A Simplified Performance Rating Method for Small Commercial Buildings

Pacific Northwest National Laboratory

Supriya Goel, Senior Research Engineer

Supriya.goel@pnnl.gov

Project Summary

Timeline:

Start date: October 2019

Planned end date: September 2022

Key Milestones

1. Development of the Draft Ruleset; December 2020
2. Validation results; December 2021
3. Pilot test and results; September 2022

Budget:

Total Project $ to Date:

- DOE: $400K
- Cost Share: $0

Total Project $:

- DOE: $600K
- Cost Share: $0

Key Partners:

IBPSA-USA

Project Outcome:

- A ruleset which can be adopted by rating authorities for code compliance analysis
- Report which identifies the variation in energy savings for the simplified PRM versus the detailed PRM

Team

Supriya Goel

Michael Rosenberg

Michael Tillou

**Expertise in codes and standards
Performance based rulesets**

Aowabin Rahman

Expertise in python scripting, building energy modeling

Code Compliance Pathways – Performance

- Performance path: use modeling to demonstrate performance meeting or exceeding that of a building built to minimum prescriptive requirements
  - \+ Effectively sets a performance target, **achieves deeper savings** than prescriptive[1]
  - \+ Provides additional design flexibility
  - \+ Supports both compliance and above code programs (e.g., LEED)
  - – Requires a (detailed) model
  - – Requires a second "baseline" model ← source of (intentional) error

Performance Target
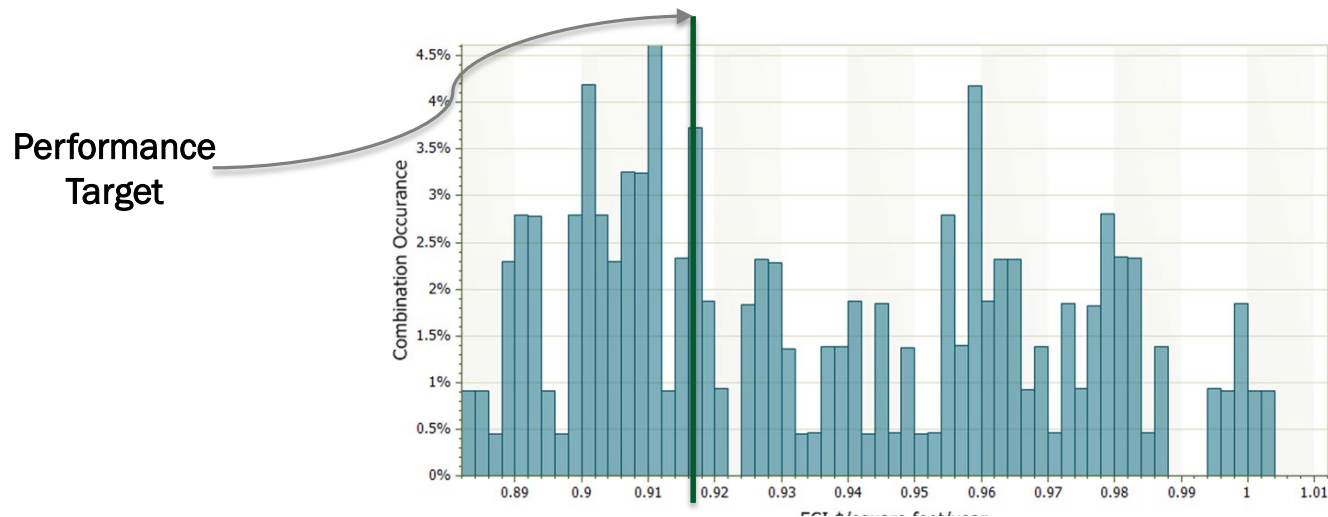
Unlocking deeper savings from energy codes requires that performance-based compliance becomes much more common

Challenge: Time and Cost of Creating Models

- Despite the flexibility and deeper savings, the **performance path is used for <5%** of compliance submittals

- Challenge: **time and cost** of creating a detailed energy model

  - Large complex buildings tend to use modeling and can use it to take advantage of flexible design, LEED, and incentives[2]

  - **88% of buildings are 25,000ft^2 or smaller**, however most projects involving buildings of that size have small budgets that cannot carry modeling costs

  - Without modeling, small projects lose access to design flexibility that leads to higher performance as well as to energy-efficiency incentives

