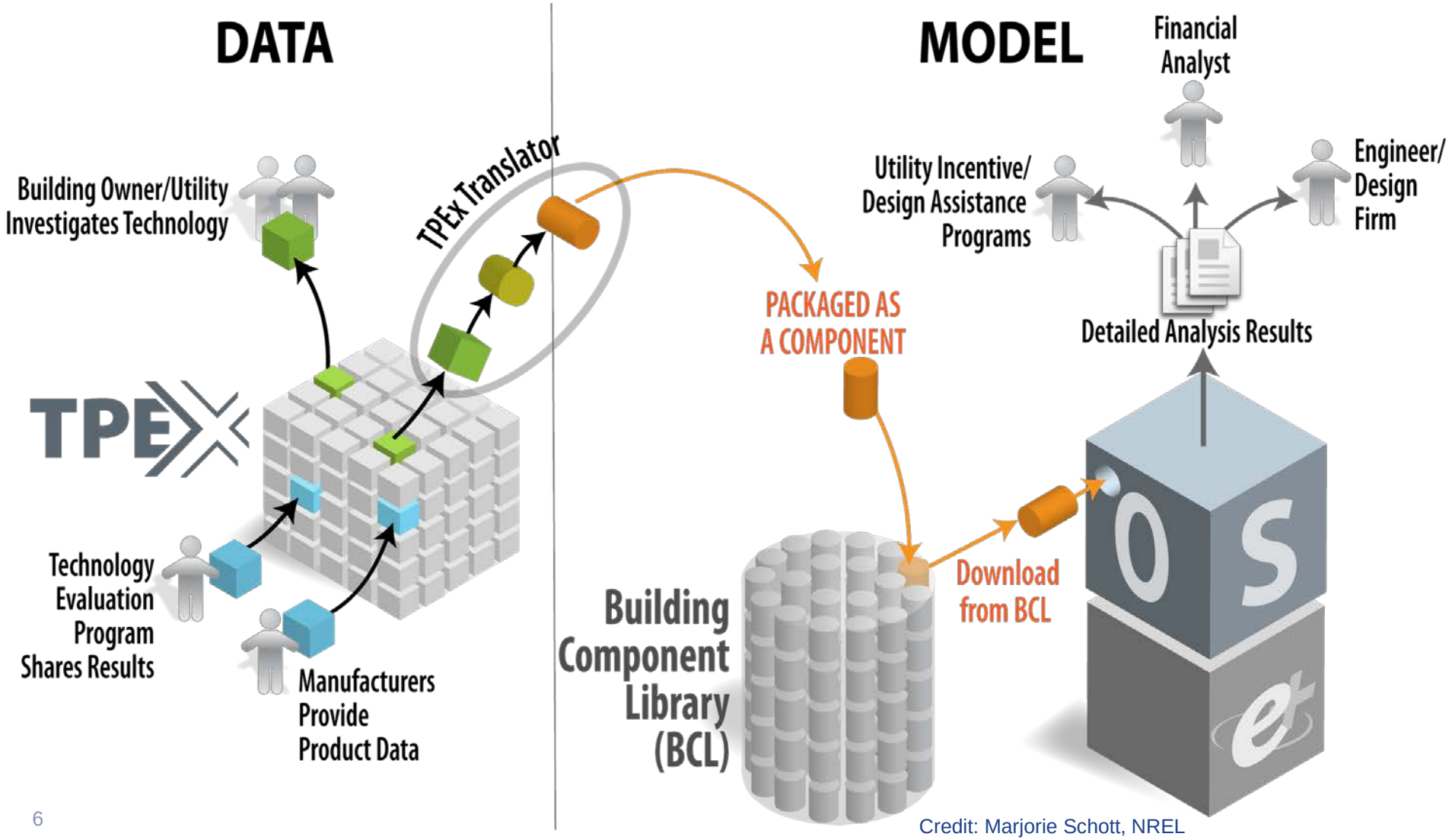
- Necessary energy performance data are easily accessible
  - Reduce investment risk
  - Drive uptake of cost-effective efficiency measures





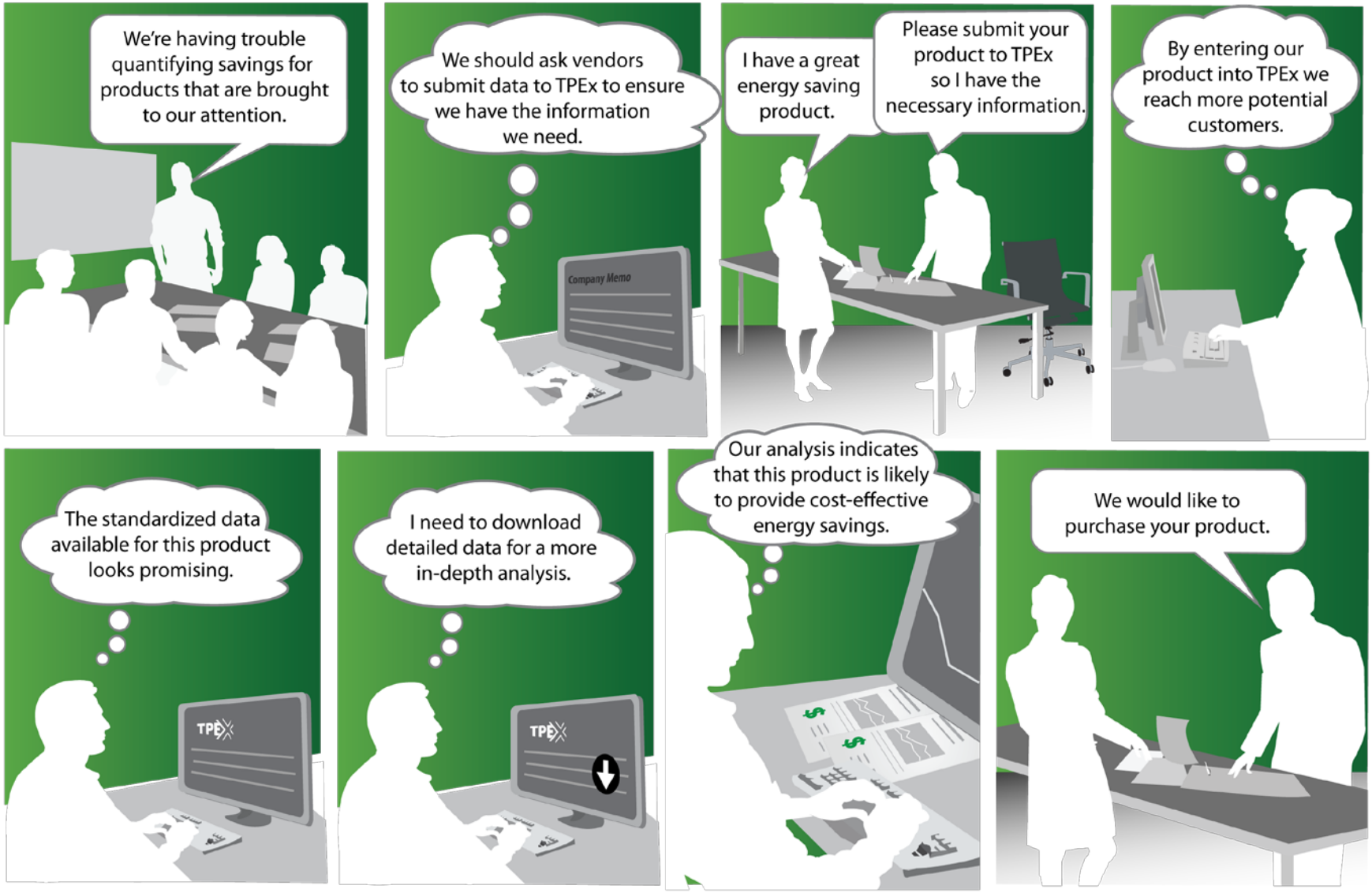
Credit: Marjorie Schott, NREL

TPEx: An Integrated Ecosystem



Credit: Marjorie Schott, NREL

TPEx: The Data Value Proposition



Credit: Marjorie Schott, NREL

TPEx: Demonstration

TPEx.org

TPEx User Perspective: Building Owners

Scott Williams, Target
Jim McClendon, Walmart

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TPEx User Perspective: Manufacturers

Kevin McNamara, LG Electronics USA

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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/ft2)	13.5	12	21	17	–
VRF with heat recovery (kBtu/ft2)	9.5	7.5	10	10.5	–
Percent savings	**30%**	**38%**	**52%**	**38%**	**39%**
RTU with economizer ($/ft2)	$0.54	$0.18	$0.59	$0.51	–
VRF with heat recovery ($/ft2)	$0.39	$0.14	$0.44	$0.33	–
Savings ($/ft2)	$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

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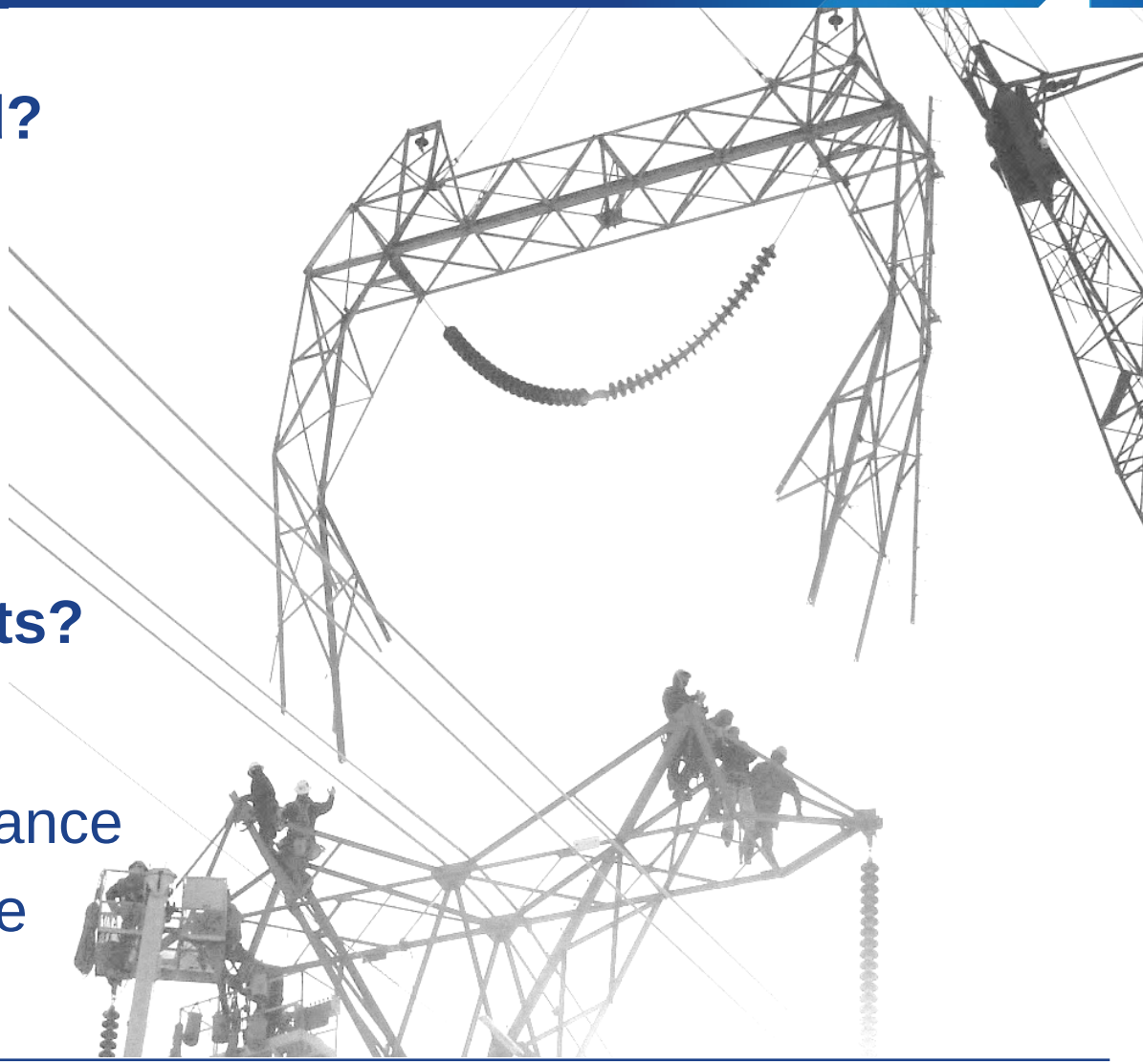
Utilities are a stakeholder in building design and use.

How is energy used?

