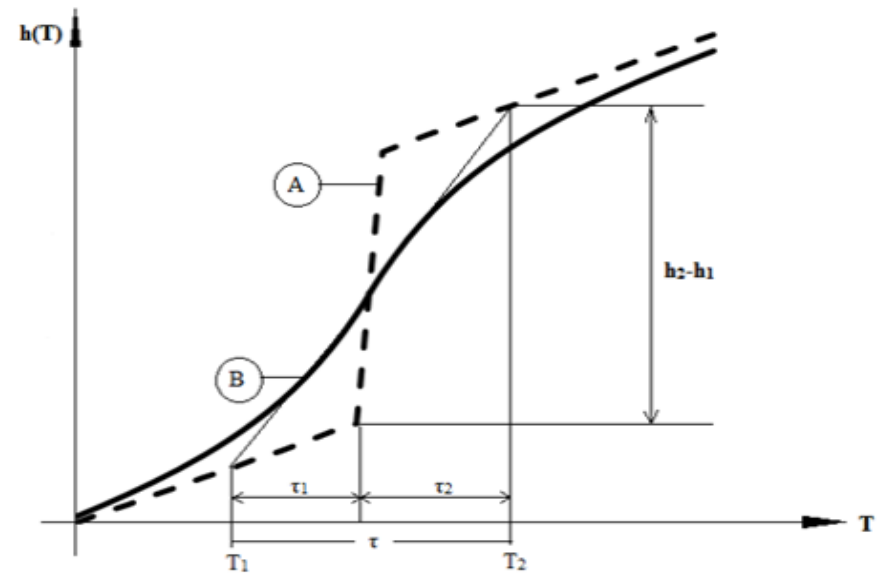


# Enhancing Phase Change Material Modeling

2017 Building Technologies Office Peer Review



NRGsim   
Energy Systems Simulation

  
EnergyPlus

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy

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National Renewable Energy Laboratory

# Project Summary

## Timeline:

- Start date: October 1, 2016 (New Project)
- Planned end date: June 30, 2017

## Key Milestones:

1. Go/No-Go for model evaluation; 12/31/16
2. EnergyPlus Team Review; 1/31/17
3. Completed Implementation; 6/30/17

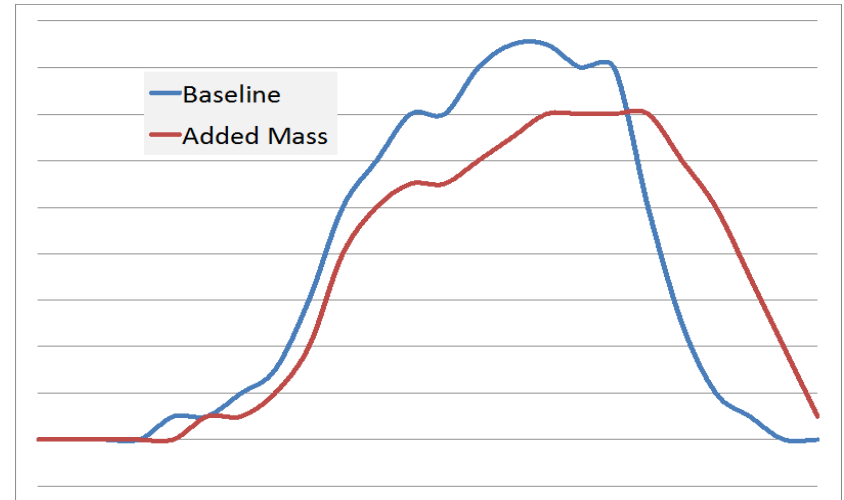
## Budget:

