(Ex) Ante LOPE: Living Open Platform for Efficiency

A "DEER Alternative" proposal

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

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Executive Summary

Proposal: upgrade DEER ecosystem using open source, state-of-the-art DOE tools

Part I: replace DOE-2 with EnergyPlus

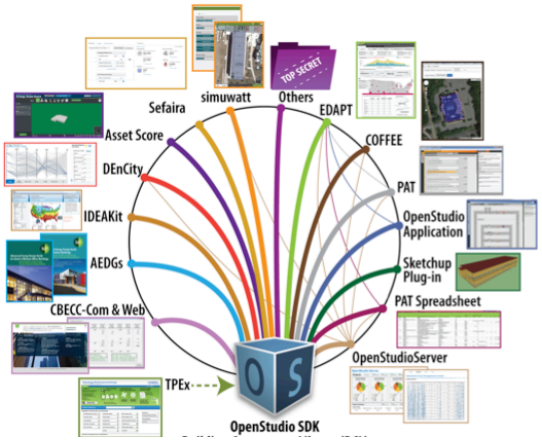
- Expand coverage of low-energy measures
- Reduce need for one-off workarounds in workpapers
- Align IOU programs with CEC Title 24 & POU programs
- Benefit from DOE investment & continuous improvement

Part II: leverage OpenStudio "measures"

- Increase transparency of engineering assumptions, inputs & methods
- Simplify & standardize review of work-papers & custom projects
- Engage larger talent pool for development of measures & XA review
- Increase consistency across IOU jurisdictions

Part III: tap into DOE's modeling tools ecosystem

- Align deemed, custom & code compliance modeling
- Enable data synchronization across multiple workflows
- Connect to growing ecosystem of tools, resources & users
- Leverage cost sharing from DOE, utilities & private companies …
- … including cost-sharing to build AnteLOPE!



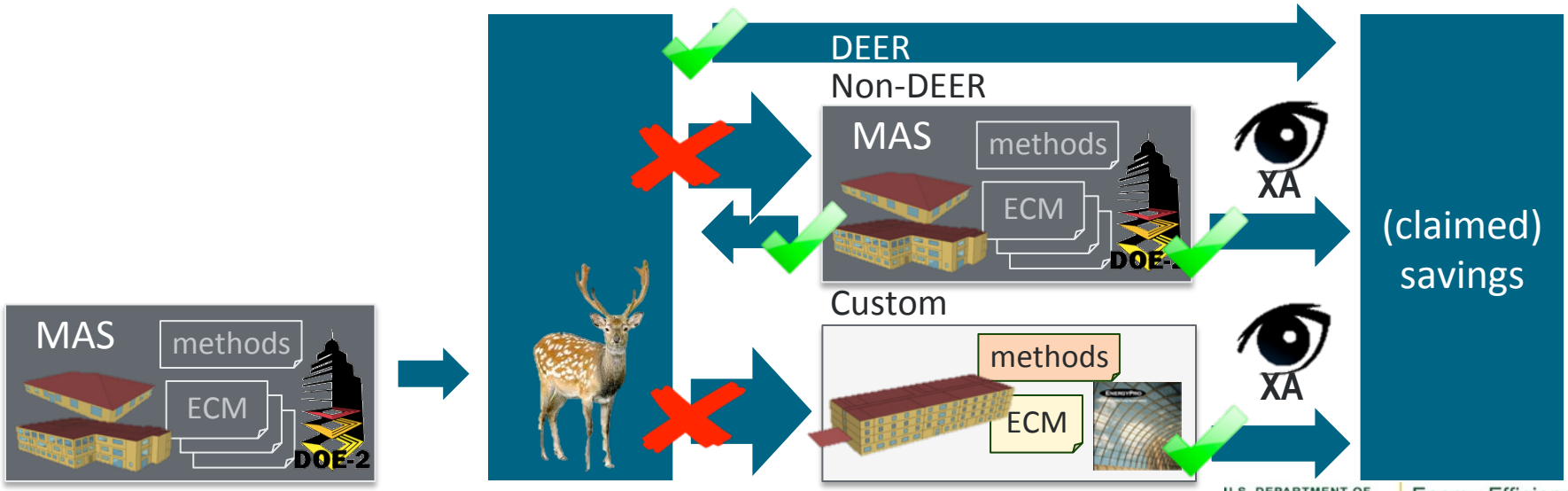
Status Quo Overview

DEER "database": ECM deemed savings per building-type (& climate-zone)

MAS: prototype models + DEER methods + ECMs + DOE-2 ➔ "DEER measures"

Three use paths

- **DEER measure:** claim savings
- **Non-DEER measure:** work-paper ➔ *ex ante (XA)* review ➔ claim savings ➔ add to DEER
- **Custom project:** work-paper ➔ *XA* review ➔ claim savings



Status Quo Problems

MAS is free-to-use but proprietary (important distinction)

- Forces all DEER updates through MAS vendor ➔ increases cost & delay

DOE-2 has limited capabilities

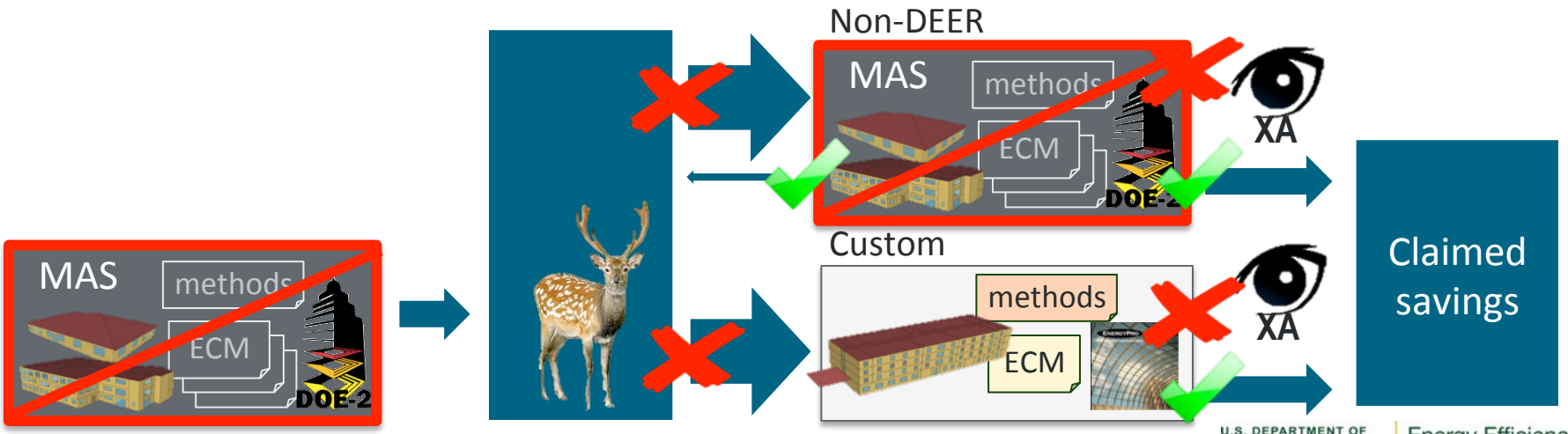
- Limits DEER expansion to new technologies ➔ forces projects into expensive "non-DEER" paths

DEER assumptions buried in MAS, only Ex Ante team understands them well

- Leaves room for *XA* reviewer interpretation ➔ arbitrary rejections & deratings ➔ uncertainty

Ex Ante Team led by DOE-2.2 developer ➔ conflict of interest

- Bias against work-papers developed using non-DOE-2 software? Bias against DOE-2 workarounds?