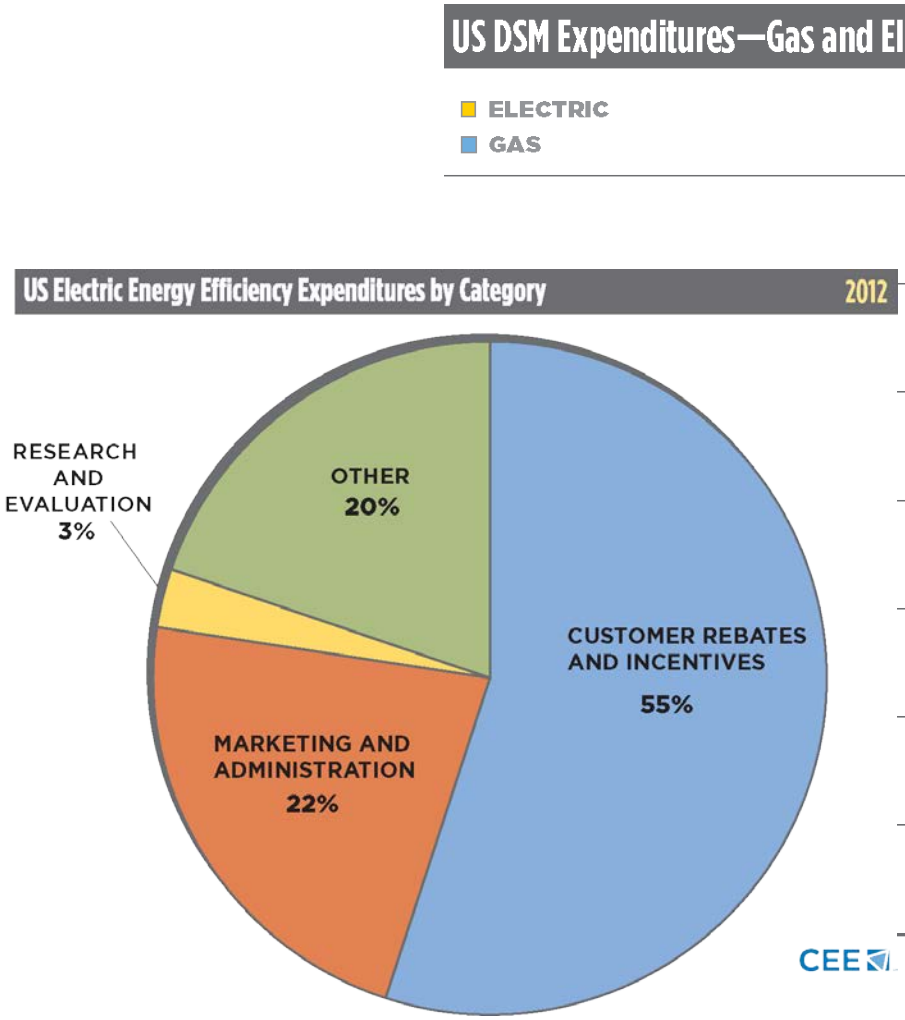
- Base load
- Peak demand
- Power quality
- Long-term trends

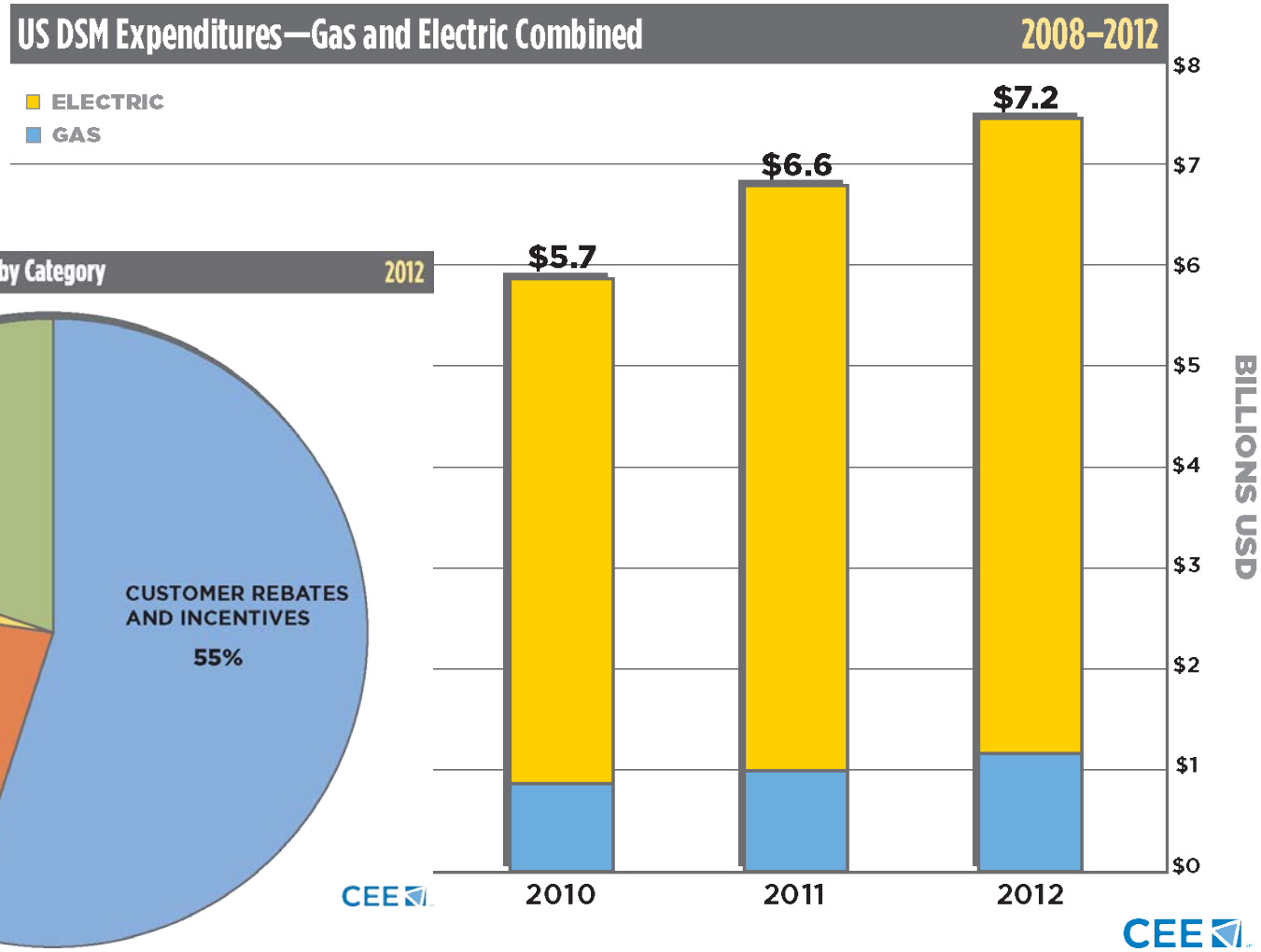
What are the impacts?

- Rate design
- Regulatory compliance
- Capital expenditure



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





CEE

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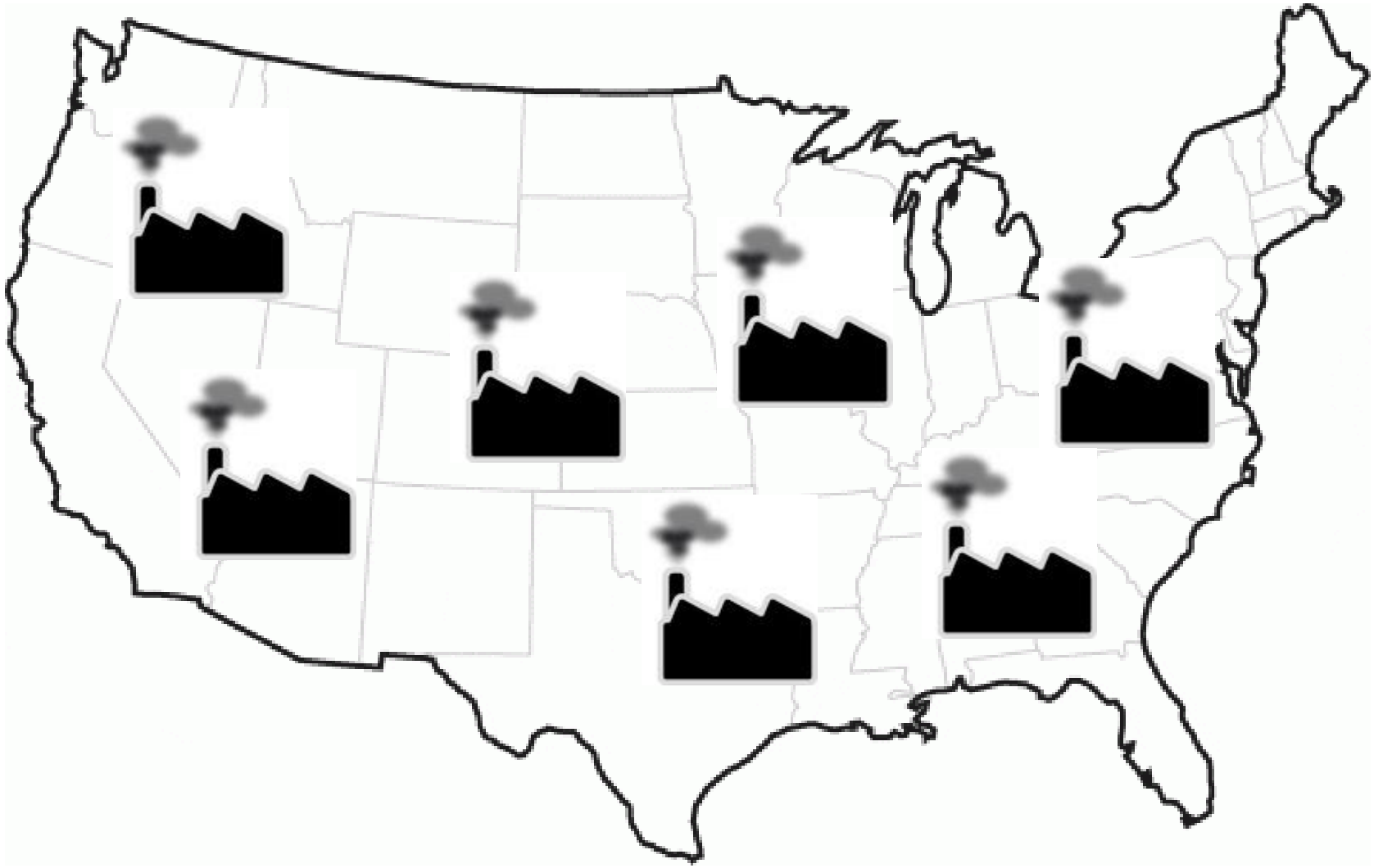
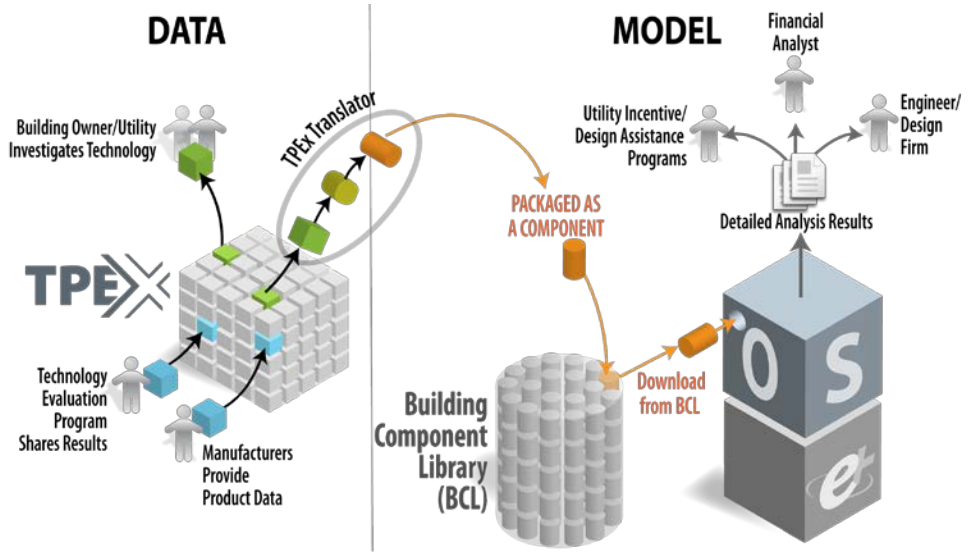
$6 billion of that was spent by electric utilities, to conserve seven Rosenfelds of energy…



