Working Group 1 Action Plan

Creating a Streamlined Process for Building Simulation

CalBEM 2019

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Subtopic Context

Future of Public & Private Code Compliance Software

What are the roles of public and private code compliance software tools?

National Alignment

What initiatives are happening at a national level that California can leverage? Are differences in California and national code compliance processes necessary? Can those differences be addressed to improve the overall impact and efficiency of code compliance analysis?

Software Interoperability & New Developments

What are the technical limitations of using multiple software tools for different types of analysis for a single building? (This subtopic does not include BIM-to-BEM workflows. While this is an important topic, it is a bigger picture issue for BEM in general.)

Problem Statements and Actions

Problem Statement A: Role of Public Software

Summary

The role of public software is not always clear. It can be difficult to assess how much support to provide to users of the free public option versus enhancements to the core ruleset and engine that is the basis for third party integration.

1. Previous efforts by CEC and DOE have not worked as well as intended. Public software tools are not able to provide all features desired (either through user interface features or capabilities supported by the tools) and private software tools struggle with developing workflows and capabilities to integrate with these tools.

Key discussion points for the group:

2. Based on this history, what role should public software or regulatory authorities have in software development?
3. Should regulatory authorities be certifying software and mandating the use of specific compliance software?
4. What might be the most productive use of public funds? Software development, Software testing, Software certification?

Discussion with the group-

1. Compliance with performance-based codes require tools that can model the requirements of the standard. Regulatory authorities need to provide a no-cost tool to support this. CEC funded the development of CBECC-COM to provide a compliance engine and the 'no-frills interface' was made to encourage other tools to adopt CBECC-Com.
2. The intent of this approach was to ease the pain for vendors: make it easier for vendors to get into the process.
3. However, this approach also does not allow other performance approaches to be approved. Buildings using the exceptional technologies cannot be certified because those technologies are not supported by CBECC-Com. The group suggested that in such cases CEC should allow certification of buildings using exceptional technologies, if the exceptional technologies have been peer reviewed.

Relevant Subtopics

1. The future of public and private code compliance software

Actions

Action 1	Clarify role of public software
Description	The role of public software is not always clear. It can be difficult to assess how much support to provide to users of the free public option versus enhancements to the core ruleset and engine that is the basis for third party integration. There are also different expectations from energy modelers, software developers and policy makers. Energy modelers expect a tool to provide all capabilities they need and be easy to use, software developers need a compliance engine which is easy to integrate with and policy makers are looking for a solution which gives them

	greater confidence in results. It can be challenging for a public software to provide all capabilities and there is the question on how much public funding should go into providing all of these capabilities.
Status	1. Status of CBECC-Com 2. Compliance software as required by other codes and standards.
Driving Stakeholders	CEC, SCE, CABEC
Impacted Stakeholders	Public software users, Private software users, Public software developers, Private software developers
Key Barriers	Code officials prefer to have 'certified software', so that there is more confidence in results. Software vendors find it challenging to integrate with CBECC-Com, and would prefer to have an approach for certifying their own implementations for code compliance.
Milestones	Short Term (July 2020) 3. The group recommended developing a **White paper** which addresses the public software and private software issues. White paper should evaluate whether the CA approach resulted in better buildings (including public software, reporting requirements). 4. Recommended as an **IBPSA-USA and CABEC** co-publication (Brian Selby from CABEC). 5. There would be no funding to support this effort, will have to be voluntary. **6.** If the paper needs to be based on real building data, then CEUS might be a good source for it. Else the paper could be structured around a survey which could be sent to energy modelers, software developers and policy makers in CA to get their input on the impact, benefits and limitations of the public compliance software approach in CA. **7. Timeline: Short term effort.**

Problem Statement B: Private code compliance implementations

Summary

There are multiple interpretations of CA code requirements – resolved through a public software. The 2019 ACM allows private tools to be used for compliance however, there is still an issue of how to address consistency among implementations. At present CA has a test suite with sensitivity analysis. However, it is only 3-5% of what is required intentionally so as tools are required to use CBECC. Reporting schema for CBECC Com is not a part of SDD. IES has been struggling with the reporting schema.

In order to enable private code compliance implementations, the CEC will have to define a level of acceptable consistency across implementations, including physics/engine consistency and ruleset application consistency.