Part I – DOE-2 → EnergyPlus (energyplus.net)

Pro: open source license & committed federal support

Pro: advanced modeling capabilities

- Surface temperatures, thermal comfort, radiant heating/cooling & condensation
- Detailed lighting & shading, airflow within & between zones, natural ventilation
- (Nearly) arbitrary system configurations, *e.g.*, VRF & integrated heat-pumps
- Sub-hourly time-steps, cycling equipment, advanced controls, demand response & occupant behavior

Con: "EnergyPlus is slower than DOE-2"

- EnergyPlus trades execution time for (longer & more expensive) modeler workaround time
- EnergyPlus users don't complain — non-users cite it as an excuse not to switch!
- Commodity cloud computing makes argument even less relevant

Con: "EnergyPlus has not been validated"

- All simulation tools have been tested against ASHRAE Standard 140
- Much easier to validate EnergyPlus than to validate numerous DOE-2 workarounds

Con: "Nobody can use EnergyPlus"

- Multiple interfaces: OpenStudio (free, open source), Simergy, DesignBuilder, AECOSim, Sefaira, more
- 27,000+ downloads of every EnergyPlus version update
- 1000+ AIA 2030 Commitment projects: DOE-2: 28%, EnergyPlus: 13%*, TRACE**: 28%
- Consultants are successfully using EnergyPlus in Savings By Design programs outside of California

MAS+ – An Improbable Transient

MAS+: replace DOE-2 with DOE's EnergyPlus

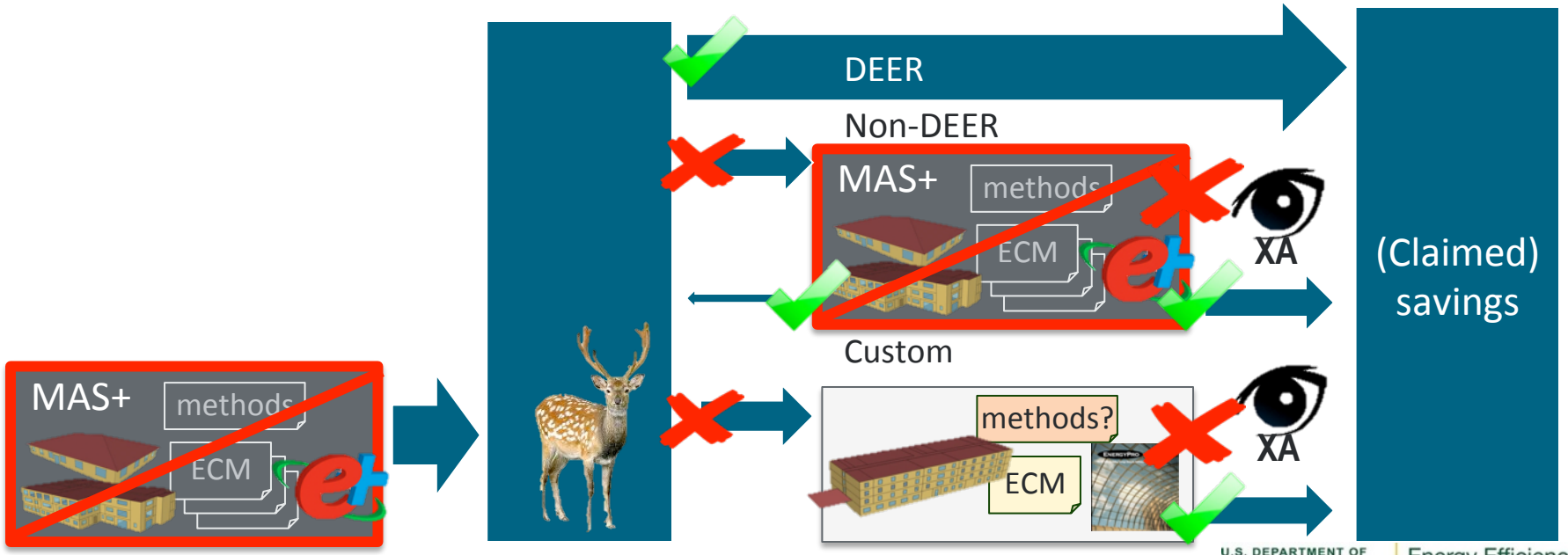
- Align with POUs & Title 24 (CEC) ➔ reduce confusion & consultant burden
- Expand DEER to cover low-energy ECMs ➔ reduce non-DEER work-paper stream, for remaining …
- Reduce workarounds ➔ reduce *XA* effort

Transient: assumptions & methods still opaque, ECMs still difficult to manipulate

- Rejections & deratings will continue

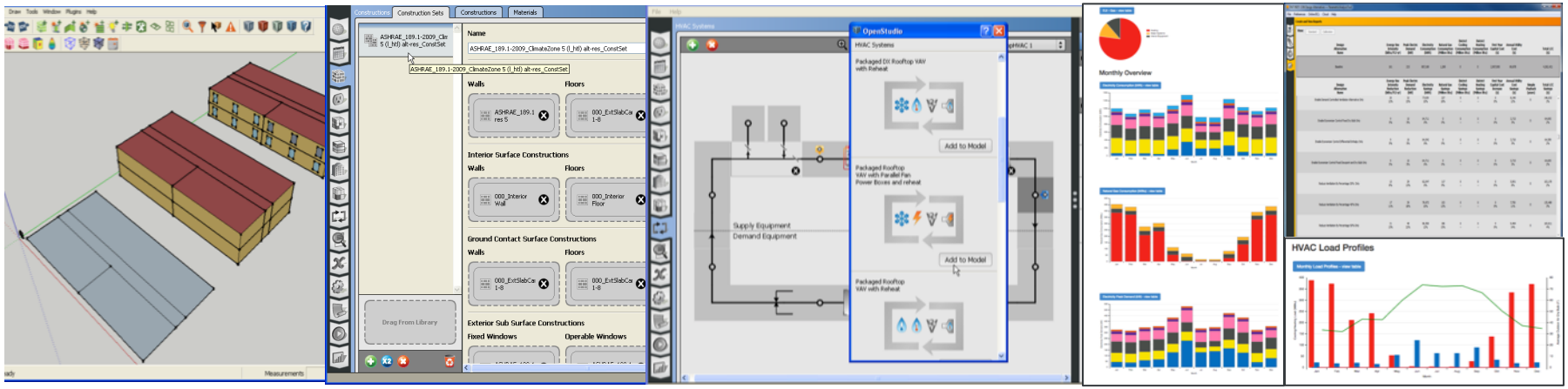
Improbable: MAS is proprietary & developed by DOE-2 vendor