[1]Rosenberg, M., R. Hart, J. Zhang, and R. Athalye. 2015. Roadmap for the Future of Commercial Energy Codes. Richland, WA. PNNL-24009

[2]Karpman M, M Rosenberg 2021. Performance-Based Code Compliance: A Roadmap to Establishing Quality Control and Quality Assurance Infrastructure https://www.energycodes.gov/sites/default/files/2021-07/Performance-Based_Code_Compliance_Roadmap_Final.pdf
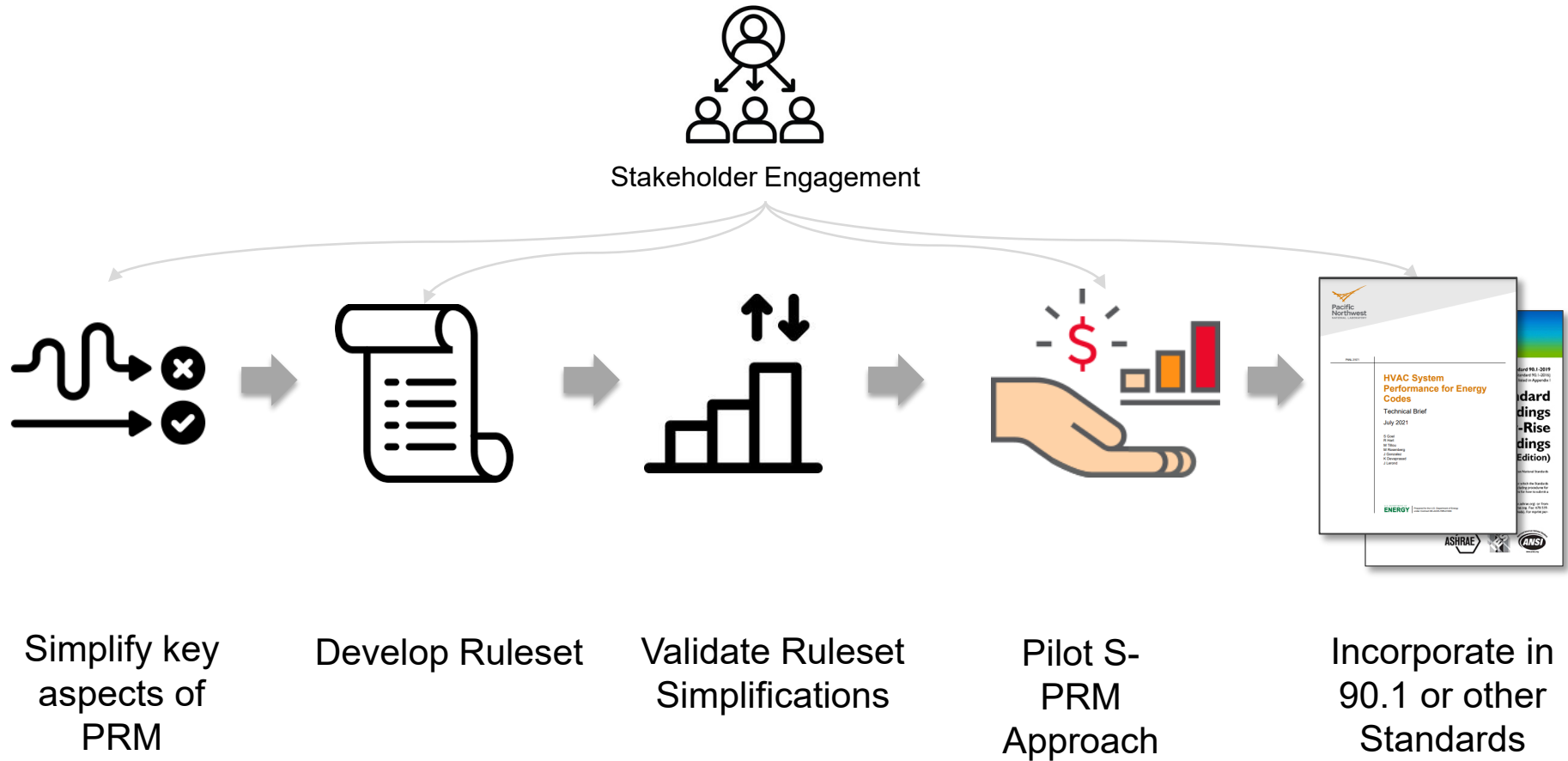
Approach: Proposed Solution

