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:

All BTO Labs	NRCan/NRC
CEC, CalTF	PSD Consulting
BPA	NYSERDA
Xcel Energy	Multiple Universities
National Grid	Several Private Sector Companies

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.
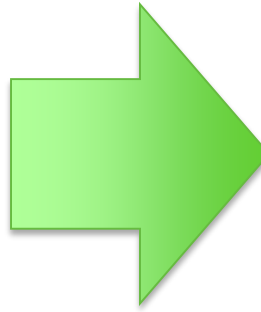
EnergyPlus & OpenStudio

EnergyPlus: The Chip   OpenStudio: The Operating System

- Building physics
- Equipment sizing

- 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 …
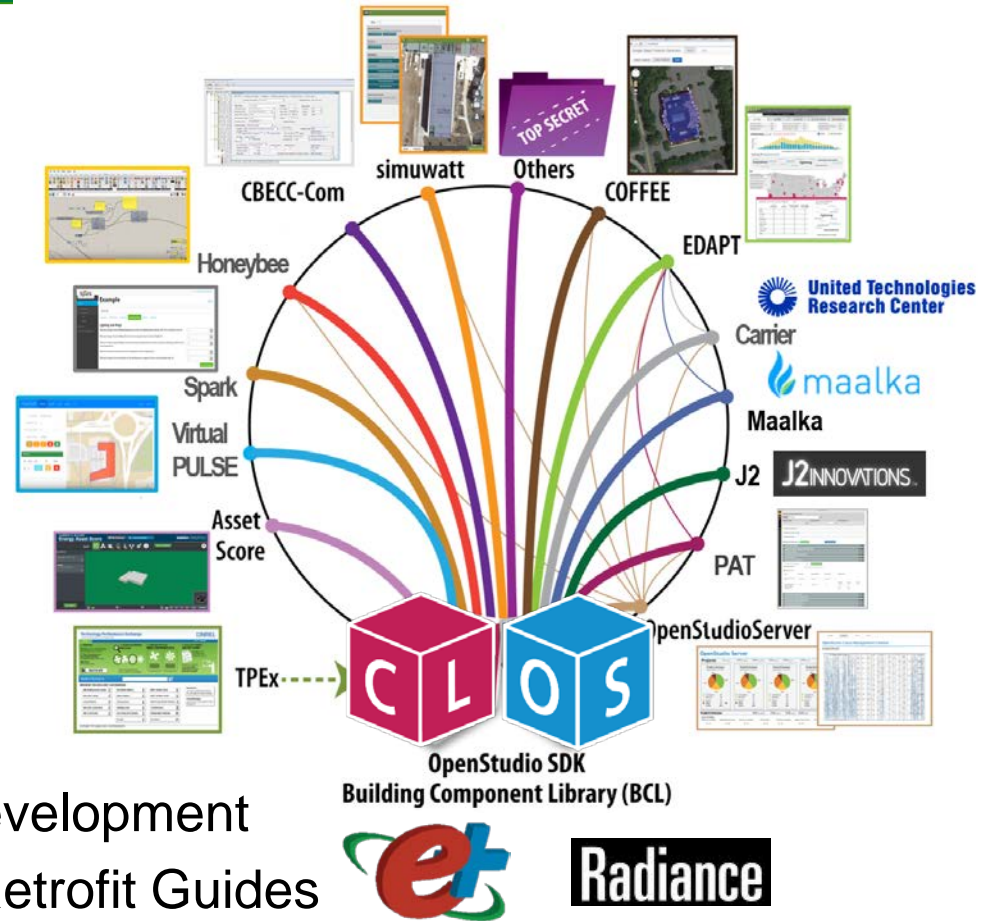
Team

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

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

Berkeley Lab
- DOE prototype building development

Oak Ridge
- Software performance optimization
- DOE prototype building development

Pacific Northwest
- DOE prototype building development
- Codes & Standards evaluation and support

Partial List of Partners

Stakeholder Engagement

Direct engagement with software developers

Eight others
(asked not to be named)