- Unlikely to swap engines to EnergyPlus



Part II – Introducing OpenStudio (openstudio.net)

Envelope → Constructions, loads schedules, etc. → HVAC templates or custom systems → Run, compare, report, QAQC, parametrics



OS Application

- Workflow specific “skin”, demonstrates …

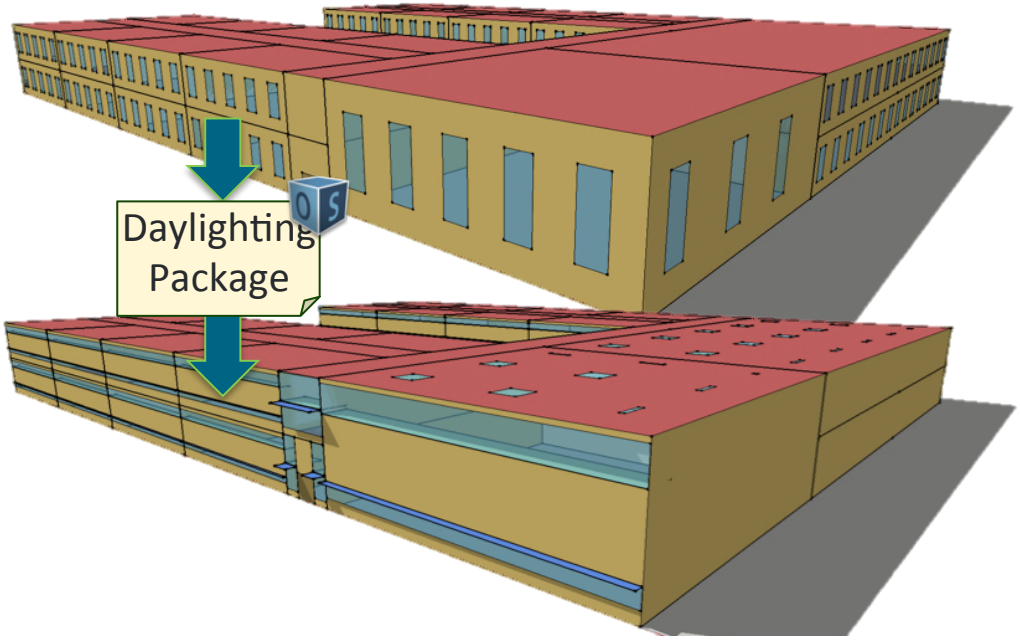
OS Software Development Kit (SDK)

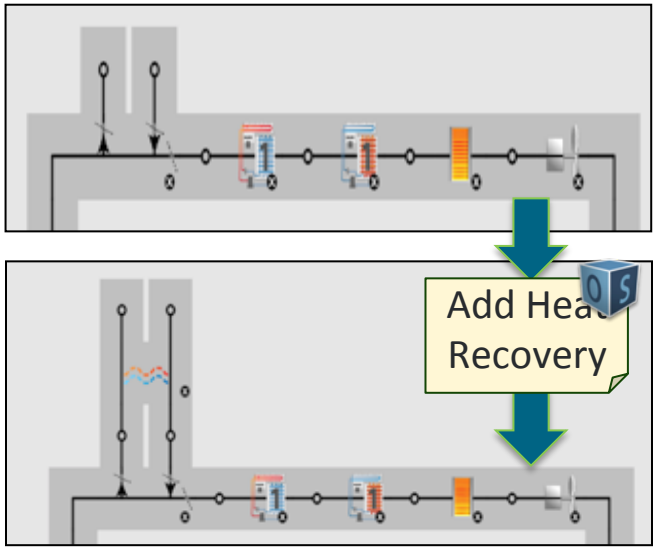
- 90% of the iceberg
- Non-graphical “common-core” logic
  - Import geometry
  - Articulate standard HVAC systems
  - Manage simulation on desktop or cloud
- Scripting facility that resembles Microsoft Excel’s Visual Basic Macros

Scriptable API (C++, Ruby, Python, JS, C#)

OpenStudio Measures (Scripts for modeling)

```
# Measure structure to replace exterior wall orig construction with new
model.getSurfaces.each do |s|
   if s.outsideBoundaryCondition == "Outdoors" and s.surfaceType == "Wall"
         if s.construction.name.get_s == orig
            s.setConstruction(new)
```