Make the performance path more available to simple buildings

- **Simplifications, workflow automation and improved reporting** are some of the key initiatives identified to addressing some of the barriers to a greater use of the performance approach
- A **set of simplified modeling guidelines and requirements,** applicable to small/simple buildings could reduce the barriers to performance-based compliance for these buildings
- It could **reduce the time, cost** as well as errors associated with BEM in compliance (and LEED and incentive) modeling

Simplified Performance Rating Method (S-PRM)

Approach

Stakeholder Engagement

| Simplify key aspects of PRM | Develop Ruleset | Validate Ruleset Simplifications | Pilot S-PRM Approach | Incorporate in 90.1 or other Standards |

Approach: Identify S-PRM Use Cases

- Code Compliance

- Utility Incentive Programs

- Green Building Ratings

- Tax Credits

- Corporate Policy

S-PRM would allow more extensive use of performance-based analysis for each of these applications

Approach: Simplify

- Identify key aspects of the PRM that can be simplified
  - A simplified approach for **building geometry** specification
  - **Prescribe defaults** for schedules and loads
  - Simplified modeling guidelines for complex measures such as **lighting and HVAC controls**
  - **Standard reporting requirements** for compliance with S-PRM
  - **Automatically generated baseline**
- Each aspect was discussed with the technical advisory group (TAG) to identify appropriate simplifications
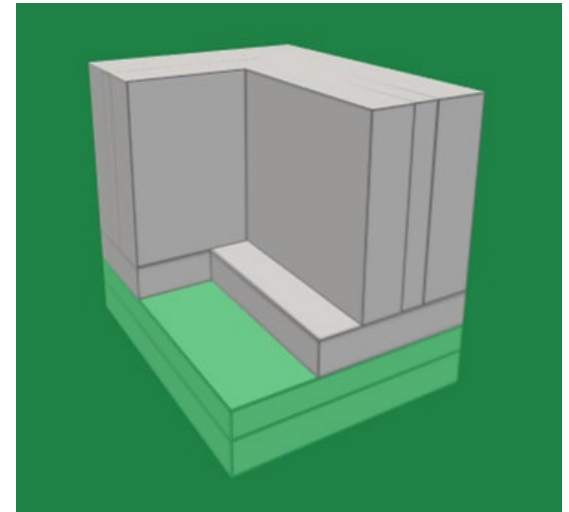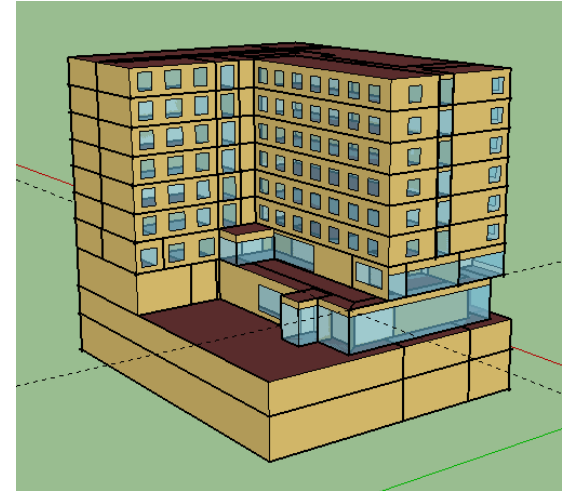
Could reduce the modeling effort from 80+ hrs to <20 hrs.

