OpenStudio Core

NREL, LBNL, ORNL, PNNL

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Project Summary

Timeline:
Start date: Q1 FY10
Planned end date: Ongoing w/ off-ramping of components

Key Milestones
1. Bi-annual major releases
2. Next-gen modeling engine integration: FY20

Budget:
Total Project $ to Date:
• DOE: $13,236,000
• Cost Share: $6,718,000*

Total Project $:
• DOE: $21,046,000**
• Cost Share: $6,718,000

*Includes funding from Asset Score and Prioritization Tool
** Includes FY19-FY21 planned funding

Key Partners:

<table>
<thead>
<tr>
<th>All BTO Labs</th>
<th>NRCan/NRC</th>
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<tbody>
<tr>
<td>CEC, CalTF</td>
<td>PSD Consulting</td>
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<tr>
<td>BPA</td>
<td>NYSERDA</td>
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<tr>
<td>Xcel Energy</td>
<td>Multiple Universities</td>
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<tr>
<td>National Grid</td>
<td>Several Private Sector Companies</td>
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Project Outcome:
Develop BTO’s building energy analysis ecosystem as a best-in-class capability that enables rapid, low-cost development of new market facing tools produced by the National Laboratories, Universities, Private Sector, and other agencies.

Facilitate successful deployment of the software development kit across BTO performers, utilities, and private sector developers to drive real energy savings in new construction and retrofit projects.
EnergyPlus & OpenStudio

EnergyPlus: The Chip
- Building physics
- Equipment sizing

OpenStudio: The Operating System
- Model creation & results management
- Interoperability
- Workflow automation & customization
- Large scale analysis

Different functions, necessary & co-dependent!
OpenStudio facilitates EnergyPlus adoption
OpenStudio Supports a Large Ecosystem

Third-party tools
- Public sector
- Private sector

BTO tools and analyses
- Technology R&D prioritization
- National ECM analysis
- ASHRAE & ICC energy code development
- Advanced Energy Design and Retrofit Guides
- Asset Score and (soon) Home Energy Score
- Technical assistance for ENERGY STAR for Tenant Spaces
- More …
Team

Multi-lab team w/ deep expertise in building physics, energy modeling, software development, codes & standards

- Project lead & key developers
- Large scale analysis (optimization, sampling, UQ, etc.)
- Engine integration
- Complex automation (90.1 baseline, national-scale modeling)
- 3rd party support

- DOE prototype building development
- Software performance optimization
- DOE prototype building development
- DOE prototype building development
- Codes & Standards evaluation and support
Partial List of Partners
Stakeholder Engagement

Direct engagement with software developers

Industry stakeholder groups
- IBPSA-USA Advocacy Committee
- California BEM working group

Practitioners
- Unmethours.com (online Q&A forum)
- IBPSA-USA, IBPSA-World, ASHRAE, & other technical conferences

Eight others (asked not to be named)
FY17+ Accomplishments

• Command-Line Interface (CLI)
• OpenStudio Server upgrades
• Standards gem
• FloorspaceJS
• EnergyPlus EMS support
• Alfalfa
OpenStudio Command Line Interface (CLI)

Developers talked, we listened

- Reduced size from 1.3 GB installer to 124 MB executable
- Backwards compatibility of SDK and API
- Ongoing support for latest EnergyPlus & Radiance
- Software development patterns in C++ (desktop) and JavaScript (web)
- Adoption: 9 market-facing tools, 5 in-house company tools
OpenStudio Server

Modular architecture scales to large (300,000+) analyses
- Local server or cloud
- Algorithms: mesh, sampling, optimization, etc.

Example analysis: ENERGY STAR for Tenant Spaces
OpenStudio-Standards “Gem”

Prototype models – Measure-driven creation
• Supermarket & data center models, office models with space plans
• Detailed model defaulting from arbitrary geometries

90.1-2013 Appendix G baseline automation
2D Floorplan editor – step back from 3D editing (SketchUp)

New pattern for graphical widget development

- (JSON) schema-driven → not tied to OpenStudio API
- Web technologies (JavaScript) for broad reusability
- [https://nrel.github.io/floorspace.js/](https://nrel.github.io/floorspace.js/)
EnergyPlus EMS Support

EnergyPlus EMS (Energy Management System)
- EnergyPlus-interpreted sensor/actuator scripts for custom controls

Abstract sensors/actuators, expose EMS in OpenStudio API
- Allow EMS to be used in OpenStudio Models and Measures
- Scale usability of EnergyPlus control features

![Graph showing energy usage and control stages]
Alfalfa – Simulated Controls Test Framework

Virtual building (EnergyPlus model) running on a server
• Script maps “control points” (sensors/actuators) to Haystack tags
• Exposes via RESTful Haystack web-API
• Develop & test control algorithms quickly
• In use by private sector already!
Future

Advance state-of-the-art, focus on operational use cases
• More advanced controls capabilities
• Spawn integration

Support private-public partnerships
• Continue support of new EnergyPlus versions and features
• Automate continuous integration testing and documentation
• Support integration and adoption by new private-sector developers
• Modularize code base and consider off-ramping some components

FY19-21 Merit Review tomorrow!
Thank You

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REFERENCE SLIDES
Project Budget

FY 2018 Spending to Date:
$928,000 (Feb)

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<th>FY 2010– FY 2017 (past)</th>
<th>FY 2018 (current)</th>
<th>FY 2019 – FY 2021 (planned)</th>
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<tr>
<td>DOE</td>
<td>Cost-share</td>
<td>DOE</td>
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<tr>
<td>$11,179,000</td>
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Additional Funding Sources:

- Xcel Energy
- Austin Energy
- Bonneville Power Administration
- National Grid
- Noresco
- NYSERDA
- ESTCP
- Energy Trust of Oregon, Inc.
Project Plan and Schedule

Project Initiation Date: Q1/FY10
Planned Completion Date: Ongoing with Frequent Off-Ramping of Components
Release Schedule: Bi-annual Major Releases with DOE-Prescribed Focuses
Past Work: On-time major quarterly release since Q1 FY 2012

Past Work:
- OpenStudio 2.4.0 (Ext. Interface, Algorithms)
- OpenStudio 2.5.0 (Sensor, actuators, E+ 8.9)

Current/Future Work:
- OpenStudio 2.6.0
- OpenStudio 2.7.0
- OpenStudio 2.8.0
- OpenStudio 2.9.0
- OpenStudio 2.10.0
- OpenStudio 2.11.0
- OpenStudio 2.12.0
- OpenStudio 2.13.0