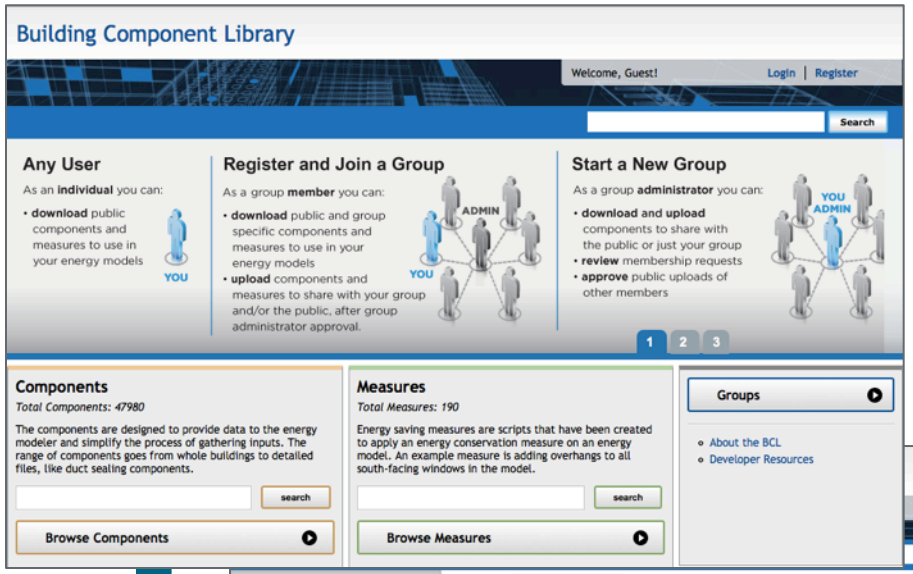


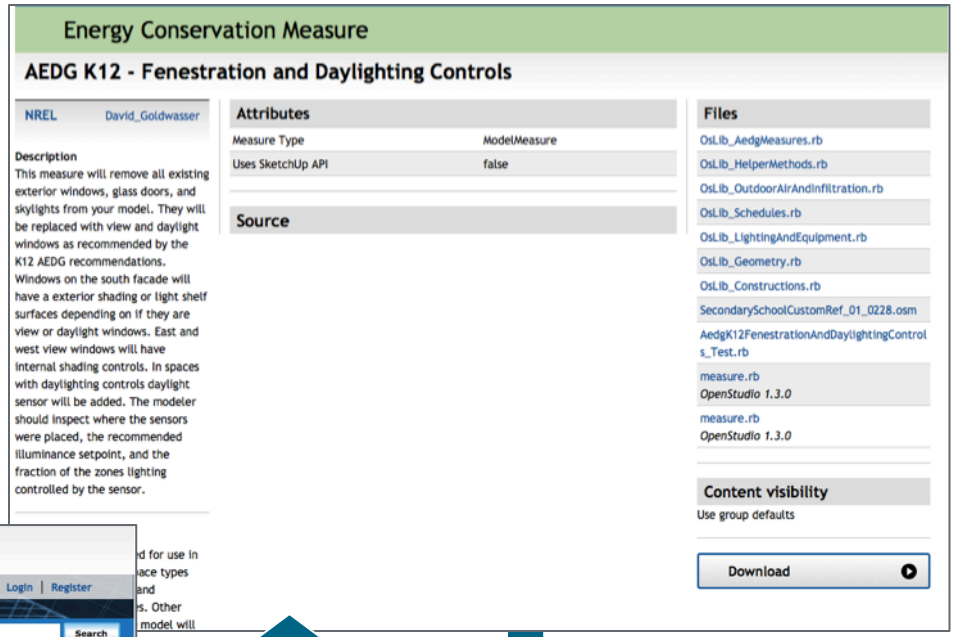
- Transform model ➔ apply ECM, *e.g.*, replace constructions, daylighting package, heat recovery, etc.
- Query model & results ➔ produce custom reports or perform automated quality checks
- Perform these actions repeatedly, consistently & quickly on any model
- An open way of extending functionality & transferring knowledge ➔ unique & powerful feature

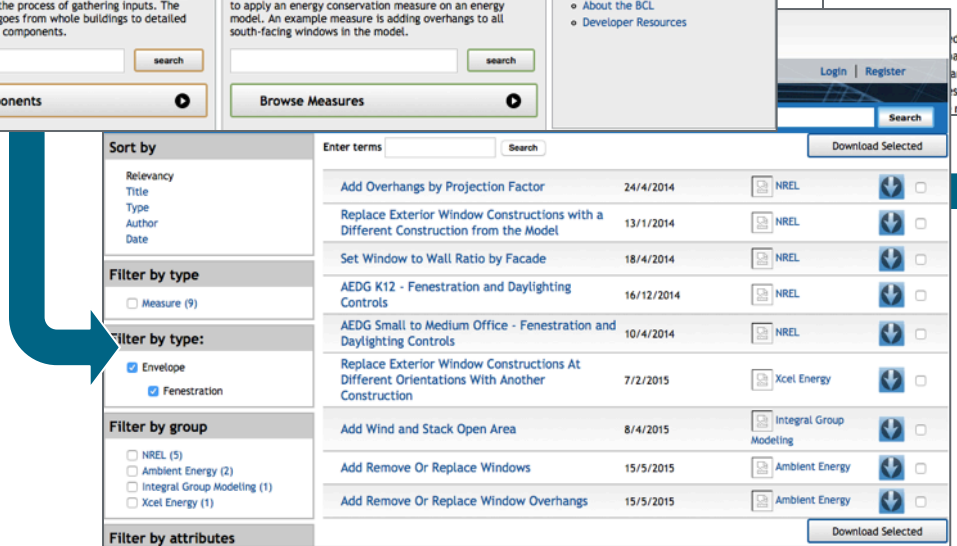
Building Component Library (bcl.nrel.gov)

Online repository of measures ➔ "electronic TRM" starter kit

- Other simulation objects too, *e.g.*, schedules, equipment, constructions, weather files
- Supports meta-data, versioning, "group" privacy & sharing, API
- Integrated with OpenStudio SDK & application

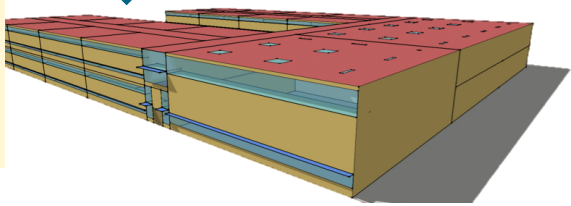






Drag & drop

Browse & search on web or in app via API



OpenMAS – Probable & Almost Real

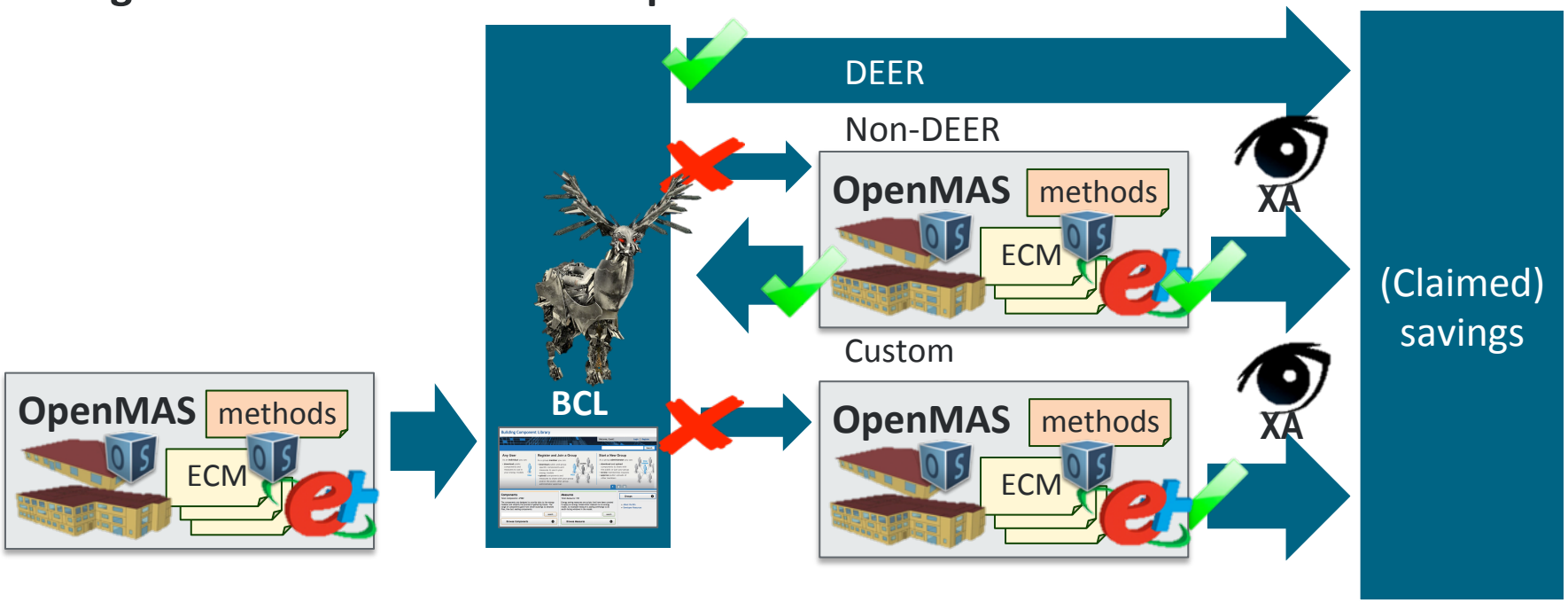
OpenMAS+: MAS rebuilt using OpenStudio (with EnergyPlus inside)