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

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
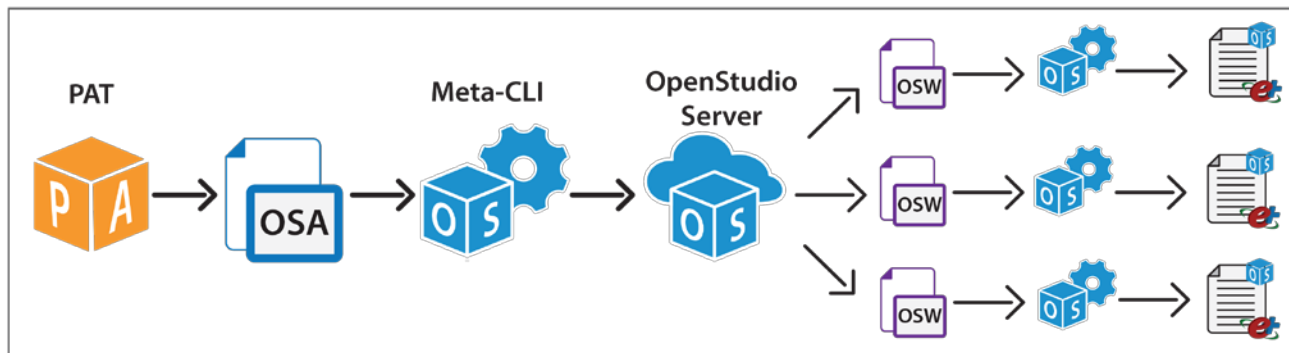