Approach: Review Existing Methodologies

- Review existing tools and methodologies

- Identify salient features of existing simplified modeling tools

- Identify key requirements of existing simplified rulesets

- Identify energy efficiency programs which require energy modeling

- Make recommendations for key aspects of a simplified modeling ruleset

PNNL-29801

Simplified Energy Modeling - Review of Existing Rulesets, Tools and Programs

March 2020

Michael M. Tillou, PE
Supriya Goel
Michael Rosenberg

ENERGY | Prepared for the U.S. Department of Energy under Contract DE-AC05-76RL01830
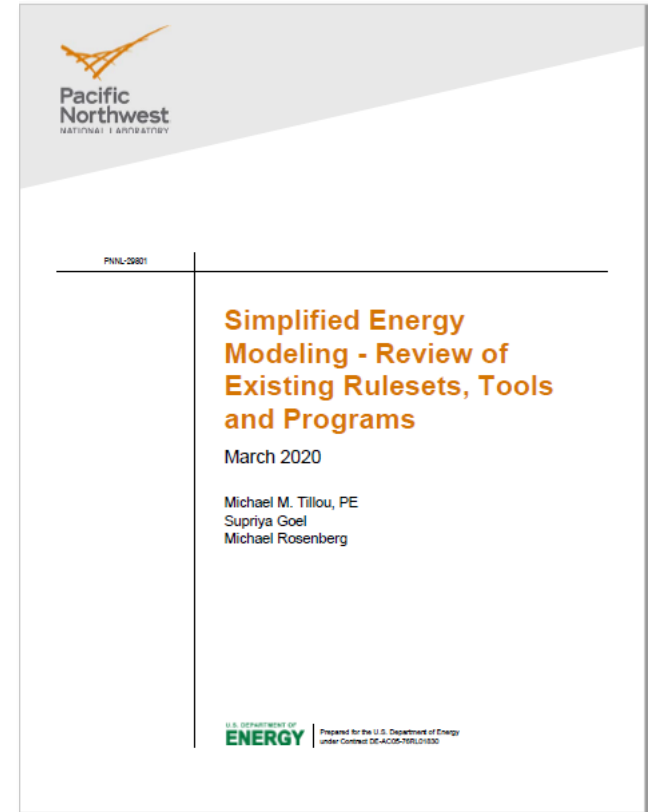
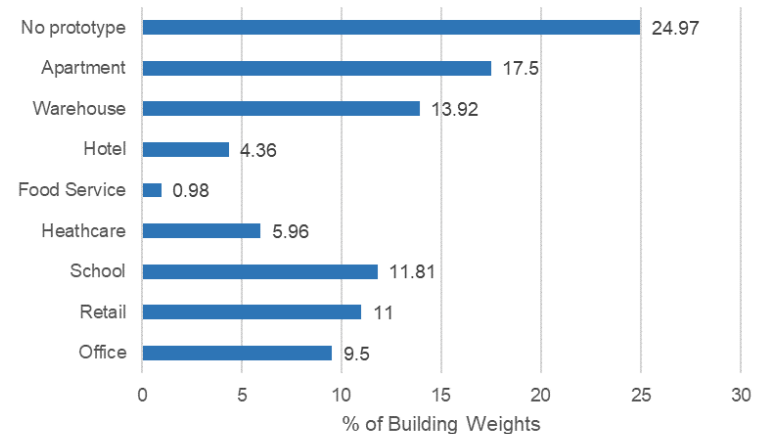# Approach: Define Applicability Criteria

Identify key **'Applicability Criteria'** to define **'Simple Buildings'**

- Building area or number of floors

- Building use type

- HVAC system type

- Specific systems or capabilities

Approach: Define Applicability Criteria

- **Building area or number of floors**
  - Large buildings can also have simply systems: Focus on building characteristics to define applicability criteria

- **Building use type**
  - Exclude use types with specific internal loads and ventilation requirements (i.e. hospitals, restaurants, refrigerated warehouse)

- **HVAC system type**
  - Applicable only to single zone systems
  - Complex ECMs like natural ventilation etc. would require use of the whole building approach

Prototype Building Weights

Building Type	% of Building Weights
No prototype	24.97
Apartment	17.5
Warehouse	13.92
Hotel	4.36
Food Service	0.98
Heathcare	5.96
School	11.81
Retail	11
Office	9.5

Predominant Heating Equipment Type

Legend: Boilers, Heat pumps, Furnaces, Individual space heaters, Packaged heating units
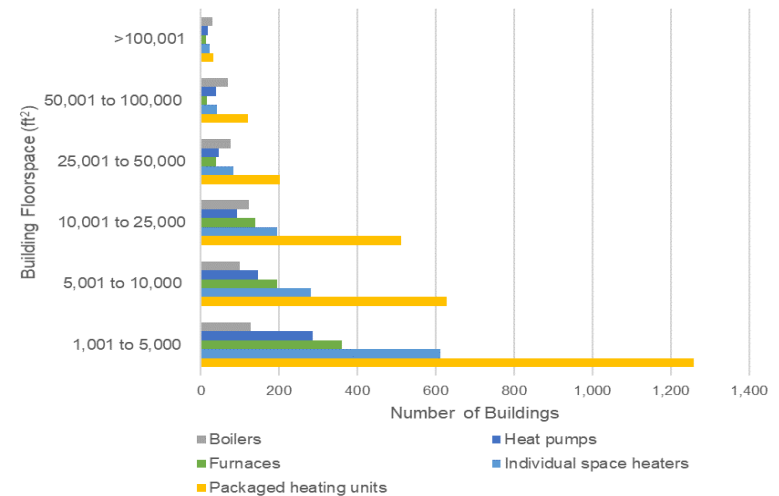
Approach: S-PRM Ruleset