- Make DEER assumptions, inputs & methods transparent, reviewable & portable
- Improve XA review transparency & consistency ➔ reduce rejections & deratings
- Expand contractor pool for DEER update & *XA* review ➔ reduce cost & delay
- Automate apply-measure-to-model process ➔ streamline XA review for custom projects

Almost real: basic package is there

- Need CA-specific prototypes & ECMs + any unique integration requirements

Reimagine DEER workflow with OpenStudio measures …



Non-DEER Measures – OS Measures Style

IOU consultant uses OpenMAS to develop work-paper & potentially OS measure

- Measures are (much) easier to develop than "core" OpenStudio code
- A dozen consultants already develop measures to automate common modeling tasks

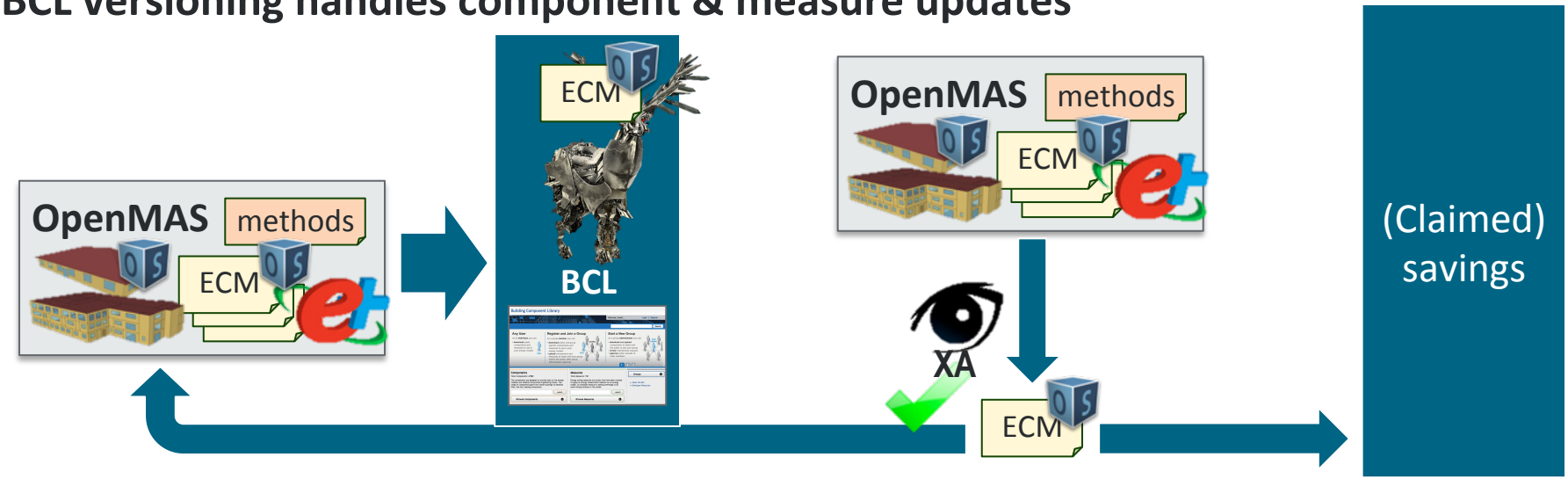
XA consultant reviews work-paper & OS measure

- Assumptions & actions explicit in code ➔ easier to review than "diffing" before & after models
- Potentially develops OS measure if one wasn't submitted

OS measure reviewed by CPUC/CalTF/whomever

- If approved, automatically applied to CA prototypes ➔ DEER measure
- Engages community of stakeholders, rather than a single contractor

BCL versioning handles component & measure updates



Custom Projects – OS Measures Style

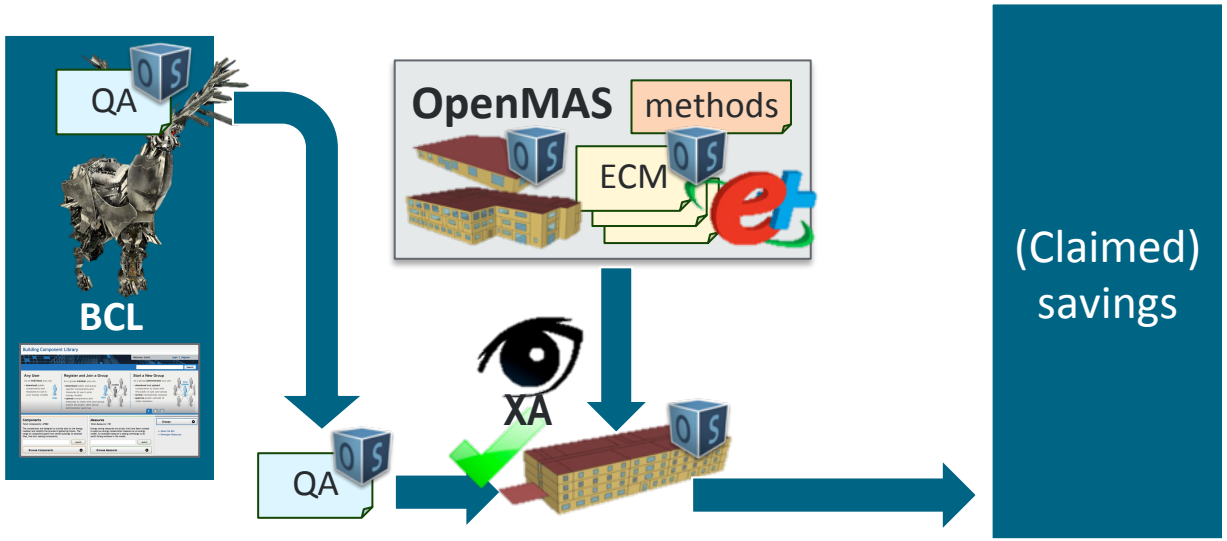
IOU consultant submits custom project as baseline model + approved measures

- Measure savings "agreed upon in advance"
- XA consultant reviews baseline model ➔ lighter, less contentious review

XA team can develop measures to perform sanity checks & detect "cheating"