6,650 files, 1,300 MB
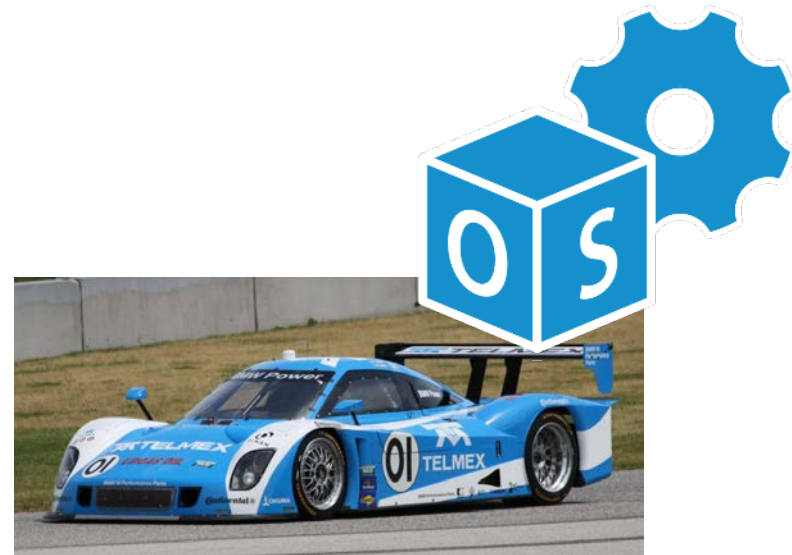
1 file, 124 MB

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

FloorSpace JS
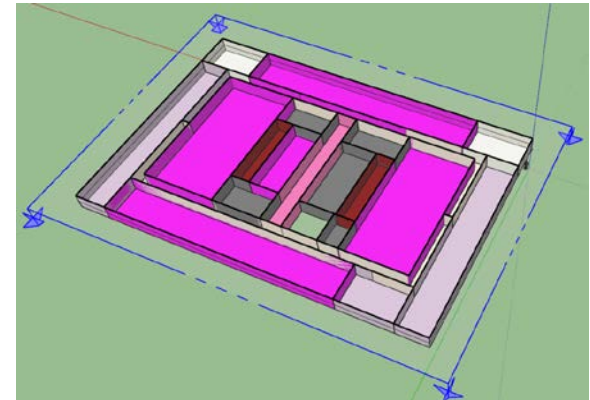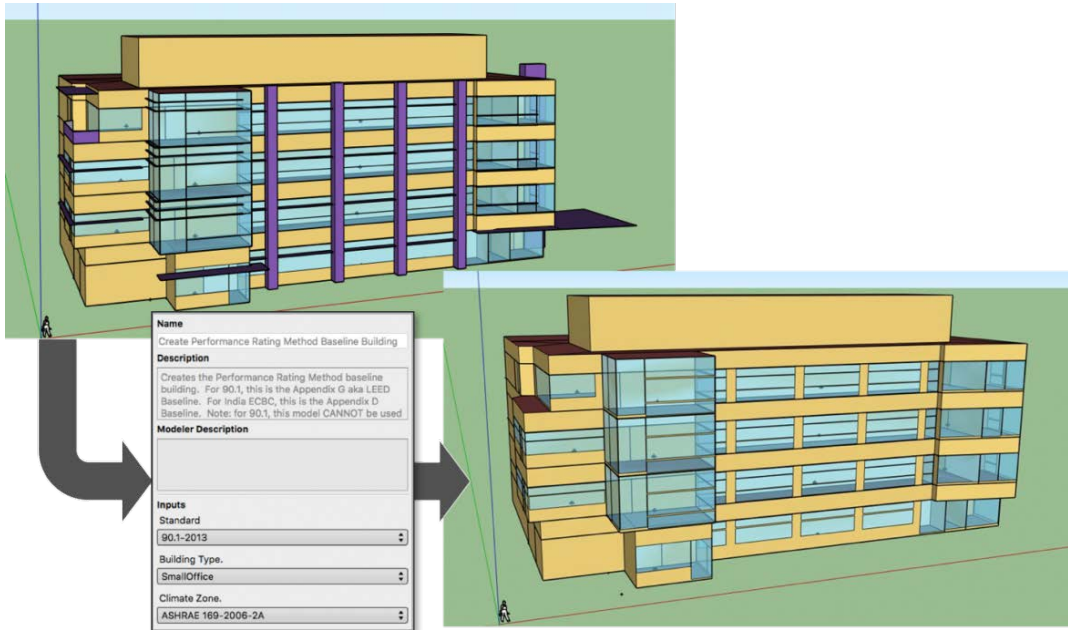
2D Floorplan editor – step back from 3D editing (SketchUp)