…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																								
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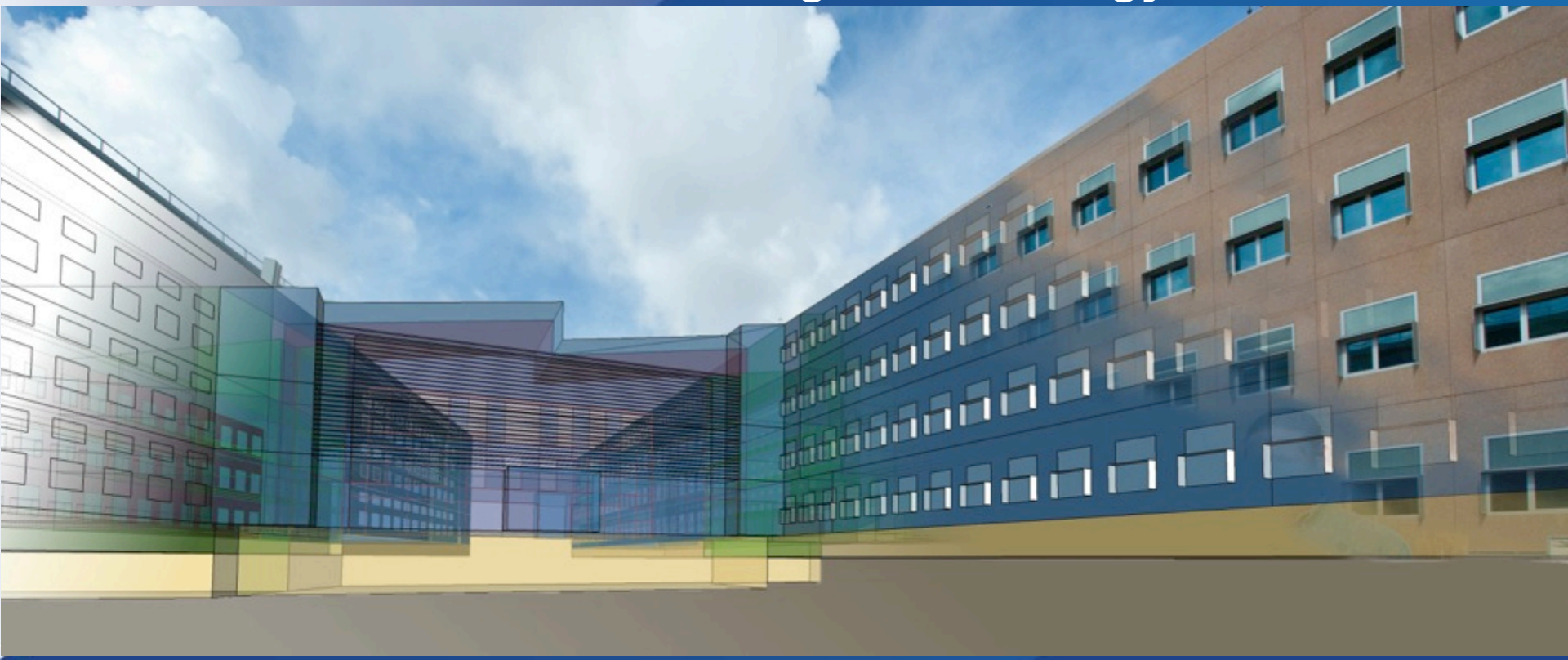
	4.4°C/2.2°C																								
	7.2°C/5.0°C																								
	8.3°C/6.1°C																								
	10.0°C/7.8°C																								
	12.8°C/10.6°C																								
	15.6°C/13.3°C																								

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

Dr. Larry Brackney, NREL
Jennifer Elling, Xcel Energy



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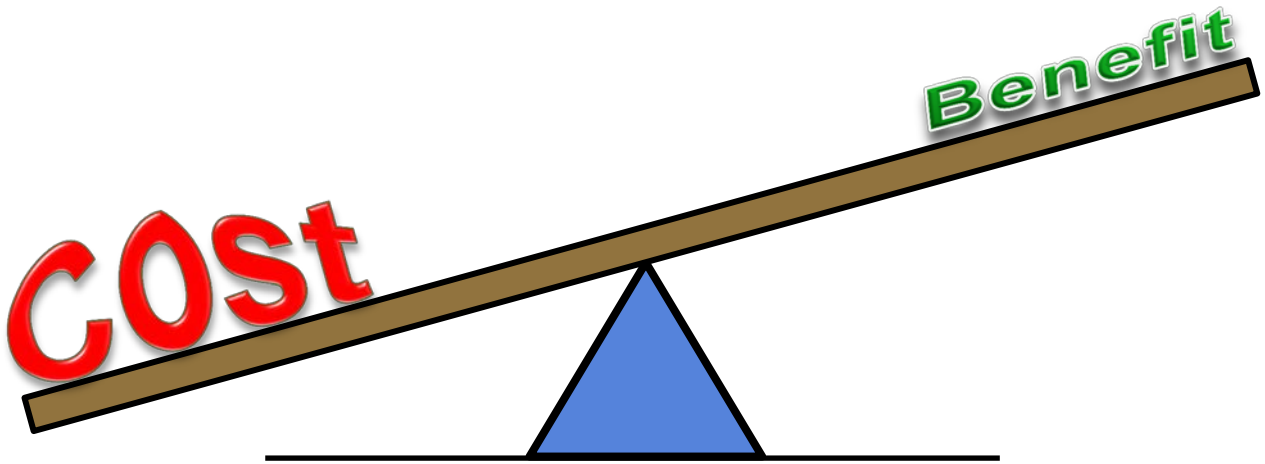
Agenda

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

The Problem with Energy Modeling

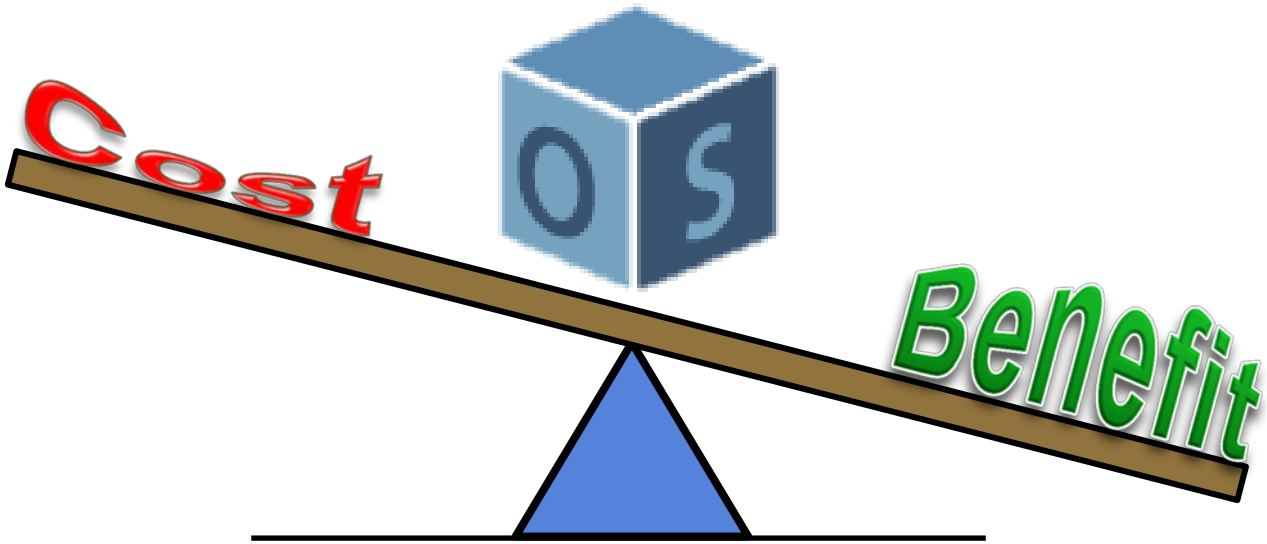


- **Highly specialized skillset**
- **Tools are too hard to use**
- **Every building is different**

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**

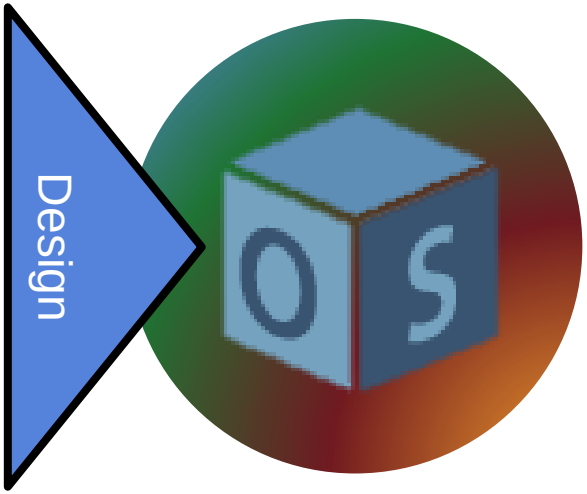
Outcomes:

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

OpenStudio: A Platform That Supports All Stakeholders

A&E Firms

- More projects
- Reduced costs
- Greater workforce engagement



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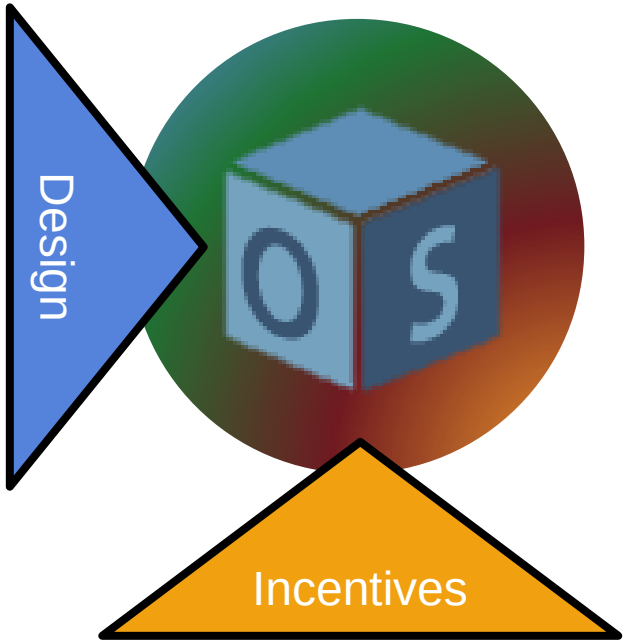

Utilities

- Reduced costs
- Reduced risk
- Greater realization rates

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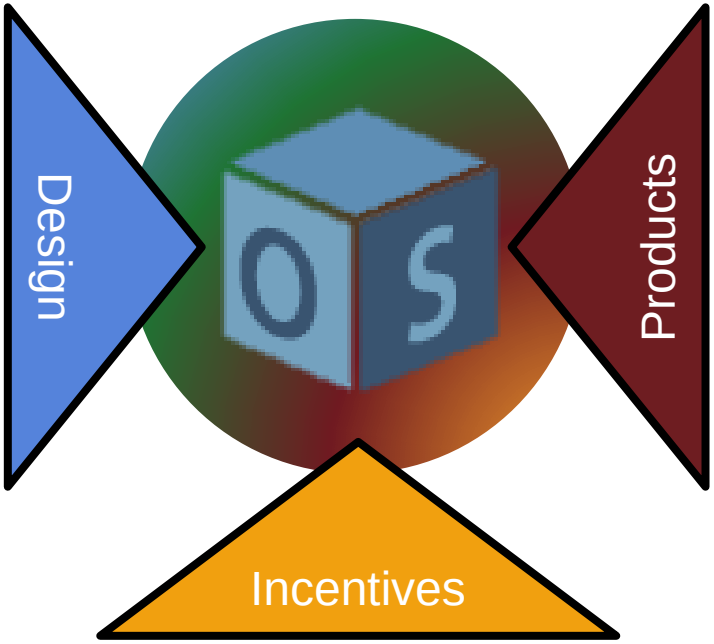

Manufacturers

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

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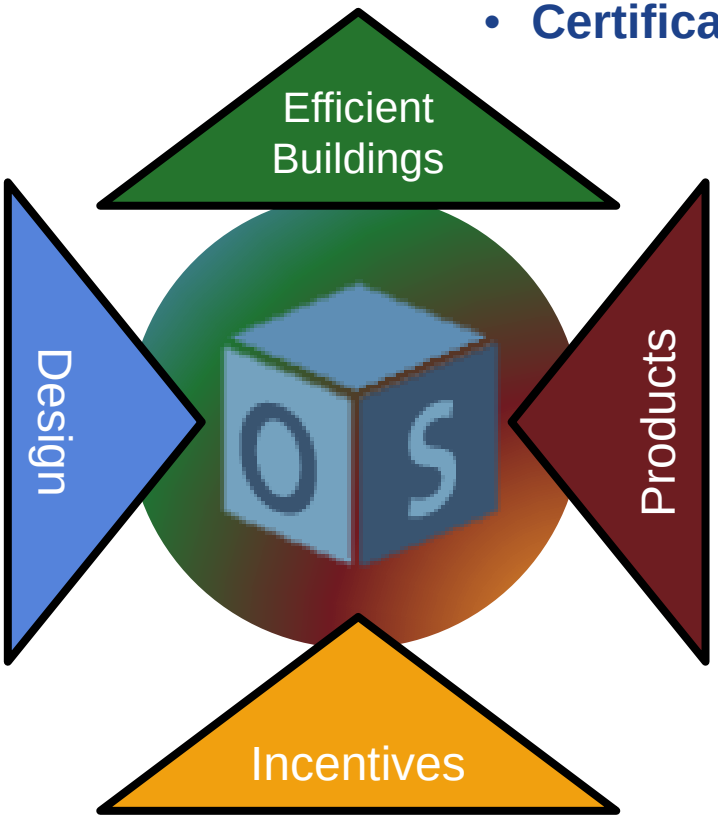
OpenStudio: A Platform That Supports All Stakeholders