- S-PRM ruleset has been developed which encapsulates the applicability criteria, simplification requirements and is applicable to the key use cases
- The draft ruleset builds upon Standard 90.1 Appendix G
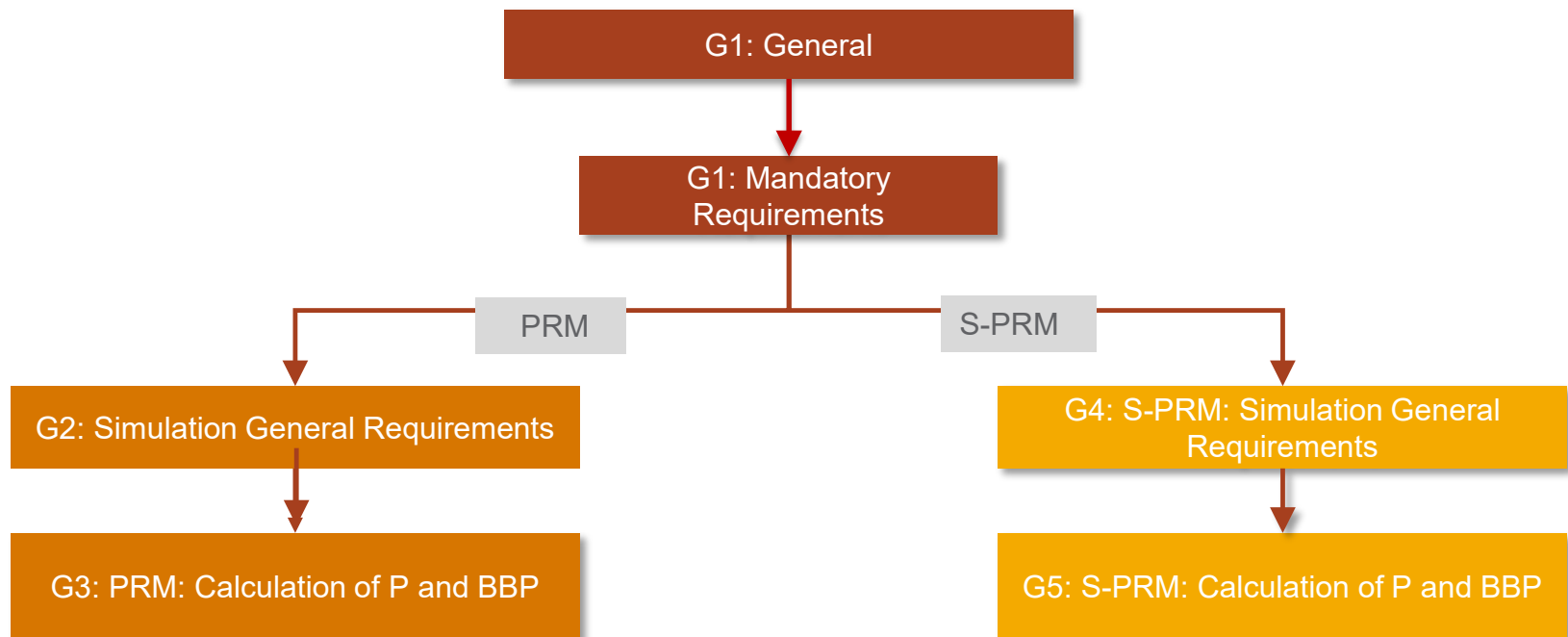- Project team is working with Standard 90.1 committee to incorporate this into the code.

```
                          ┌─────────────────────┐
                          │     G1: General     │
                          └──────────┬──────────┘
                                     ↓
                          ┌─────────────────────┐
                          │   G1: Mandatory     │
                          │   Requirements      │
                          └──────────┬──────────┘
              ┌────────── PRM ───────┴─────── S-PRM ──────────┐
              ↓                                               ↓
   ┌────────────────────────────┐            ┌────────────────────────────┐
   │ G2: Simulation General     │            │ G4: S-PRM: Simulation      │
   │ Requirements               │            │ General Requirements        │
   └──────────────┬─────────────┘            └──────────────┬─────────────┘
                  ↓                                          ↓
   ┌────────────────────────────┐            ┌────────────────────────────┐
   │ G3: PRM: Calculation of    │            │ G5: S-PRM: Calculation of  │
   │ P and BBP                  │            │ P and BBP                   │
   └────────────────────────────┘            └────────────────────────────┘
```
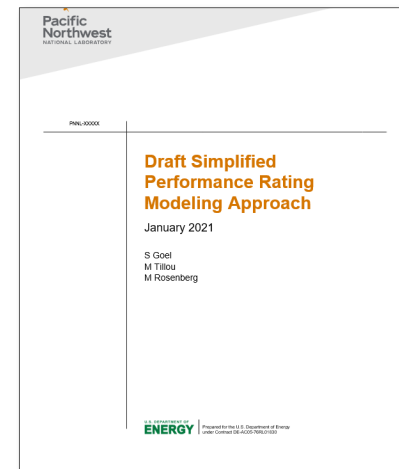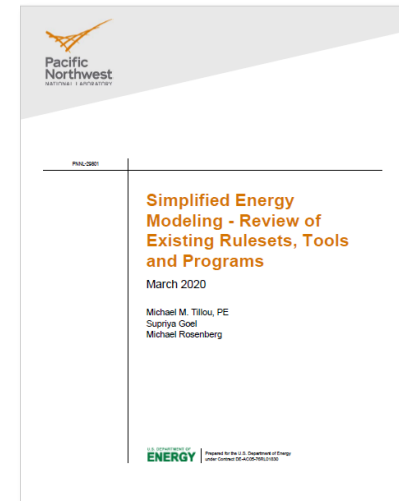
Impact