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/

3D preview
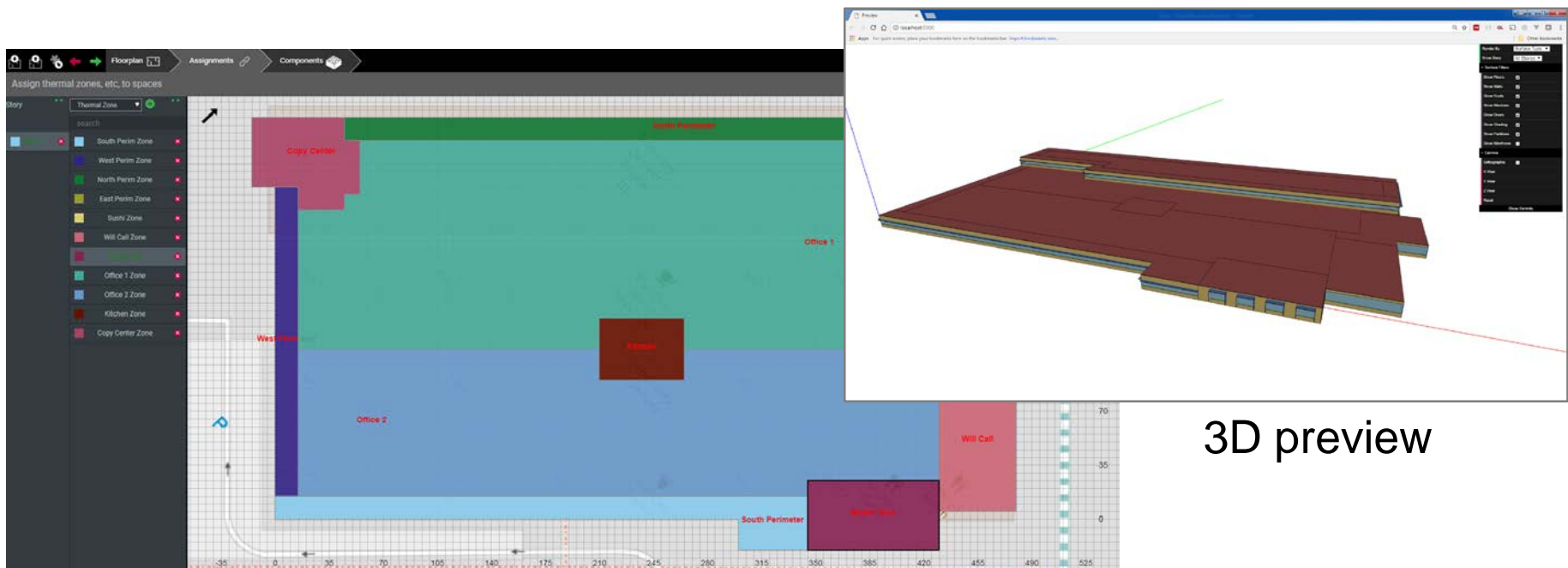
EnergyPlus EMS Support

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
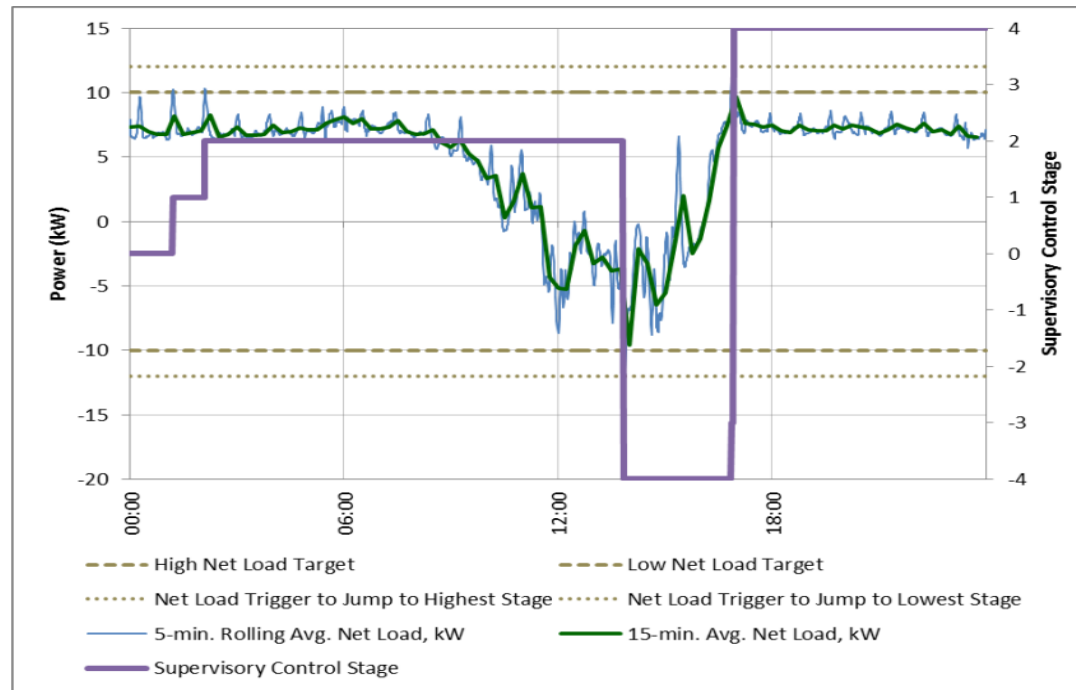
Alfalfa – Simulated Controls Test Framework