Owners

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



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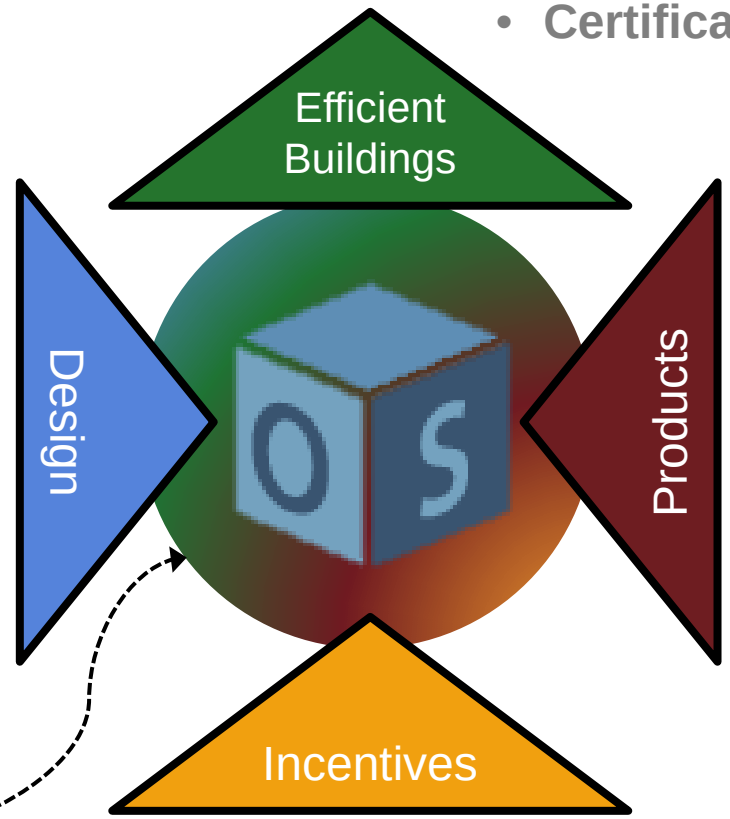

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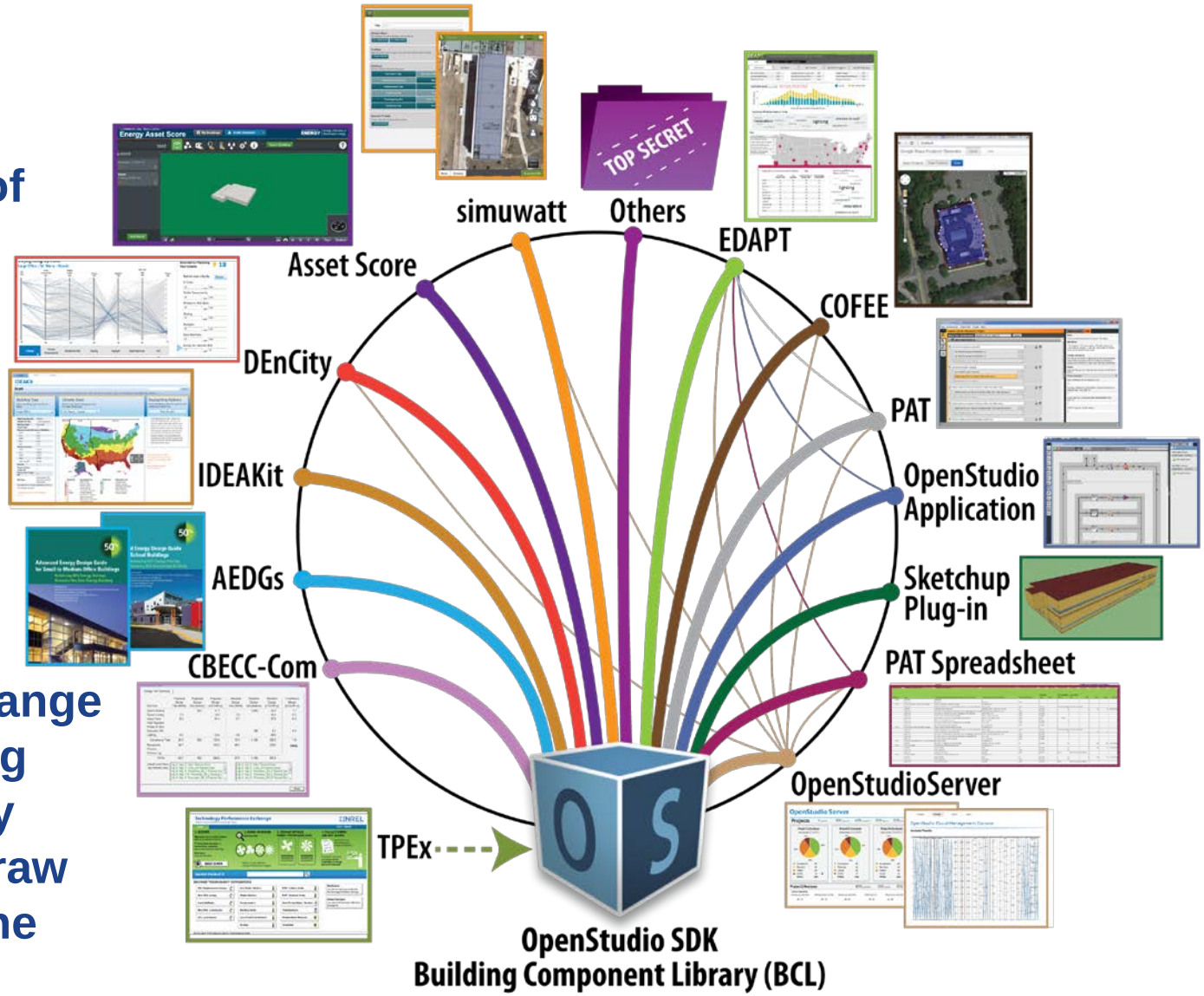
R&D Geeks too!

Utilities

- Reduced costs
- Reduced risk
- Greater realization rates

OpenStudio – Not a Single Tool

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

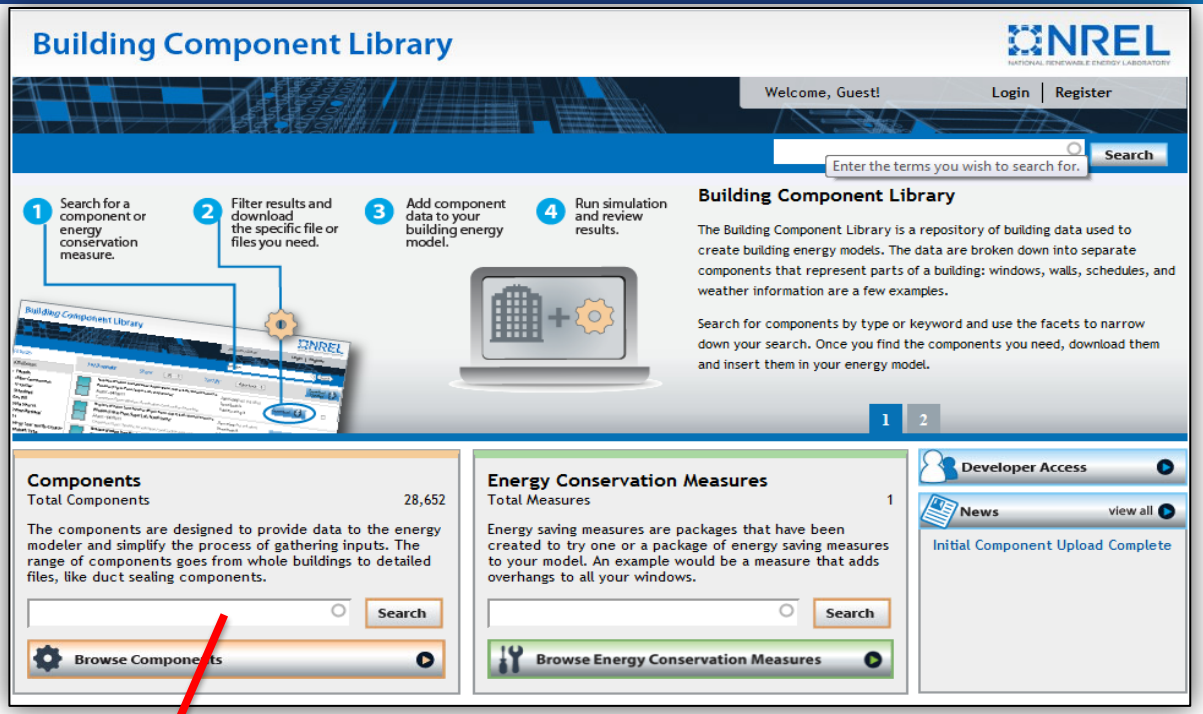


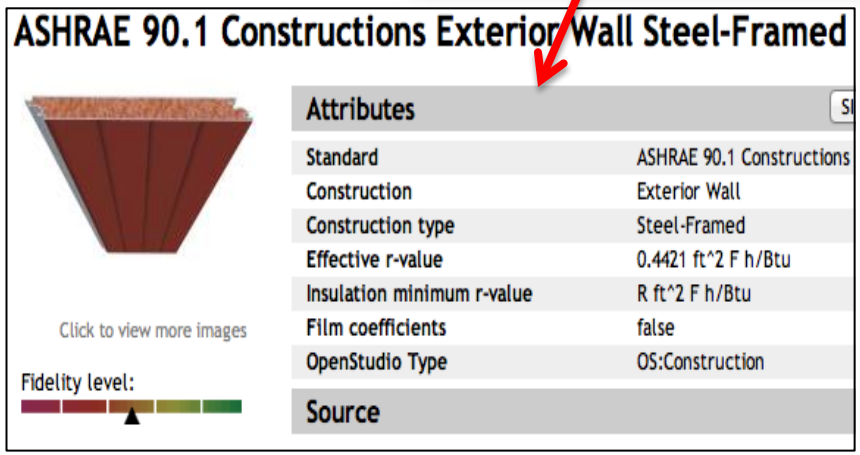
The Technology Performance Exchange (TPEx) and Building Component Library (BCL) provide the raw data that powers the ecosystem.

Credit: Marjorie Schott, NREL

The BCL: A Source for Reusable Input Data

Components are used to quickly build complete models





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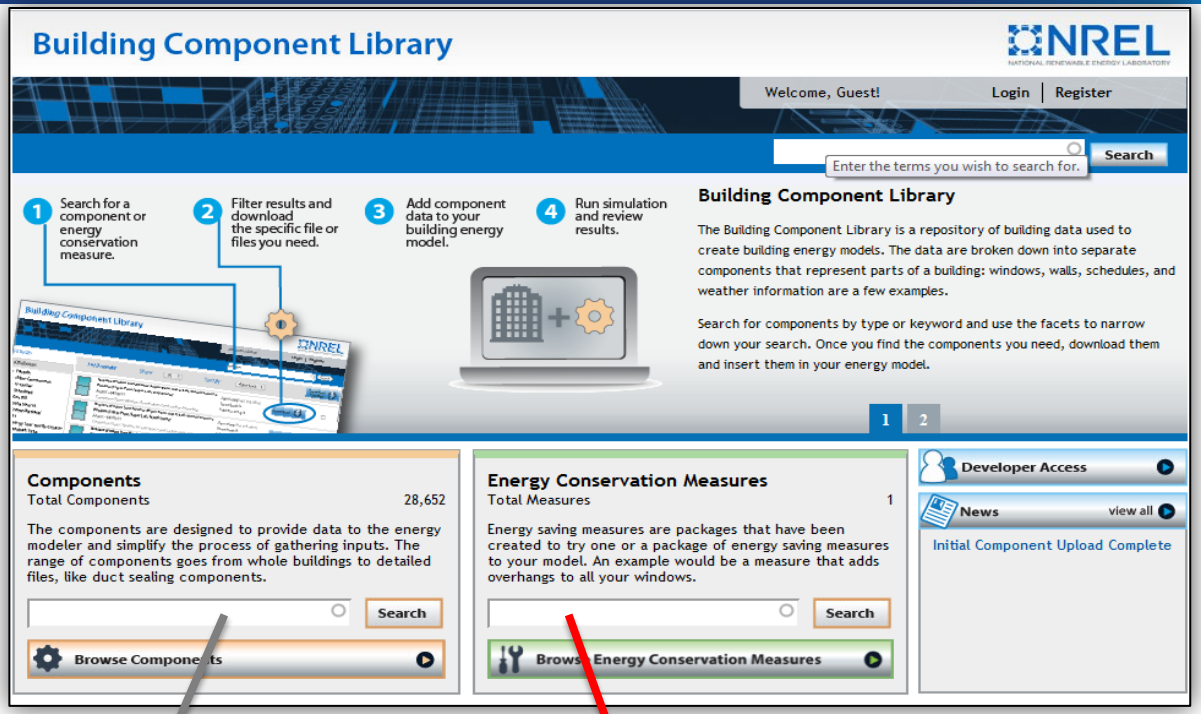