- Create report for both submitter & reviewer
- Automate screening & use *XA* reviewer time efficiently
- IOU consultants can self-screen before submission ➔ fully transparent – no surprises

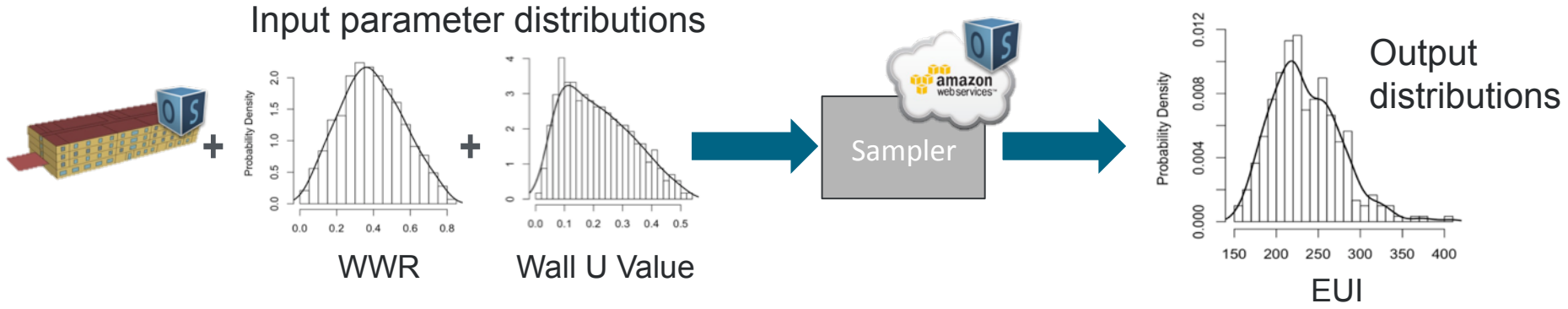
QA measure can verify use of recent & approved versions of components & ECMs



Cooking with Gas – Measures + OpenStudio Server

ECM package optimization ➔ DEER ECM packages?

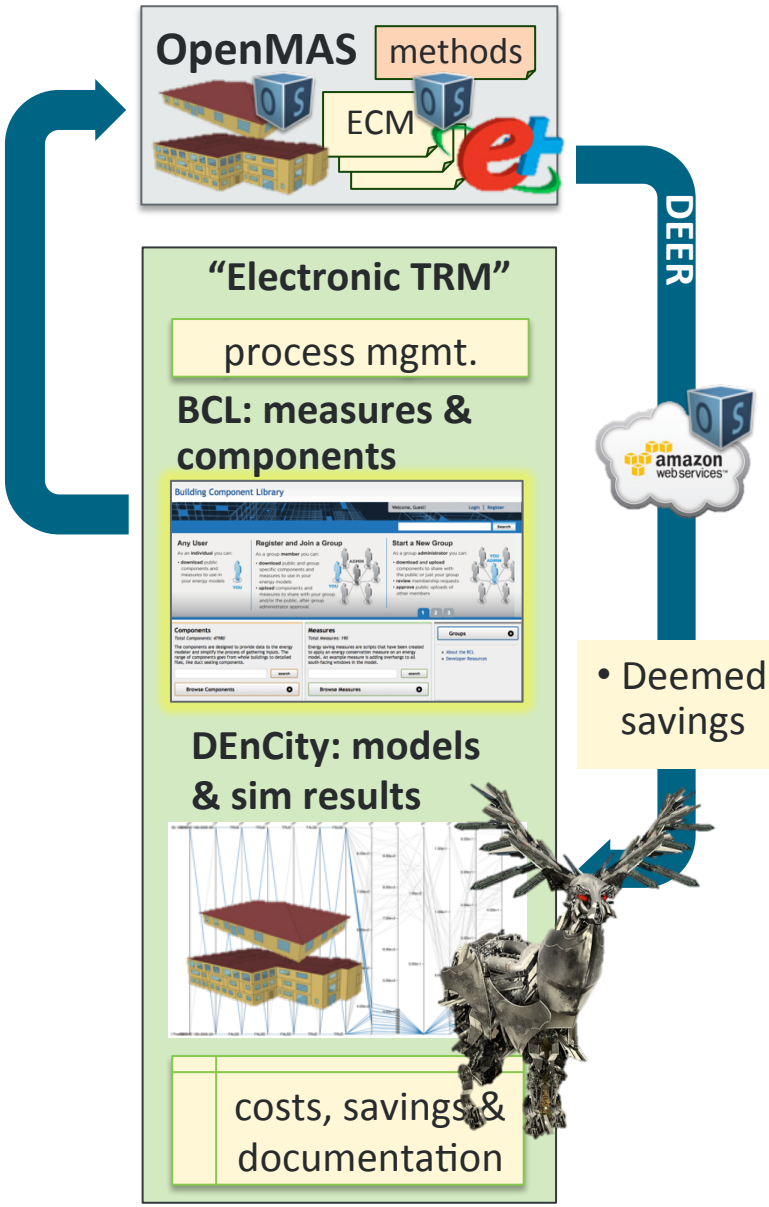
But also uncertainty analysis ➔ DEER savings ranges?



And calibration ➔ Better estimates for retrofit projects?

“Electronic TRM” – Next Generation ECM Database

- Prototypes
- Measures
- Weather
- Cost
- Uncertainty



- Deemed savings

Electronic TRM

- BCL
- DEnCity model & result database
- Cost & documentation storage
- Process management glue