The group will keep tabs on several related efforts:

- ASHRAE 140 (Neal, Michael, Patrick)
- ASHRAE 140/90.1 ECB acceptance criteria (Neal, Michael, Patrick)
- ASHRAE Standard 229P: Ruleset testing standard (Supriya, Scott, Alamelu, NORESCO, Will, Neal)

Other discussion:

- Disconnect between design plans and performance software: software should not be required to resolve the disconnect between the two.
- Future Action Item: New buildings versus existing buildings – need consistency between T-24, BEQ and Portfolio Manager. Hand-off between new buildings and existing buildings. Could be an BEM-to-BEM schema or I/O schema requirements for a model (digital twin).
- Repository for building data (model, metered energy use) to facilitate calibration. Next year CA will have AMI data which could facilitate this.
- Reporting Process
    - Clarify use cases
    - Identify what aspects of reporting need to be worked on.

Relevant Subtopics

8. The future of public and private code compliance software
9. National Alignment (this is a national problem)
10. Software interoperability and new developments

Actions

Action 1	Allow private implementations of rulesets and calculations
Description	National model codes do not require the use of a specific software. Require compliance with the ruleset and Standard 140. Some states have a certification process for compliance software (FL). Proposed ASHRAE ruleset for testing of ruleset implementation in software tools.
Status	Provision in 2019 Non-residential, but no private implementations have been established.
Driving Stakeholders	CEC, ASHRAE, DOE, RESNET, IBPSA-USA
Impacted Stakeholders	Private software developers, private software users
Key Barriers	Consistency

	1. Engine 1. ASHRAE Standard 140 (diagnostic physics) 2. Prototype test suite (general testing – depends on BEM-to-BEM data standard) 3. ASHRAE 90.1 ECB/140 acceptance criteria 2. Rulesets 1. New ASHRAE Ruleset verification standard (depends on BEM-to-BEM data standard) 2. Standard software implementations of rulesets Certification (expense)
Milestones	6/30/2020 Wilcox and NORESCO provide CEC with proposed approach for accrediting private implementations possibly including: • Establishing a compliance consistency committee for non-res (similar to RESNET) • Adopting ASHRAE Standard 140 (engine/physics tests) and establishing acceptance criteria (Kruis will provide updates) • Prototype test suite (general application testing) • Reference new ruleset testing standard (Goel will provide updates)

Action 2	**Prototype Analysis, Framework Development and consolidations**
Description	Prototypes have several uses in CA: • CASE development • CBECC-Com examples • Deemed Savings • Benchmarking database • Forecasting More prototypes outside of CA: • PNNL 90.1 prototypes • DOE Commercial reference buildings • RTF building stock assessment An effort to standardize and consolidate these models will help interactions among organizations and across analysis efforts. If possible, prototypes should be described in an engine-neutral format (may require BEM-to-BEM data translation). Until then, use EnergyPlus for commercial prototypes and CSE for residential.
Status	Little-to-no coordination on prototype development efforts
Driving Stakeholders	CalTF, NORESCO, Big Ladder, SCE, TRC, CEC, CPUC, PNNL
Impacted Stakeholders	Private software developers
Key Barriers	Getting people to agree on a single framework

Milestones	Early 2020	CalTF to establish framework for developing new prototypes with input from other stakeholders

Action 3	**Standardizing software readable rulesets**	
Description	All rulesets are currently manually translated from a written document into data and rules that software can read. If this translation was standardized, all implementations of the ruleset could reference a single software readable source of the data. Some ruleset requirements might be better in look-up tables versus pseudo code. Could potentially be a part of the ruleset checker for checking code requirements.	
Status		
Driving Stakeholders	CEC, ASHRAE, RESNET, DOE	
Impacted Stakeholders	Private software developers	
Key Barriers		
Milestones	Early 2020	Michael, Neal, and Scott will prototype a common format for envelope tables and write a white paper on the concept.

Problem Statement E: BEM-to-BEM Translation

Summary

There is no standard data model for describing energy models. SDD describes the proposed buildings for commercial compliance, but it is specific to one modeling engine and does not describe the as-designed building or residential buildings. Residential buildings have a different data model.

Relevant Subtopics

13. Software interoperability and new developments
14. The future of public and private code compliance software
15. National Alignment

A BEM-to-BEM translation capability would greatly help with maintaining consistency across public/private compliance tools. It is also useful in the scenario where when prototype and sensitivity analysis is performed in different BEM engines where I can facilitate translation of the energy model from one tool to another without requiring a modeler to recreate the model in either tool. The data model developed to support this capability could be used to standard test cases for compliance with ASHRAE Standard 140, prototype buildings for use with various software tools and the use of the same model for design and code compliance. E-TRMs could leverage the standard prototype buildings.