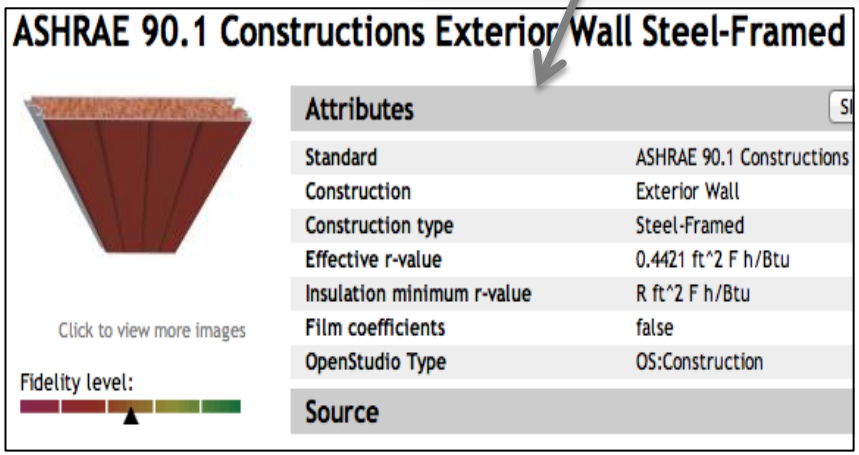

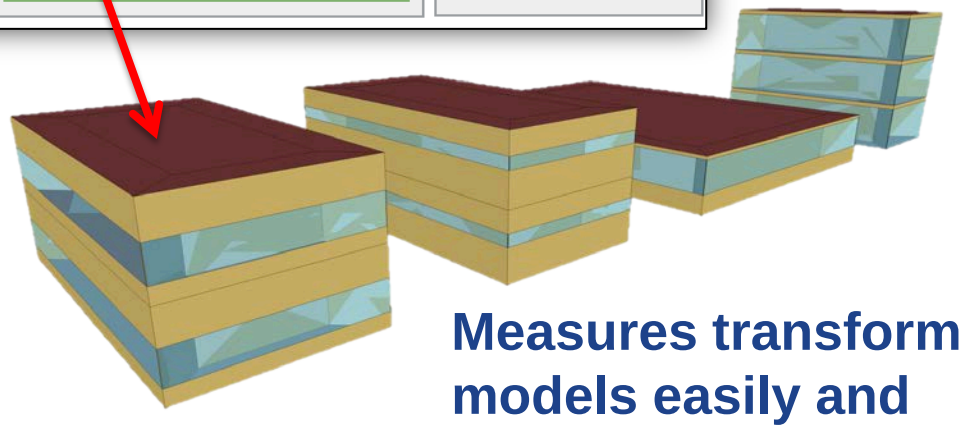

Measures transform models easily and consistently

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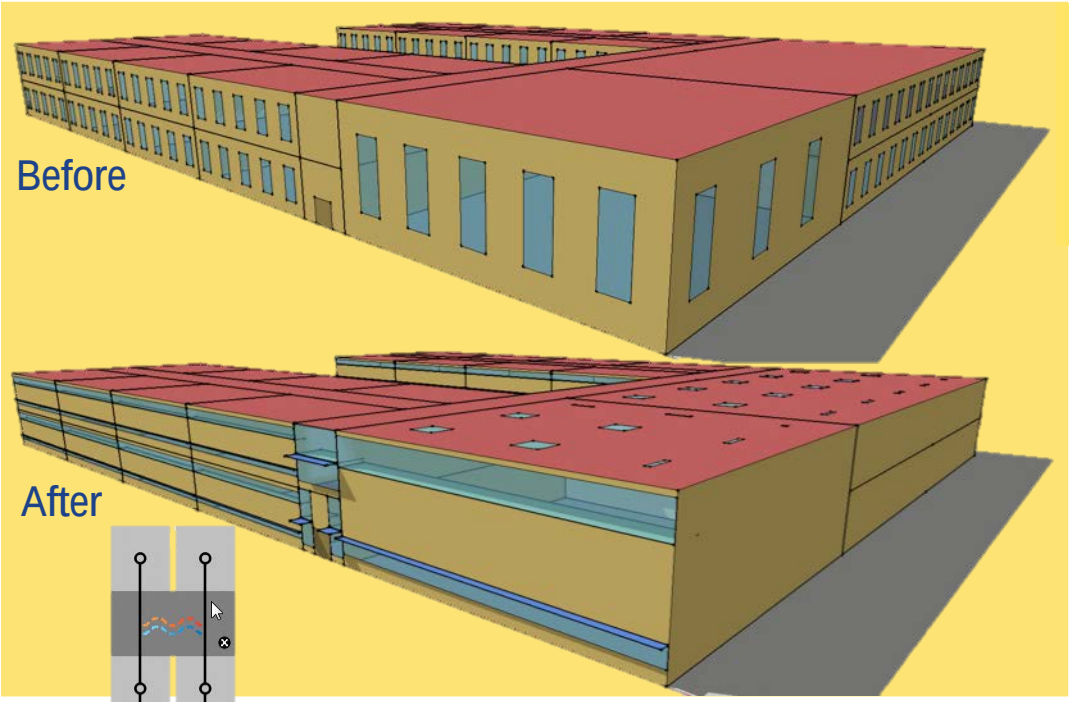
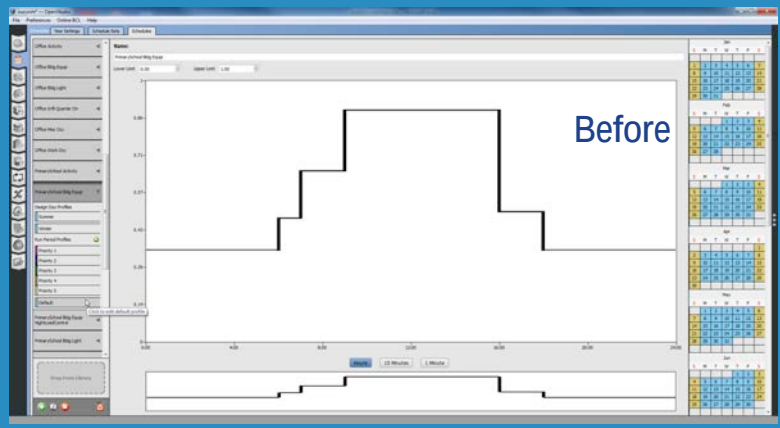
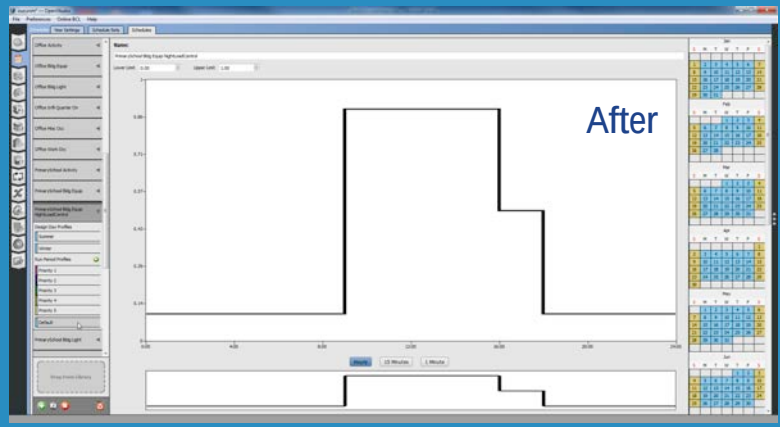
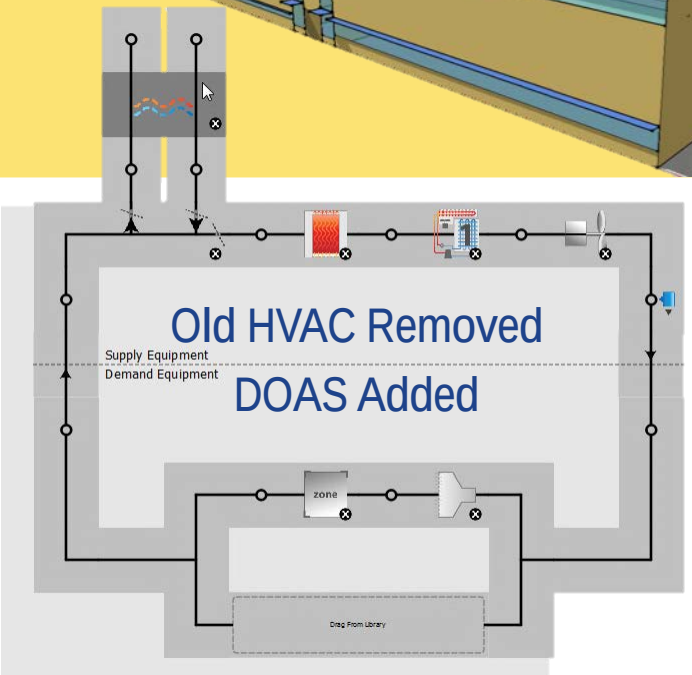
Sample Measures for Rapid Design



Daylighting Measure Package Applied







Night Setback Schedule Applied

simuwatt: OpenStudio-Based Low-Cost Auditing Tool

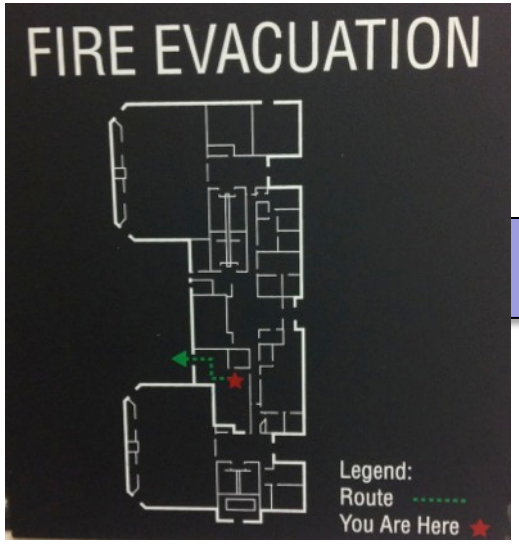


Photo of on-site evacuation plan

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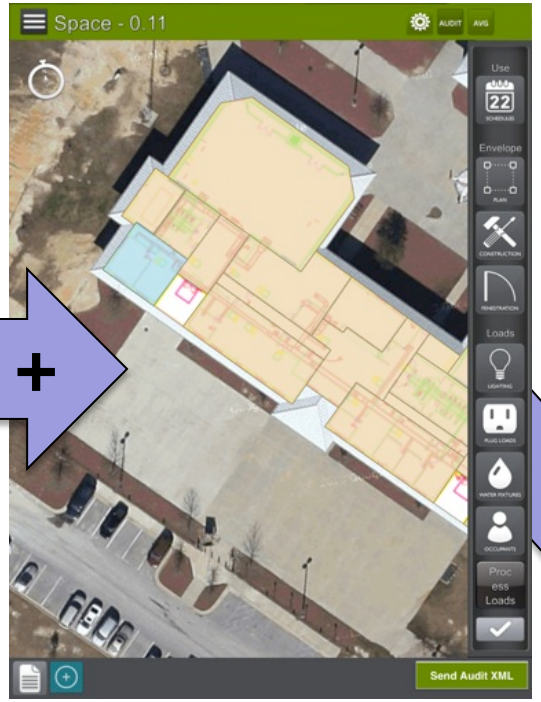
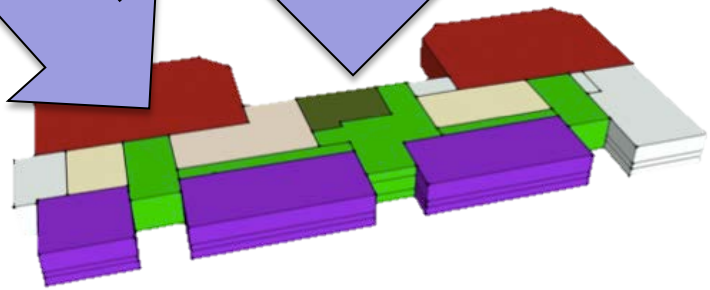


Google Maps satellite imagery

BCL Components



Ft. Jackson Bldg 10400

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

simuwatt

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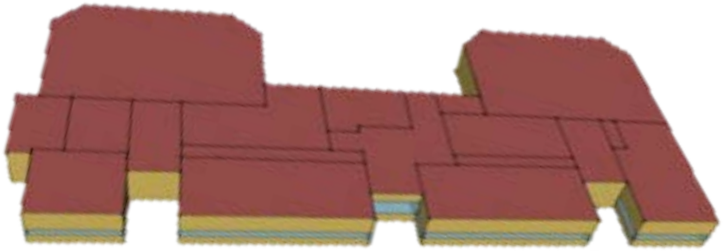
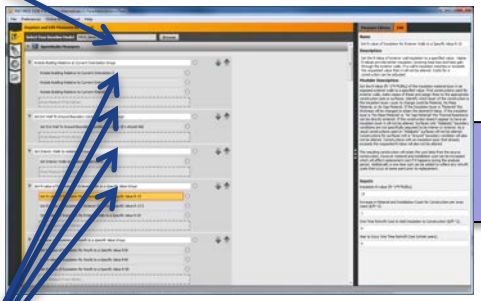
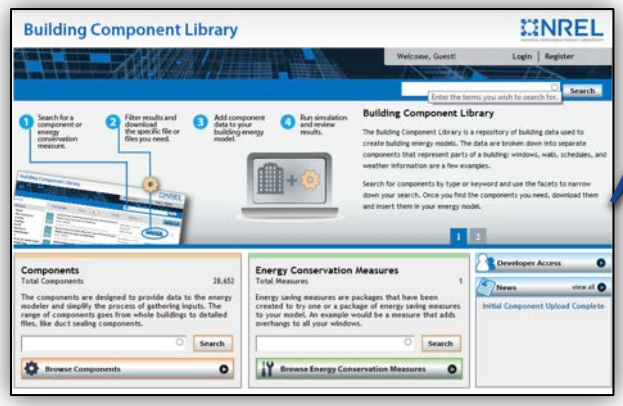
EEM Analysis with simuwatt