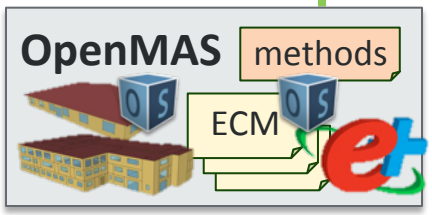
Evergreen loop with OpenMAS

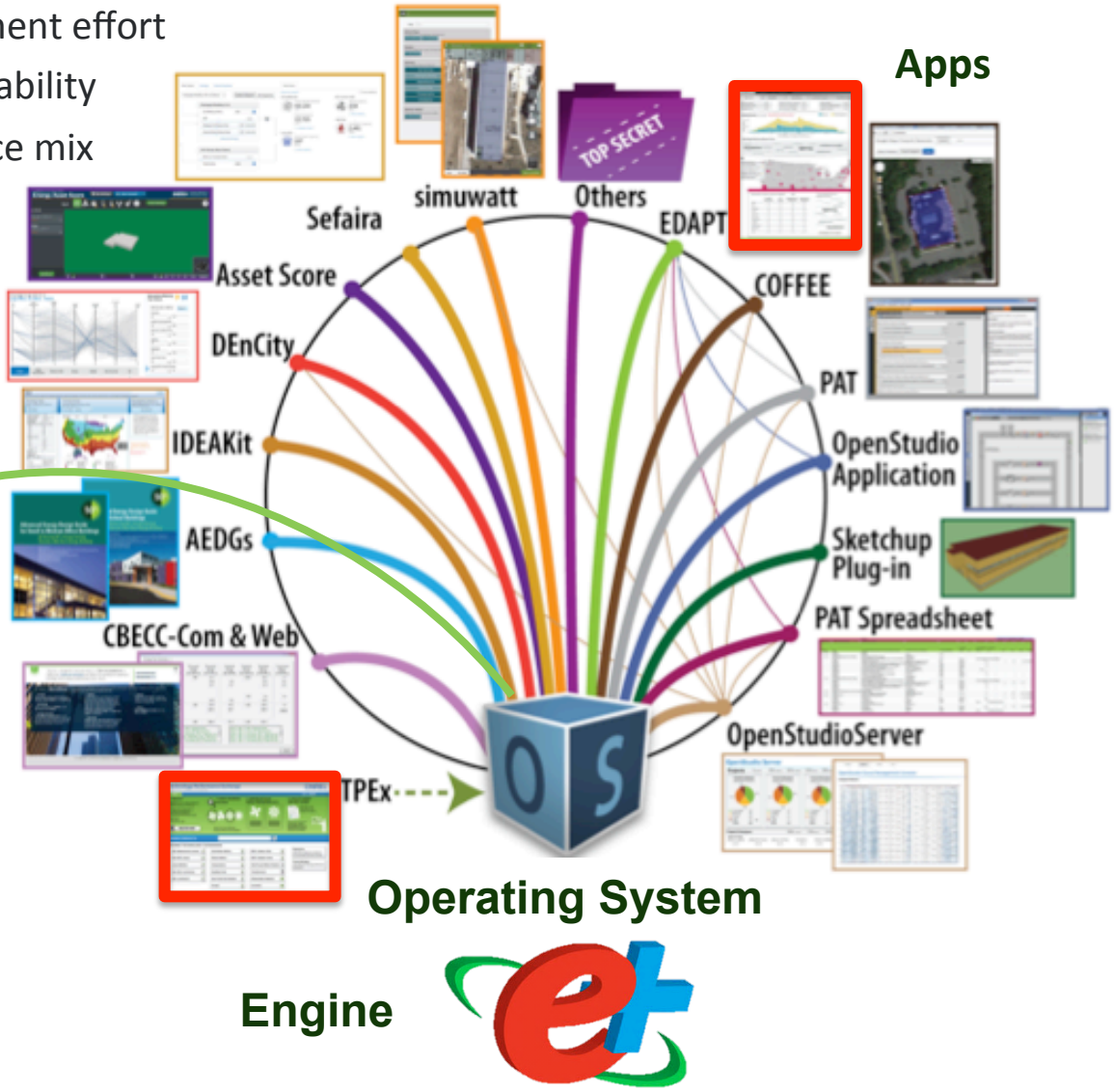
- Latest prototypes & measures
- Automated database updates

Part III – DOE's Energy Modeling Ecosystem

OpenStudio is the iOS of energy simulation—a platform for "apps"

- *Dramatically* reduces app development effort
- Shared infrastructure ➔ inter-operability
- Allows for proprietary & open source mix
- Metcalfe's law of networks

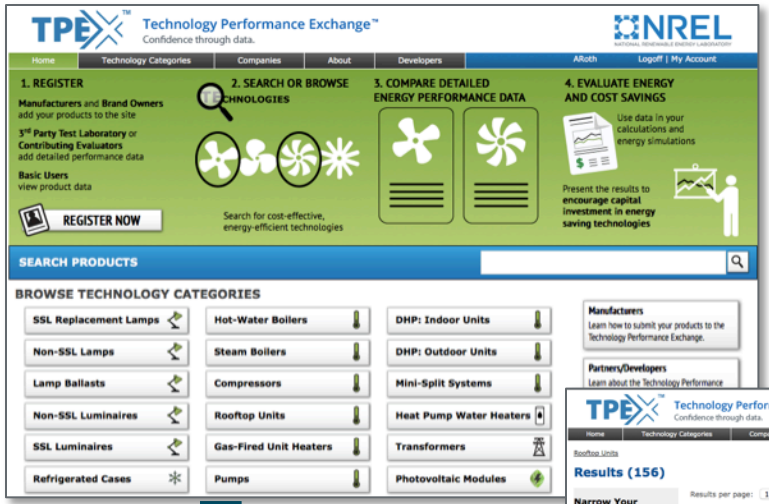




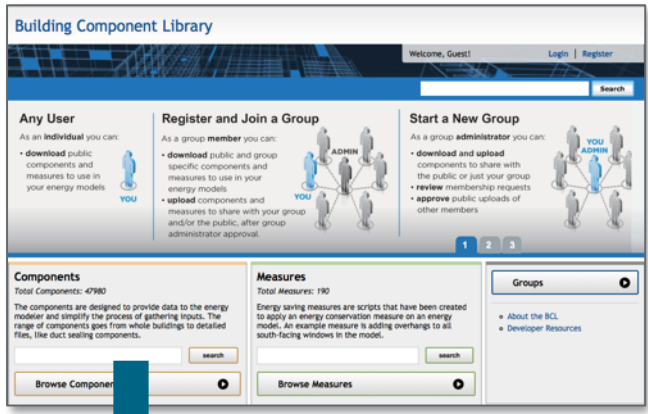
Technology Performance Exchange (tpex.org)

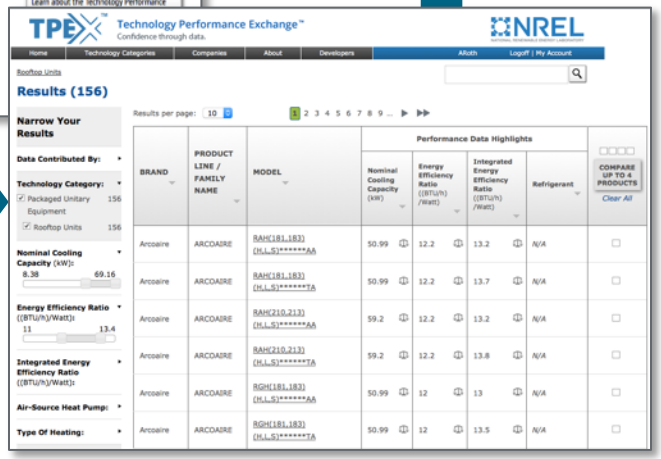
Provides OpenStudio ecosystem with component-specific "data" path

- Equipment performance data from manufacturers (*e.g.*, LG VRF), M&V'ed demos & pilots
- Automated translation to BCL performance data ➔ OS ecosystem
- Good source for uncertainty distributions ➔ can complement, cross-check simulation results