- Performance based codes are critical to meet ambitious energy and carbon reduction goals

- Though complexity of codes and hence energy modeling is not the only barrier to a wider adoption of performance-based codes, it is a significant one

- S-PRM will likely **increase the use of performance-path for compliance**, leading to more savings

  – This approach will reduce the barrier for BEM for small/simple buildings

  – It will allow more buildings to comply via the performance path

  – Buildings complying with the performance path are more likely to use BEM early at the design phase, encouraging an integrated design process.

- Focus on performance-based compliance will allow development of codes and standards with aggressive targets for energy savings and carbon reduction

Progress

- PNNL evaluated several simplified modeling tools, rulesets and energy efficiency programs and **published a report** which outlines key requirements of a simplified PRM

- Project team (PNNL + IBPSA-USA) identified key stakeholders and **established a technical advisory group (TAG) in FY20.**

- The **S-PRM ruleset was developed** with input from the TAG and shared with the 90.1 ECB subcommittee for review and input in January 2021

- **Ongoing Validation Analysis:** PNNL is now analyzing each proposed simplification using prototypes to identify the impact on savings due to the simplification

- Overall project is on-track and on budget

Pacific Northwest
NATIONAL LABORATORY

PNNL-SB81

Simplified Energy Modeling - Review of Existing Rulesets, Tools and Programs

March 2020

Michael M. Tillou, PE
Supriya Goel
Michael Rosenberg

ENERGY   Prepared for the U.S. Department of Energy under Contract DE-AC05-76RL01830

Pacific Northwest
NATIONAL LABORATORY

PNNL-XXXXX

Draft Simplified Performance Rating Modeling Approach

January 2021

S Goel
M Tillou
M Rosenberg

ENERGY   Prepared for the U.S. Department of Energy under Contract DE-AC05-76RL01830

Stakeholder Engagement

A Technical Advisory Group (TAG) was established. It includes:

- Software developers (Sefaira, cove.tool, NEO, Praxis, Ripple...)
- Consulting firms
- Authority having jurisdiction and program managers (GBCI, NYC DOB)
- EE service providers (Slipstream)

Pilot Program

- PNNL will identify a project partner to pilot the S-PRM ruleset in FY22
- The ruleset will be updated and published based on the pilot outcome

Remaining Work

- Ongoing:
  - **Validation Analysis:** PNNL is now analyzing each proposed simplification using the Appendix G prototypes to identify the impact on savings due to the simplification
  - **90.1 Engagement:** PNNL is in the process of engaging 90.1 ECB subcommittee to incorporate the S-PRM approach into Standard 90.1
  - **Pilot Partner:** PNNL has reached out to several project partners to identify an organization willing to pilot the S-PRM approach

- Next FY:
  - PNNL will pilot the S-PRM approach with a partner
  - The S-PRM ruleset will be published as a stand-alone document for jurisdictions to adopt into their code.