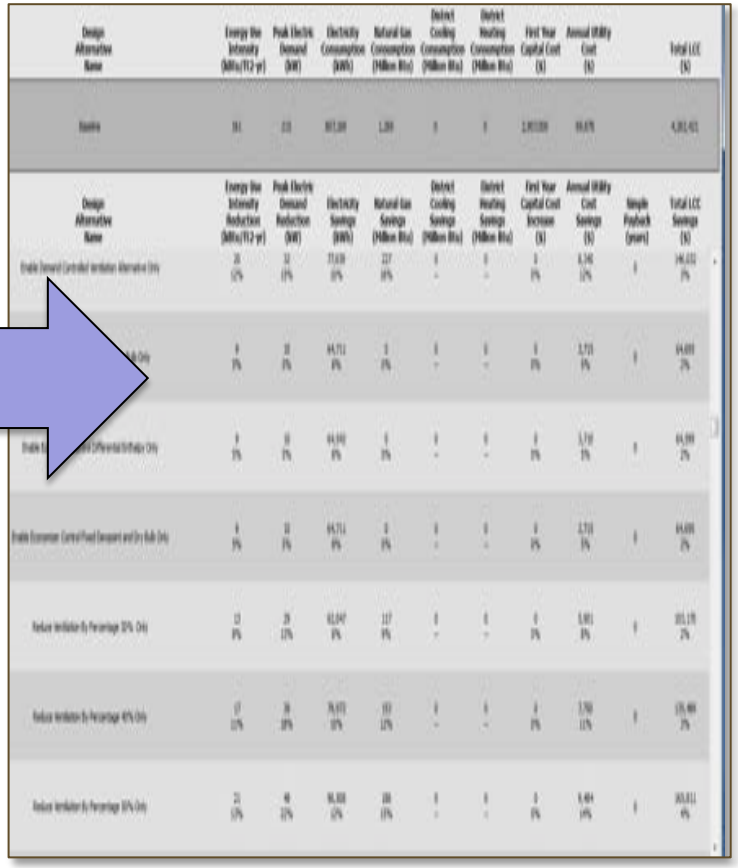
Baseline Model



EEM Comparison Tool



BCL Measures



Ft. Jackson Bldg 10400

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

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New Construction Programs

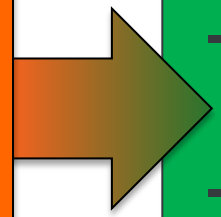
Utility programs that incentivize energy performance beyond code

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

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

Challenges!!

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

Xcel Energy's Solution

1. EDAProjectTracker web service - Lower admin costs

- Automate tracking and approvals
- Streamline communications
- Manages data and communications in one place
- Streamline reporting to regulators

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2. **OpenStudio & EnergyPlus – Reduce modeling time/cost**
   - 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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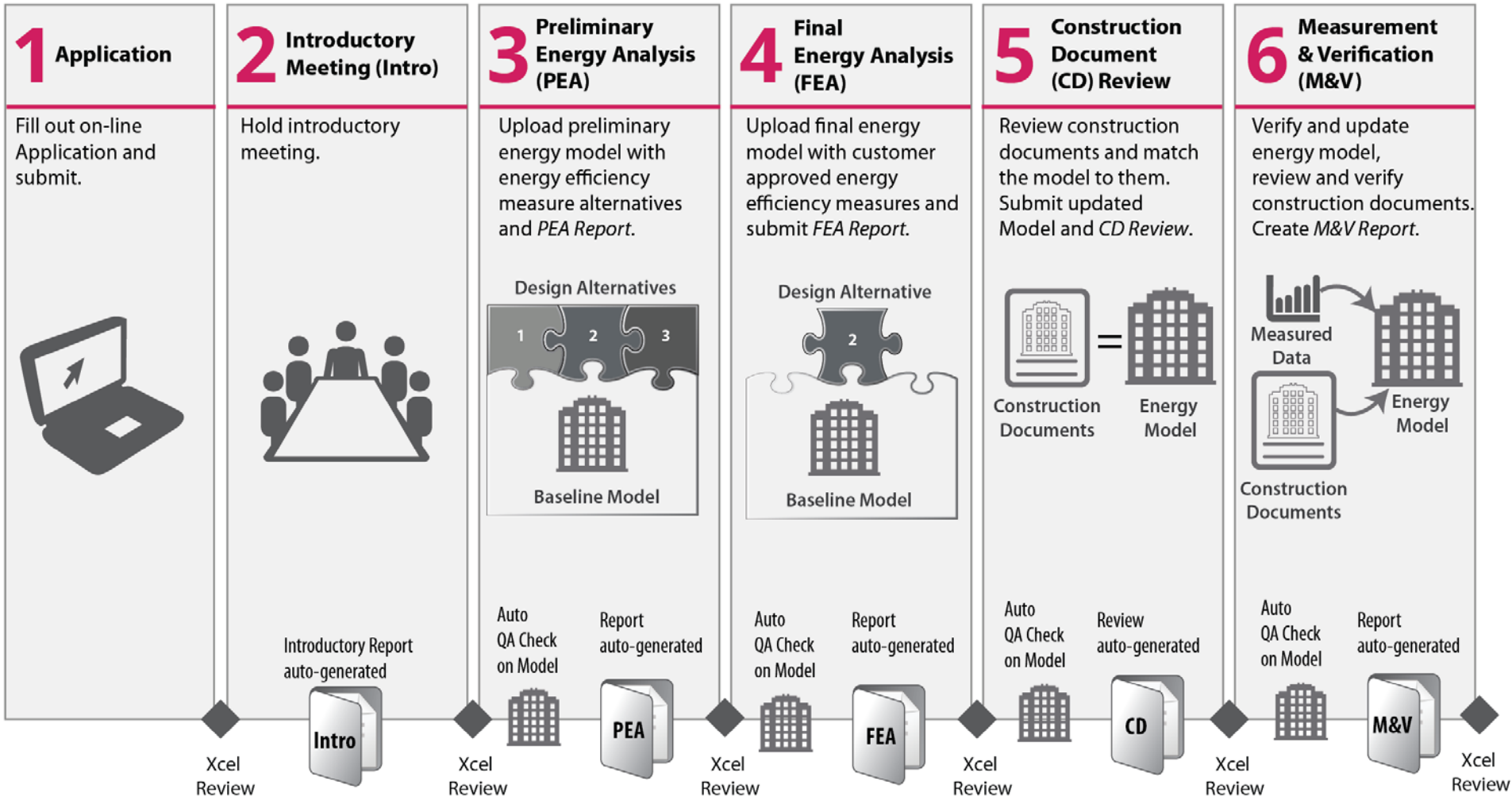
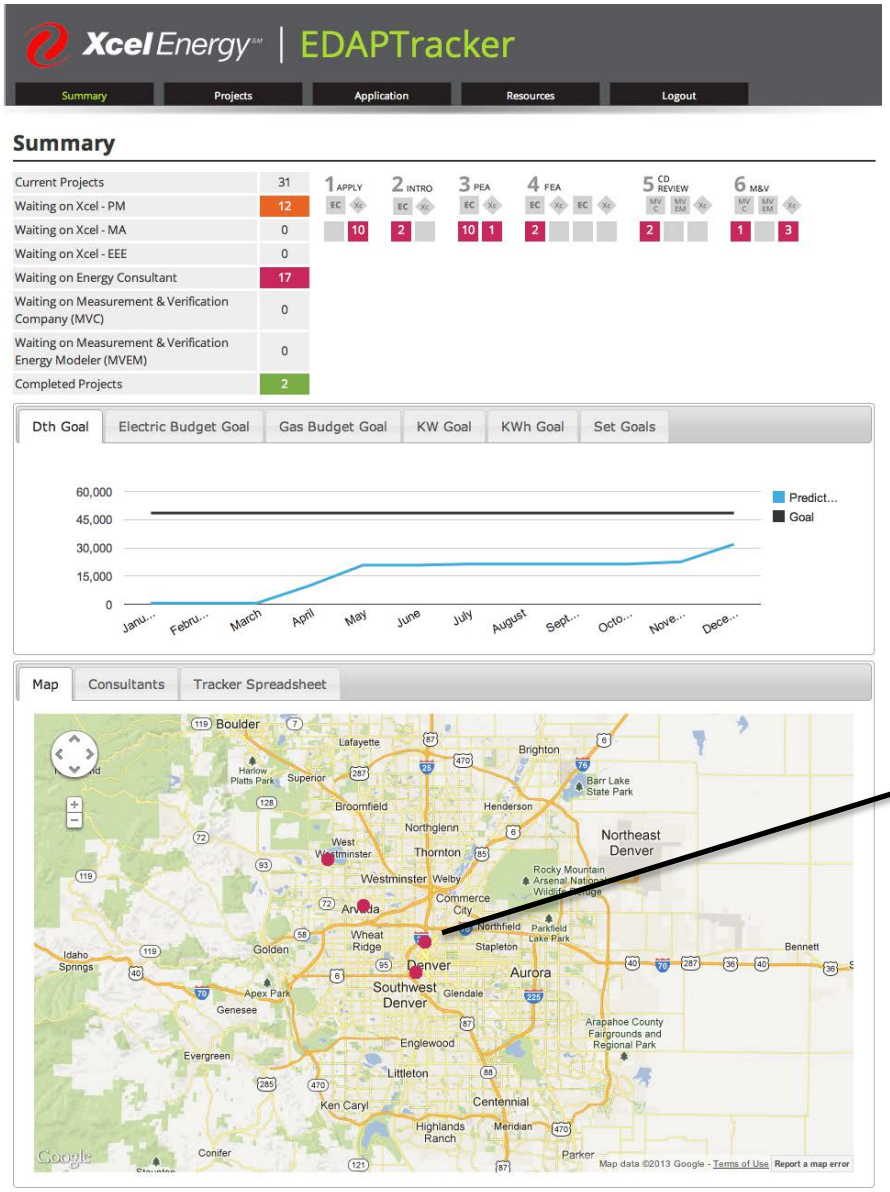
3. **OpenStudio & EnergyPlus - Find deeper savings**
   - Accurately models high performance technologies and interactive effects
   - Expanding library of EEMs to model advanced tech quickly
   - Influence design as early as possible
   - DOE continues to support and add new technologies