### **Total Project \$ to Date:**

- DOE: \$15k (through January)
- Cost Share: \$17k

### **Total Project \$:**

- DOE: \$100k
- Cost Share: \$20k



## Key Partners: NRGsim (Portland, OR)



## Project Outcome:

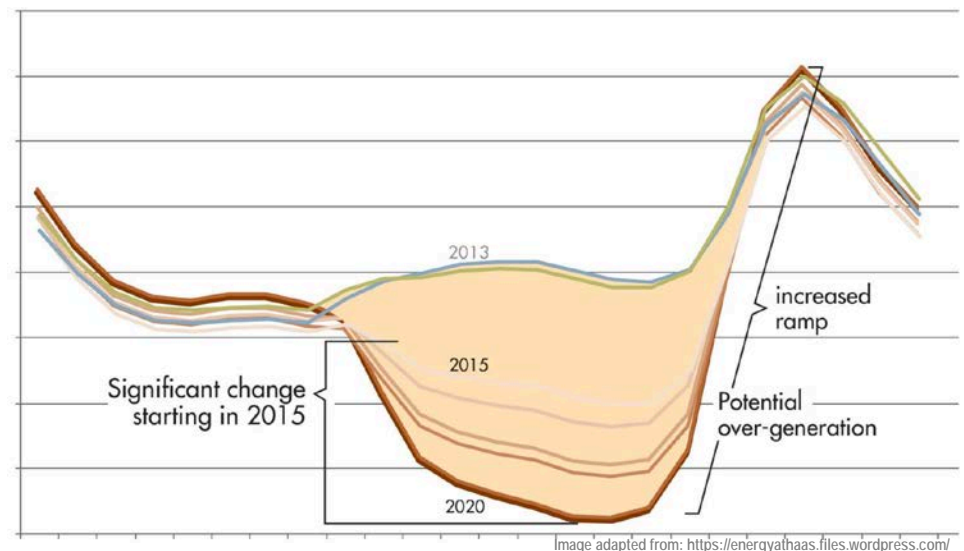
Modeling of phase change materials (PCMs) in EnergyPlus is limited. This project enhances the EnergyPlus PCM model to allow evaluation of PCMs in demand shift/energy savings measures.

# Purpose and Objectives

**Problem Statement:** Phase Change Materials (PCMs) as part of a building envelope represent a potential demand shifting/energy savings measure. The simulation of PCMs in DOE's primary energy simulation tool, EnergyPlus, is problematic due to issues with the input data form and the model assumptions. This project improves the EnergyPlus model, lowering the barrier to PCM evaluation.

**Target Market and Audience:** Designers and engineers who wish to evaluate PCMs for any building type.

**Impact of Project:** Enables further studies of PCMs. Adding thermal storage enables greater PV and renewable penetration.



# Approach

**Approach:** As a Small Business Voucher (SBV) award, the project comprises work requested by an industry expert (NRGSim) to be performed by NREL. The approach is to evaluate enhancements to the EnergyPlus PCM model, followed by work with the EnergyPlus team to implement those changes.

**Key Issues:** Two main issues: 1) current model inputs are difficult to obtain from manufacturer's data, and 2) current model does not capture physical hysteresis behavior of PCMs.

**Distinctive Characteristics:** This project is a tight coupling between industry, lab, and DOE. Industry identified a deficiency and proposed a solution, but did not have the means to solve the problem themselves. DOE funding support and NREL technical capabilities are leveraged to reach a solution.

# Progress and Accomplishments

**Accomplishments:** The enhancements have been evaluated as part of a go/no-go milestone. A design document for the enhancements was presented to the EnergyPlus team, with sufficient feedback to continue the development process. The majority of the work for this project is underway, culminating with the final milestone: completed implementation in EnergyPlus is in process and due June 30, 2017.

**Market Impact:** A more accurate PCM simulation model available to any user of EnergyPlus, lowering the barrier for users to evaluate this as a demand shift/energy savings measure.

NRGSim will no longer have to maintain a custom modified version of EnergyPlus, instead using DOE's mainline release, reducing their burden and ensuring they use the most accurate latest version.

# Project Integration and Collaboration

**Project Integration:** This project is tightly coupled with industry, using expertise to identify deficiencies in the current modeling capabilities, as well as to evaluate the design of the enhancements.

**Partners, Subcontractors, and Collaborators:** The collaborator on this Small Business Voucher is NRGSim, an industry expert in PCM simulation located in Portland, OR.

**Communications:** This work has not yet been presented, aside from internal presentations to the EnergyPlus development team for review. Publication of a paper based on this work is expected to result from the project.



# REFERENCE SLIDES

# Project Budget

**Project Budget:** DOE funds: \$100k; Cost share by NRGSim: \$20k

**Variances:** No changes to original budget

**Cost to Date:** Project is still in early state; only about 25% of total budget expended to date, major cost will be in upcoming implementation phase of project

**Additional Funding:** No additional funding.

## Budget History

Started October 1, 2016 (Not in FY16) – FY 2016 (past)		FY 2017 (current)		FY 2018 – Ends June 30, 2017 (Still FY17) (planned)	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
\$0	\$0	\$100k	\$20k	\$0	\$0



# Project Plan and Schedule

Describe the project plan including:

- Project work began in October 2016 with initial review work
- Work progressed through January 2017 with design work
- Work will continue for the remainder of the project in implementation efforts
- Two milestones have been met successfully:
  - Go/No-go review: 12/31/16
  - Regular milestone: 1/31/17
- A final milestone for completed implementation is on schedule for 6/30/17
- The only Go/No-go was 12/31/16, a review of the prior implementation to ensure project success, and it was completed with a 'go'
- The project is still in an early phase, with current efforts directed at completing the model implementation in EnergyPlus

