Project Summary

Timeline
- Official start: 1996
- Current Merit Review cycle: FY16-FY18

Key Milestones
- Two annual releases: Mar. & Sep.

Budget
- $2,500k / yr
- $1,250k labs
  - NREL, LBNL, ORNL
- $1,250k competitively solicited contractors
  - GARD, FSEC, Objexx, Fraunhofer-CSE
  - OSU, UIUC, Big Ladder Software
  - EnergyArchmage, Empty Crate Software
  - Solicitation follows 3-year Merit cycle

Key Partners
- Trane
- Carrier
- Autodesk

Project Outcome
- Software engine that is capable and robust enough to support codes & ratings as well as commercial products
Purpose & Objectives

Mission Statement: “Develop, maintain, and support a BEM engine for fair and accurate assessment of different energy efficiency measures for all types of buildings projects.”

Target Applications & Audiences:

• New construction & retrofit design, HVAC selection & sizing, energy-efficiency code development & compliance, asset ratings & labels, policy analysis, commissioning, fault-detection, demand-response & model-predictive control, control design, product design, research & education

• Architects, mechanical engineers, energy consultants, utility program administrators, ESCOs, software vendors, control engineers, control vendors, researchers, educators

Impact:

• Hard to calculate & easy to underestimate

• ~700 TBTU/yr for design use case [P-Tool]
Approach, Issues & Characteristics

Approach:
- Develop engine, work with vendors to embed into end-user use-case specific apps
  - OpenStudio really helps here (more in next presentation)
- Focus on speed, robustness & high-leverage features that vendors (and users) want
- Modern, rigorous development, documentation & testing processes & tools
- Annual in-person team planning & training meeting, bi-weekly iteration web-meetings

Key Issues:
- Stability & bugs
- Future-proofing & new use-cases
- Empirical validation
- Usability

Distinctive Characteristics:
- Long-running project
- Multi-lab collaboration
- DOE as a successful direct market actor
Progress & Accomplishments (since April 2015)

• 19,365 ➔ 33,968 ➔ 35,050!!

• Projects: 65 (6%) ➔ 76 (4%) ➔ 2 (1%)
• GSF: 63M (13%) ➔ 84M (14%) ➔ 0.7M (3%)

New Products:
• Autodesk releases EnergyPlus-based Insight360 for Revit & FormIt
• Sefaira-cum-Trimble releases EnergyPlus-based Sefaira-cum-Trimble Architecture
• Trane releases beta of EnergyPlus-based TRACE (most frequently used BEM tool)
• RESNET votes to adopt EnergyPlus-based single implementation of HERS rating
Progress & Accomplishments (since April 2015)

Technical milestones:
• V8.4: https://github.com/NREL/EnergyPlus/releases/tag/v8.4.0-Update1
• V8.5: https://github.com/NREL/EnergyPlus/releases/tag/v8.5.0
• New residential features: improved heat pump water heater
• New commercial features: 90.1 single-zone VAV control & economizer DX integration
• New daylighting feature “Octree” for significant speed improvements on large models
• New usability features: sizing, HVAC configurations & thermal storage controls
• New ground temperature models: foundation heat loss & ground heat exchangers
• New unit-testing framework
• New performance testing framework: quantify improvements & catch slowdowns
• Initial object-oriented restructuring: supports code evolution & unit testing
• Over 160 “defects” addressed: bug fixes & minor enhancements

Other improvements:
• Simplified (standard) open-source license (BSD-3) & contributor agreement
  – OpenStudio, WINDOW & THERM all moving to same license
• New documentation platform (LaTeX)
• New website (energyplus.net) ...
New Feature Request Portal (energyplus.uservoice.com)!

Planned for several years, launched Aug. 2015 in response to BEM roadmap input

- Available under Feedback tab from energyplus.net (single sign-on)
- Currently tracking & refining 64 feature requests

Replace IDF with a standardized data format (e.g., JSON, XML, etc.)

Problem: IDF is non-standard, non-extensible, and positionally dependent.

Solution: Moving to a key-value pair style input (instead of positional) means:

* Better handling of defaulting fields (no explicit blanks).
* Long lists can be infinitely extensible (the schema doesn’t need to specify fields for items 1-N, like the IDD does).
* Transitions between versions of objects is handled more simply.

nealkrues shared this idea · July 31, 2015 · Flag idea as inappropriate...
**New Feature – JSON Input Scheme**

<table>
<thead>
<tr>
<th>IDF</th>
<th>JSON</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>BuildingSurface:Detailed,</code></td>
<td>&quot;BuildingSurface:Detailed&quot; :</td>
</tr>
<tr>
<td>Bath_ZN_1_FLR_1_Floor, !- Name</td>
<td>&quot;Name&quot; : &quot;Bath_ZN_1_FLR_1_Floor&quot;,</td>
</tr>
<tr>
<td>Floor, !- Surface Type</td>
<td>&quot;Surface Type&quot; : &quot;Floor&quot;,</td>
</tr>
<tr>
<td>Insulated Carpet 6in Slab, !- Construction</td>
<td>&quot;Construction&quot; : &quot;Insulated Carpet 6in Slab&quot;</td>
</tr>
<tr>
<td>Bath_ZN_1_FLR_1 ZN, !- Zone</td>
<td>&quot;Zone&quot; : &quot;Bath_ZN_1_FLR_1 ZN&quot;,</td>
</tr>
<tr>
<td>Ground, !- Outside Boundary Condition</td>
<td>&quot;Outside Boundary Condition&quot; : &quot;Ground&quot;,</td>
</tr>
<tr>
<td>NoSun, !- Outside Boundary Object</td>
<td>&quot;Sun Exposure&quot; : &quot;NoSun&quot;,</td>
</tr>
<tr>
<td>NoWind, !- Sun Exposure</td>
<td>&quot;Wind Exposure&quot; : &quot;NoWind&quot;,</td>
</tr>
</tbody>
</table>
| !- Wind Exposure | "Vertices" : [
| !- View Factor to Ground | `{"X" : 19, "Y" : 0, "Z" : 0},` |
| !- Number of Vertices | `{"X" : 19, "Y" : 10, "Z" : 0},` |
| 19, 10, 0, | `{"X" : 19, "Y" : 0, "Z" : 0},` |
| 19, 0, 0, | `{"X" : 0, "Y" : 0, "Z" : 0},` |
| 0, 0, 0, | `{"X" : 0, "Y" : 10, "Z" : 0}` |
| 0, 10, 0; | ]
|