Overview of EDAPT Workflow

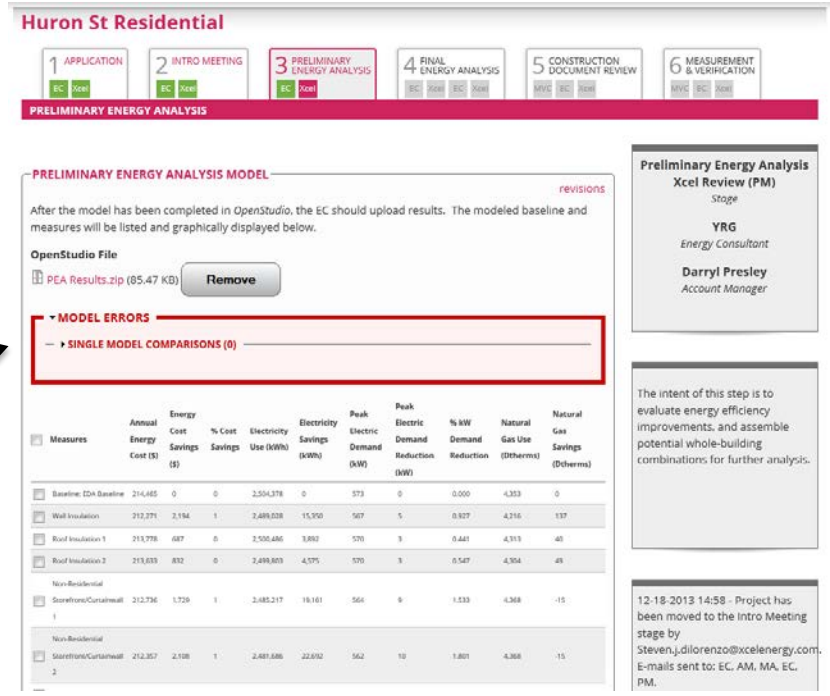


Credit: Marjorie Schott, NREL

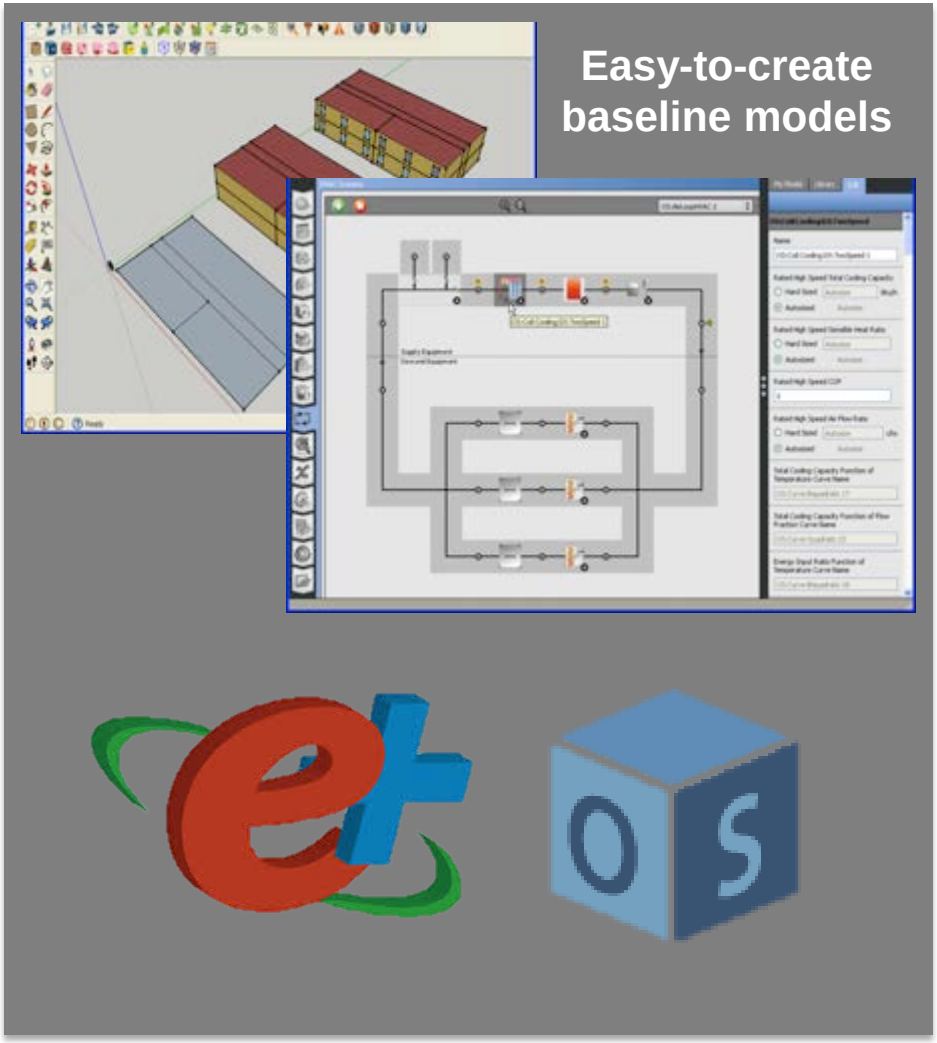
EDAPT Web Service



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

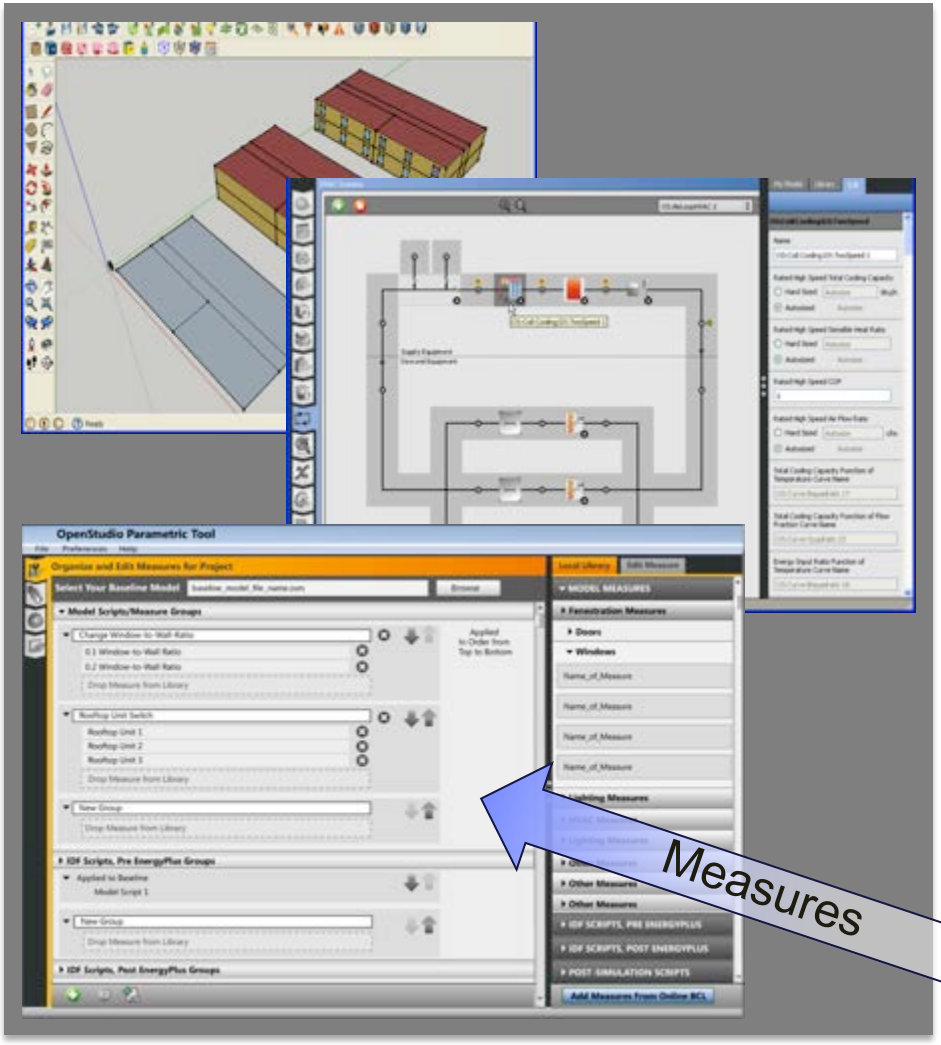


Analysis Tool – EDAPT Integration



- **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



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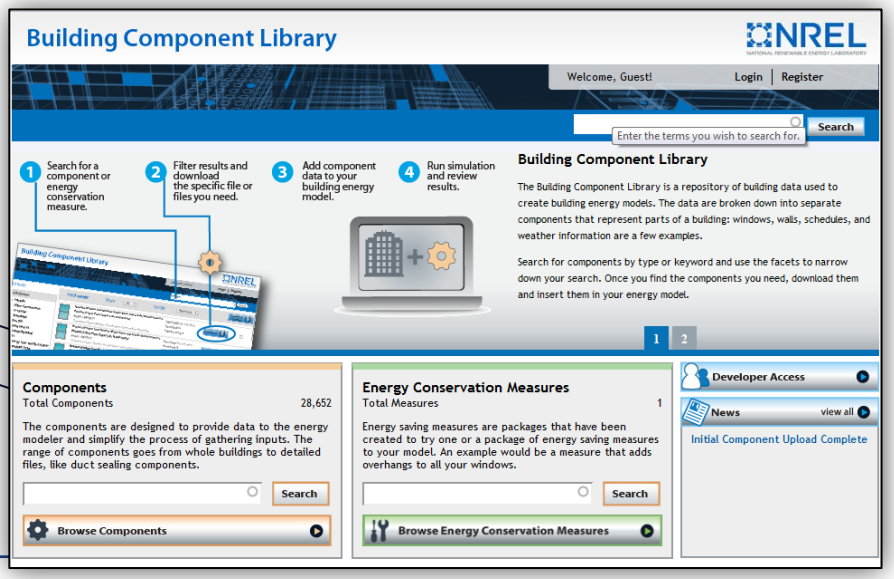
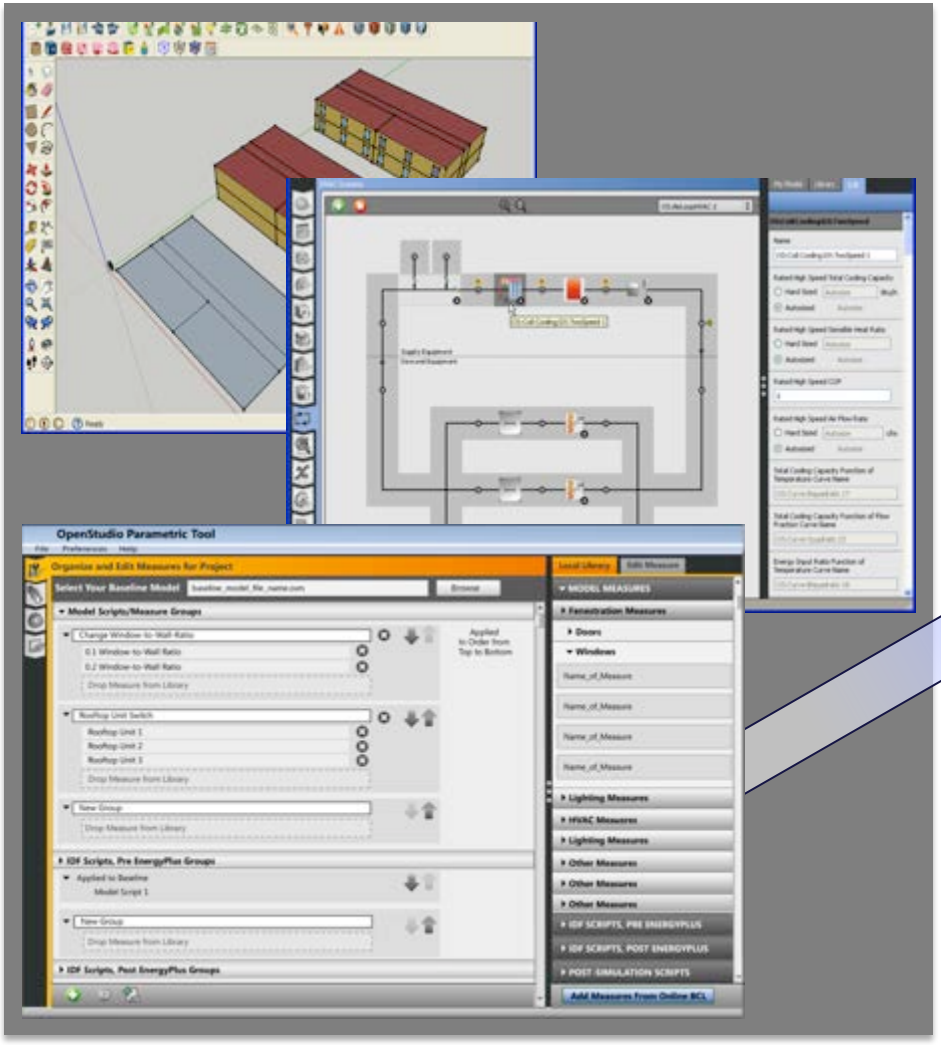


Drag-and-drop EEMs from the BCL make design alternative modeling rapid and repeatable