Thank You

Pacific Northwest National Laboratory

Supriya Goel, Senior Research Engineer

supriya.goel@pnnl.gov

REFERENCE SLIDES

Project Budget

Project Budget: 200K / FY. 600K total.
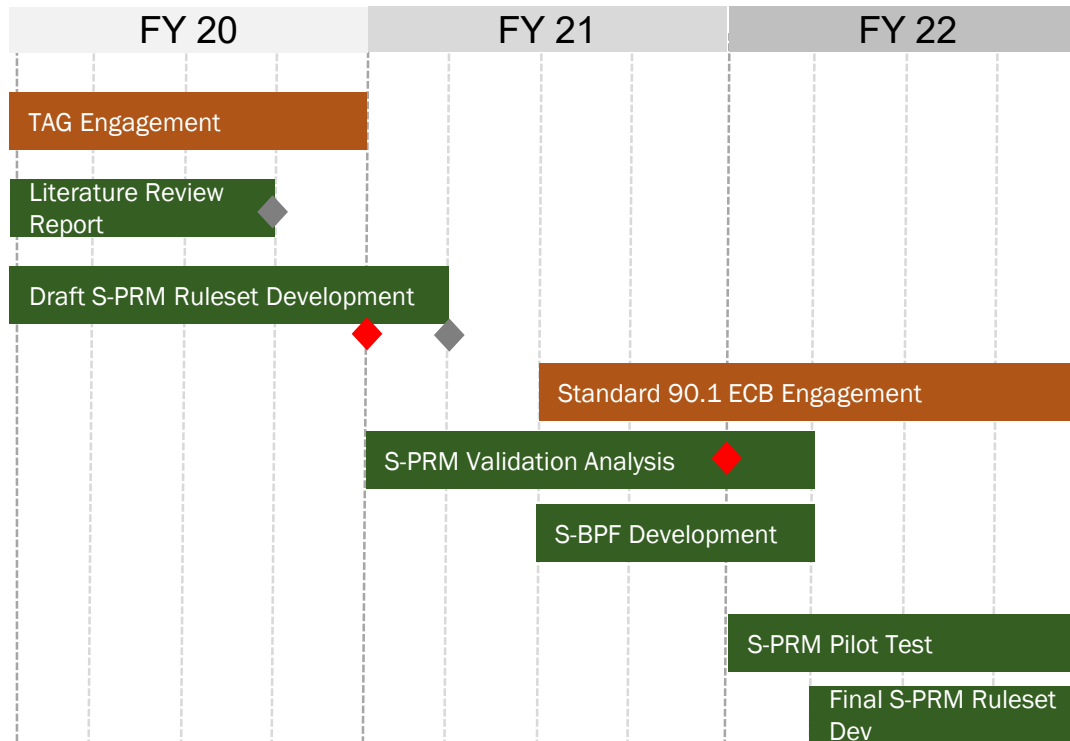**Variances**: No variations so far
Cost to Date: ~250K
Additional Funding: None

Budget History					
10.01.2020 – FY 2020 (past)		FY 2021 (current)		FY 2022 – 09.30.2022 (planned)	
DOE	Cost-share	DOE	Cost-share	DOE	Cost-share
200K	0	200K	0	200K	0

Project Plan and Schedule

Project Start Date: 10.01.2019
Project End Date : 09.30.2022

	FY 20	FY 21	FY 22
TAG Engagement	███		
Literature Review Report	██		
Draft S-PRM Ruleset Development	███		
Standard 90.1 ECB Engagement		██	██
S-PRM Validation Analysis		██	
S-BPF Development		██	
S-PRM Pilot Test			██
Final S-PRM Ruleset Dev			██

◆ Schedule/Milestone originally planned

◆ Schedule/Milestone actual

● Go/No Go Decision point