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!
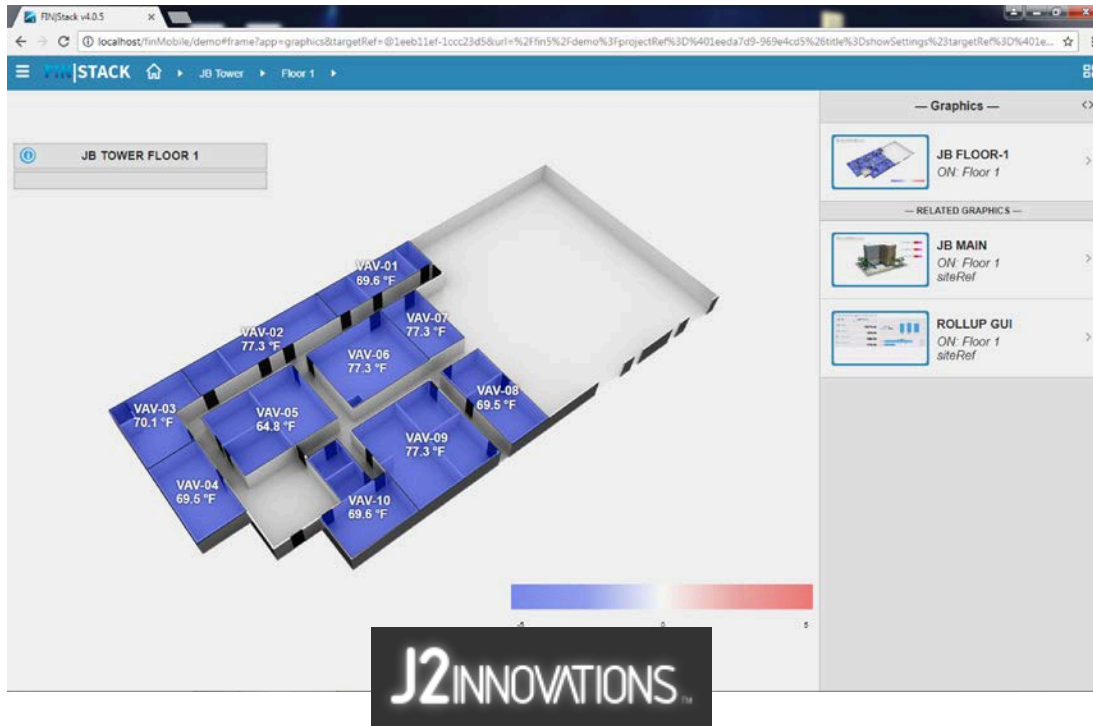
Future

Advance state-of-the-art, focus on operational use cases

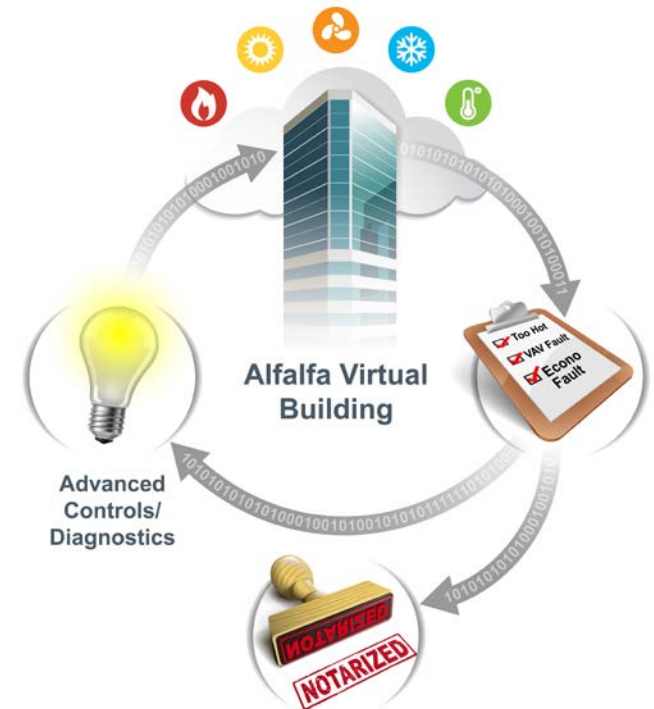- More advanced controls capabilities
- Spawn integration

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

NREL, LBNL, ORNL, PNNL

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REFERENCE SLIDES

Project Budget

FY 2018 Spending to Date:

$928,000 (Feb)

Budget History					
FY 2010– FY 2017 (past)		FY 2018 (current)		FY 2019 – FY 2021 (planned)	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
$11,179,000	$6,293,000	$2,147,000	$425,000	$7,810,000	NA

Additional Funding Sources:

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

Project Schedule																	
Project Start: Q1 FY 2010		Completed Work															
Projected End: Ongoing - FY 2021 Planned		Active Task (in progress work)															
		Milestone/Deliverable (Originally Planned)															
		Milestone/Deliverable (Actual)															
		FY2018				FY 2019				FY 2020				FY 2021			
		Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
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														■			