Analysis Tool – EDAPT Integration



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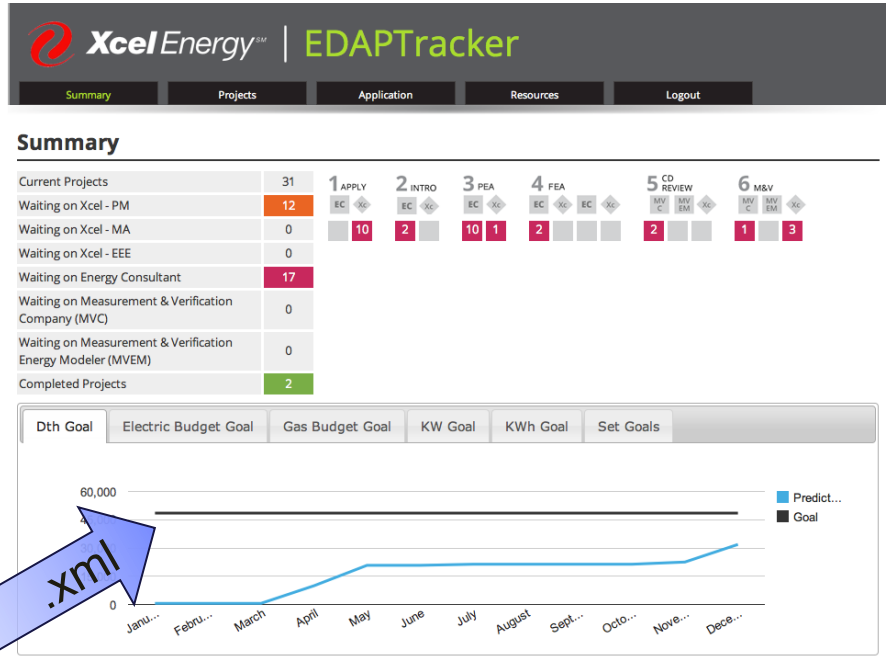
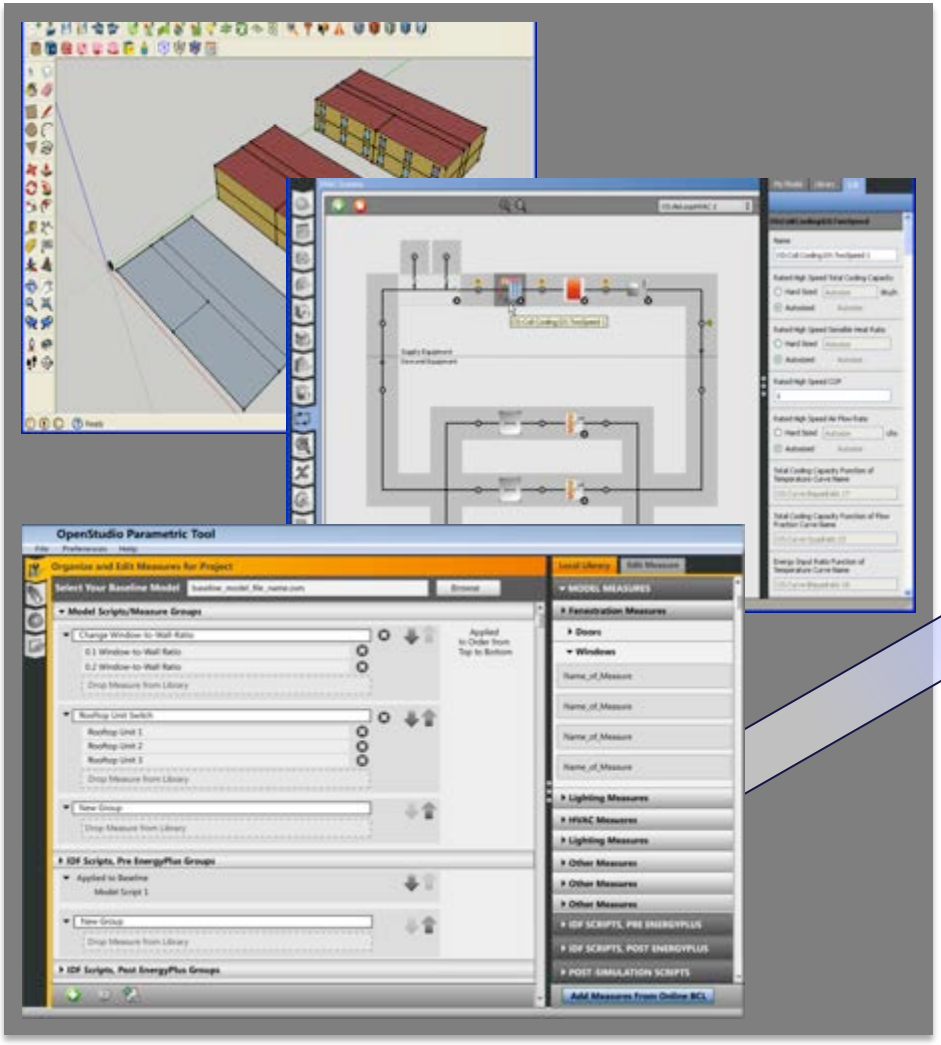
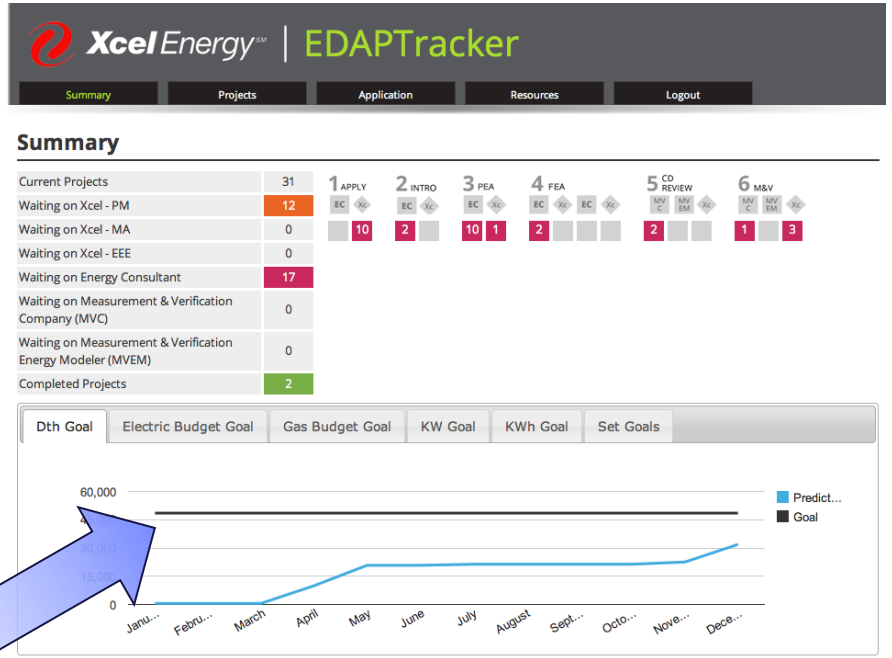
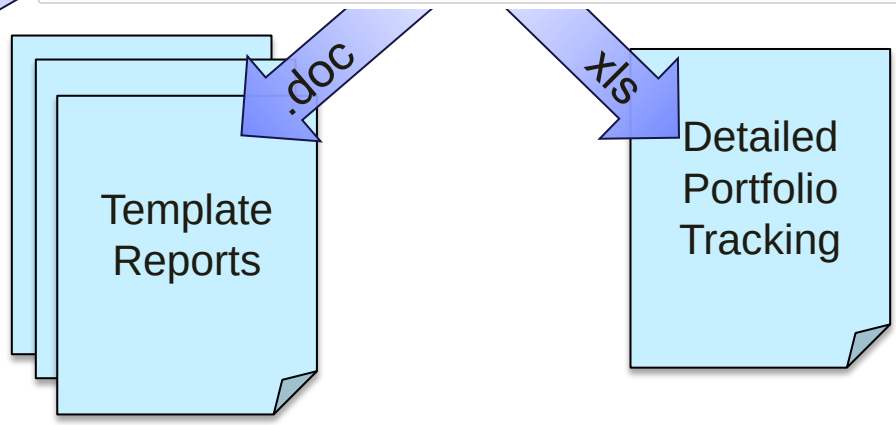


- **OpenStudio packages results for upload**
  - Required simulation results for all design alternatives
  - Automated model quality checks
  - Automated EDA protocol checks

Analysis Tool – EDAPT Integration



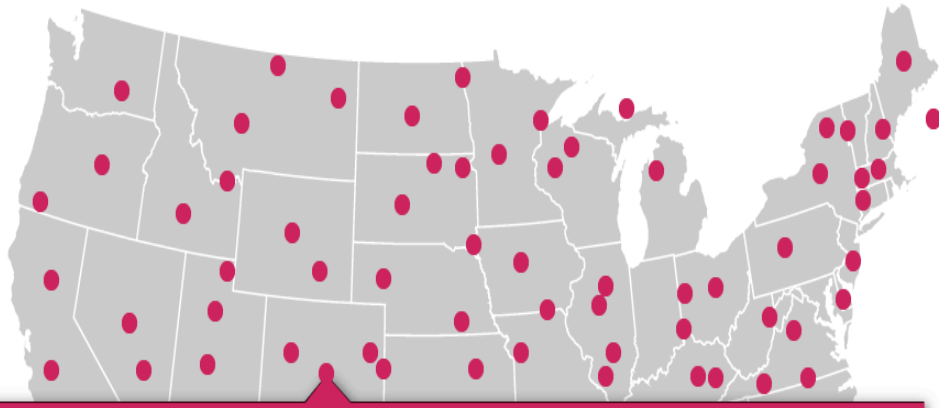




EDAPT project data + OpenStudio output = Generated documents

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

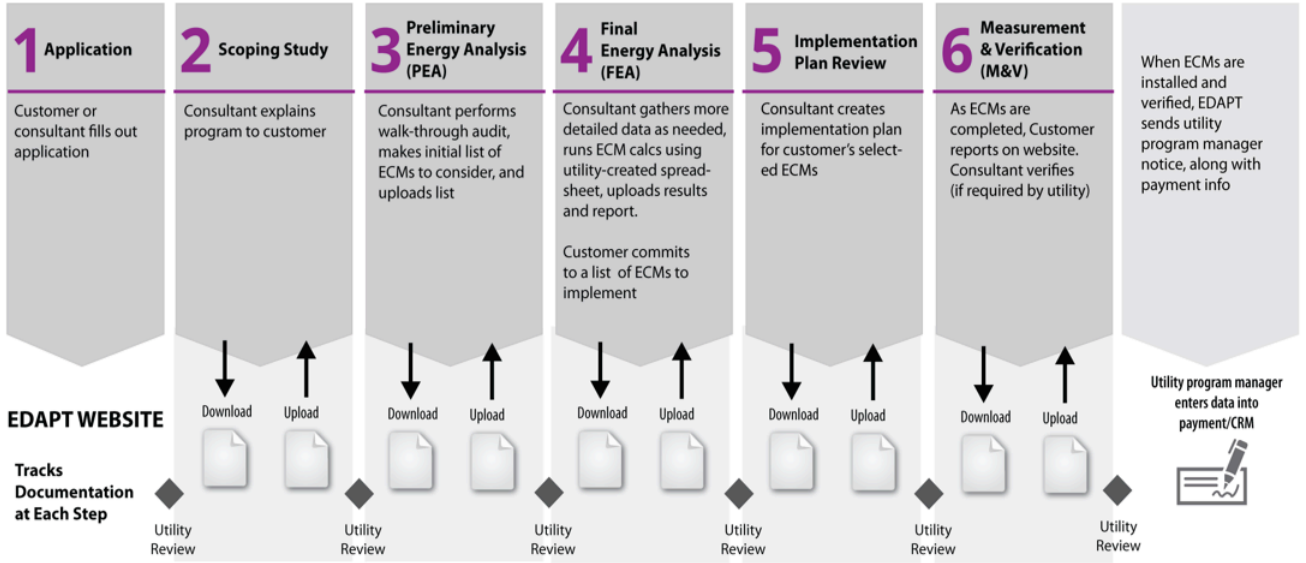
	# of New Constructions	# of Retrofits	Predicted Electric Savings (GW)	Predicted Gas Savings (Dth)
Office	XX	XX	XX	XX
Retail	XX	XX	XX	XX
Strip Mall	XX	XX	XX	XX
School	XX	XX	XX	XX
Restaurant	XX	XX	XX	XX
Warehouse	XX	XX	XX	XX
Hotel/Motel	XX	XX	XX	XX
Hospital	XX	XX	XX	XX
Supermarket	XX	XX	XX	XX
Apartment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

Top Energy Efficiency Measure Terms

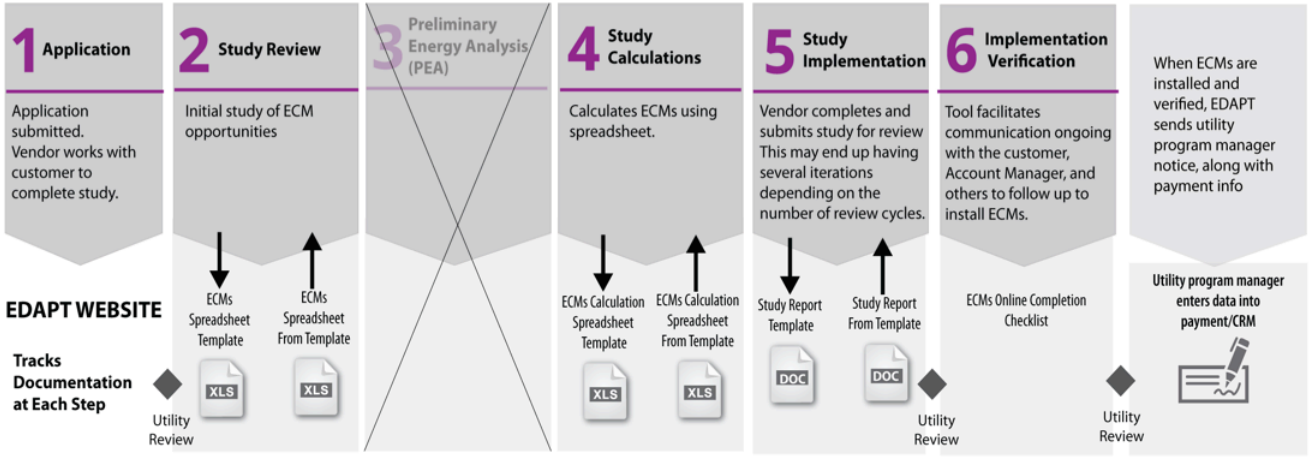
Credit: Marjorie Schott, NREL

Retrofit Extensions

Steps in EDAPT **Retrofit Program Workflow**



Example Workflow: **Xcel Recommissioning Program Workflow**



Credit: Marjorie Schott, NREL