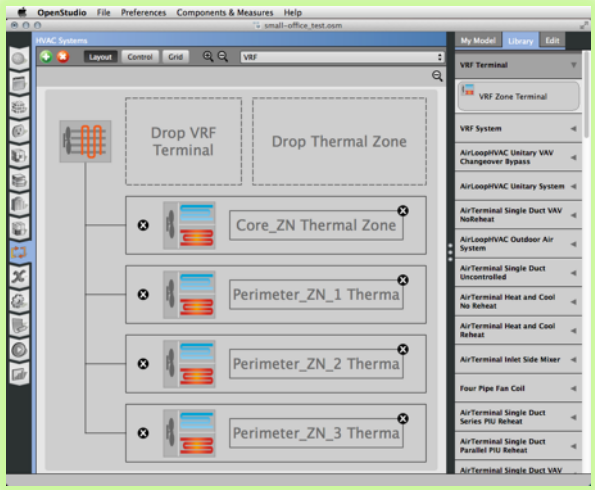


Performance data automatically converted into model objects





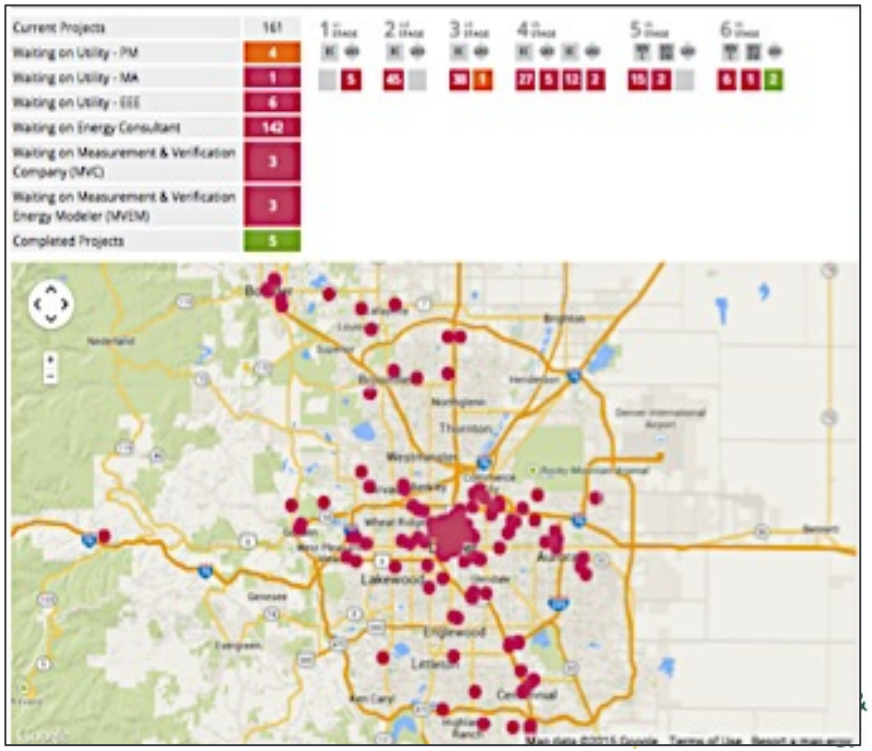
Browse & search on web or in app via API



EDAPT (eda-pt.org)

Energy Design Assistance Program Tracker

- EDA program administration tool: software-guided workflow, automated QA/QC & reporting
- New construction & retrofit workflows
- Integrated with OpenStudio, but can be integrated with other tools
- Developed by Xcel Energy, saved $500k in program administration in 1st year of operation
- Ten consultants in program, up from two beforehand
- “Bought-back” by DOE ➔ rolling out to Austin & CPS Energy, Energy Trust of Oregon



AnteLOPE – Open Interoperable Efficiency Ecosystem

OpenMAS methods

ECM

Custom

Non-DEER

"Electronic TRM"

process mgmt.

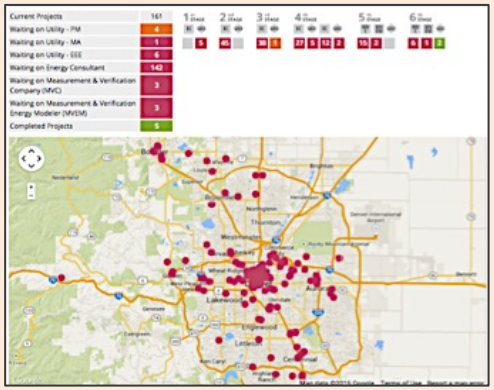
BCL: measures & components

DEnCity: models & sim results

costs, savings & documentation

DEER

EDAPT: program administration, QA/QC, XA review & reporting



TPEx

manufacturer & pilot performance & cost data

Data & methods (OS Measures) are transparent, extensible, easily updated & seamlessly linked

Making the Transition

What's needed

- Develop OpenMAS: CA prototypes & some measures ($)
- Independent cross-walk of OpenMAS vs. MAS results ($$)
- Develop AnteLOPE: major pieces already there ($)
- Ramp up consultants ($$), many already on ramp

Opportunities to collaborate & cost share (DOE loves this)

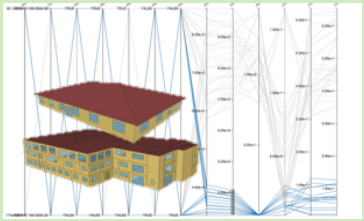
- DOE BTO has its AnteLOPE – Strategic Prioritization Tool (Scout)
- Other organizations (*e.g.*, BPA) interested in regional AnteLOPEs

"Electronic TRM"

process mgmt.

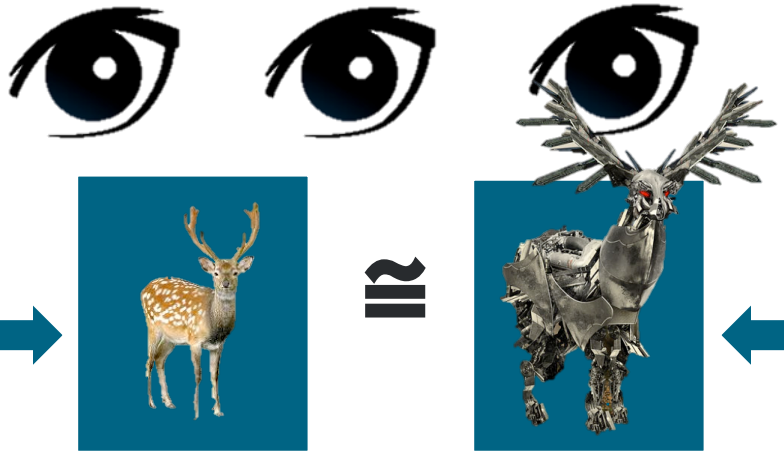
BCL: measures & components

DEnCity: models & sim results



costs, savings & documentation

Independent comparison



OpenMAS methods ECM

To Wrap Up

CA IOU programs have large energy savings potential

CA is a leader ➔ other states/utilities/regulators are watching

We believe in technical & market approach

"DEER Alternative" presents an opportunity

Let's do this!

Thank you

Follow-up?
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