**Internally translate IDF (current) to JSON (new), expose JSON as option**

- Target release is Sep. 2016

**What does this buy us?**

- More succinct (no need to represent empty elements)
- Easier handling of extensible objects & lists
- Easier schema evolution & version migration (no need to keep things in same positions)
- Many tools & libraries for dealing with JSON, IDF is EnergyPlus specific
- Vendors have been asking for this
Spawn-of-EnergyPlus

Internal initiative, intended to carry EnergyPlus forward for 20 years

- Rapid (even third-party) component development & reuse
- Component-specific time-steps & parallelization for high performance
- Unified simulation & control workflows
- How? Standard simulation interfaces (FMI), languages (Modelica) & external solvers

EnergyPlus

- Monolithic
- No component reuse channels

Spawn-of-EnergyPlus

- Modular
- Uses model libraries
- Inter-operable with control workflows
New Feature – Spawn-of-EnergyPlus Join Point

What is happening this year?
• Spawn compatible “wrapper” for existing lighting-envelope-airflow modules
  • Reformulated zone-heat-balance module acts as “join point”
  • Shared by EnergyPlus and Spawn going forward (EnergyPlus not going away soon)
• Minimal OpenStudio translator
  • Alternate engine from OpenStudio, not a drop-in replacement for EnergyPlus yet
• Continued coordinated development of Modelica libraries via IEA Annex 60

Next year?
• Initial support in OpenStudio application (GUI)
• Continued coordinated development of Modelica libraries via IBPSA-World
Project Integration & Collaboration

Integration:
- Work closely with OpenStudio (CBI) & BeOpt (RBI) project teams
- Supports: 90.1 & COMcheck (Codes), Asset Score (CBI) & Scout (cross-cutting)
- Supported by: ASHRAE140 & Validation (ET), UnmetHours (CBI), Hybrid Modeling (FOA)
Communications & Publications

Communications:
- .../buildings/listings/end-use-breakdown-building-energy-modeling-blog
  - .../buildings/articles/energyplus-logo-debuts-revit-toolbar
  - .../buildings/articles/sefaira-serves-double-helping-energyplus-collaboration-top
  - .../buildings/articles/doe-releases-updated-versions-energyplus-and-openstudio

Publications:
Communications & Publications

Publications cont’d:


Many many many other publications in many venues!
Google Scholar: 3,160 mentions of EnergyPlus since beginning of 2015!
Next Steps & Future Plans

Process
• Continue focus on object-orientation & unit testing
• Continue integration of pre-processing utilities

Features
• Refine residential modeling features including basement & attic modeling
• Continue focus on performance for large “BIM” models
• Additional support for JSON input ... including JSON output?
• Additional support for Spawn-of-EnergyPlus
• Continue focus on addressing defects & improving usability
• High-leverage new features that are important for users & vendors

EnergyPlus is a “reactive” project that tracks & responds to technology developments & user & vendor needs
Project Budget

Project Budget:
- **FY16**: $2,500K
- **FY17**: $2,500K
- **FY18**: $2,500K

**Variances**: Not Applicable

**Cost to Date**:  
- FY16: 80% (subcontract execution)

**Additional Funding**: NA

### Budget History

<table>
<thead>
<tr>
<th>Oct 2014 – FY 2015 (past)</th>
<th>FY 2016 (current)</th>
<th>FY 2017 (planned)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DOE</strong></td>
<td><strong>Cost-share</strong></td>
<td><strong>DOE</strong></td>
</tr>
<tr>
<td>$5,000K</td>
<td>$0k</td>
<td>$2,500K</td>
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U.S. DEPARTMENT OF ENERGY

Energy Efficiency & Renewable Energy
## Project Plan and Schedule

### Current FY16-18 Merit Review Cycle

#### Project Schedule

<table>
<thead>
<tr>
<th>Task</th>
<th>FY2016</th>
<th>FY2017</th>
<th>FY2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1 (Oct-Dec)</td>
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<tr>
<td>Q2 (Jan-Mar)</td>
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<td>Q3 (Apr-Jun)</td>
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<td>Q4 (Jul-Sep)</td>
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</tr>
</tbody>
</table>

- **Completed Work**
- **Active Task (in progress work)**
- **Milestone/Deliverable (Originally Planned)**
- **Milestone/Deliverable (Actual)**

### Past Work

- Release V8.5

### Current/Future Work

- Release V9.0 (JSON)
- Release V9.1 (Spawn Alpha)
- Release V9.2
- Release V9.3 (Spawn Beta)
- Release V9.4