CBECC-Com uses the Standards Data Dictionary (SDD) data model for translation of model inputs from the CBECC-Com tool user interface to OpenStudio and EnergyPlus.

Discussion Around SDDXML:

1. Envelope portion of the schema is based on gbXML. This was done with the intention to make the two schemas as interoperable as possible.
2. The two schemas diverge in terms of requirements for CA Code Compliance.
3. SDDXML is also specific to E+ in terms of representation of HVAC systems

The group discussed the possible challenges with providing BEM to BEM data exchange.

Challenges Associated with Interoperability:

- Energy modelers want a single tool for design and compliance. BEM-to-BEM translation could facilitate this.
- It is very challenging to develop an **engine agnostic schema**. Each engine handles model specifications in a different manner. To develop a schema which would be engine agnostic yet support data exchange might be very challenging.
    - Interoperability between engines might not even be possible due to the differences in HVAC modeling approach.
    - A 'translator' might be required as an intermediate between two tools in order to translate data between two tools.
    - An open API is another option that could be explored. This might not work either this capability would also require a schema.
- Vendors might not be **interested** or might have concerns about developing capabilities that can support interoperability
    - **Hence, Stakeholder engagement** is important to develop a schema which can be engine agnostic.

Two solutions were discussed by the group:

Solution 1: BEM-to-BEM Data Exchange Schema

- Explore the development of an engine-agnostic schema for inter-operability between BEM tools
    - IBPSA USA Data Exchange Committee could provide the medium for stakeholders (software developers and energy modelers) to work on this issue together.

Solution 2: High Level Input/Output Schema

- Develop a high-level schema to support exchange of model inputs and outputs.
- Such a data model could be engine agnostic, could be used for initial compliance analysis and for asset rating.
- Newly proposed ASHRAE Standard 229 intends to develop a high level input/output schema for verification of compliance rulesets in software tool, to provide a path for software certification. CA could be involved in the development of that schema and potentially adopt it for software certification.

Actions

Action 1	Establish a balanced stakeholder standard for BEM-to-BEM data exchange
Description	Several data models exist but none of them provide a comprehensive solution for representing an energy model for BEM-to-BEM data exchange. A data model

	supporting detailed model representation provides several advantages (summarized above) however, there are some significant challenges associated with developing a BEM-to-BEM data exchange capability. Addressing these challenges would require a coordinated effort from all stakeholders – including software vendors and energy modelers. A second, simpler solution discussed by the group involves the development of a high-level Input/Output schema which would facilitate representation of building details in a standard format but would not allow for data exchange between BEM tools. This high-level schema provides several other advantages including providing s format for standard representation of building parameters and certification of simulation tools used for compliance.	
Status	In Progress	
Driving Stakeholders	CEC, IBPSA-USA, DOE, Public utilities, RESNET, CalTF	
Impacted Stakeholders	Software users, software developers, energy modelers, regulators and code officials.	
Key Barriers	Not a lot of motivation for software vendors to support BEM to BEM Definition of data models in software tools are different and developing an engine agnostic schema would be challenging. Time and availability to commit to the development of the standard data model format.	
Milestones	Early 2020	Join IBPSA-USA committee for Standard Formats for Data Exchange. Identify the workplan and next steps for the committee. Work with the group to explore the possibility of a BEM-to-BEM Schema
	Early 2020	Submit application for ASHRAE SPC 229 to contribute to the development of that standard and the high level input/output schema.
	Long Term (till 2022)	Work with PNNL and other ASHRAE Standard committee members on the development of the I/O schema
	Long Term (2022-2024)	Look into the feasibility of adopting ASHRAE 229 for software testing and certification.

Appendix

The appendix summarizes the problem statements that were not selected by the group for discussion. These have been saved in the appendix for future reference.

Problem Statement C: Multiple baselines for a single building

Summary
Codes and programs have inconsistent requirements, meaning that multiple baseline models may be needed for a single building. For example, a building may require both baselines for T-24-2013 fr a certain program and T-24-2016 for another. Supporting multiple baselines is an expensive proposition for software developers.
The solution is the adopt a stable baseline, which doesn't change with every new version of code and instead the performance target is adjusted to reflect the new code requirements.

Relevant Subtopics
7. National Alignment

Actions

Action 1	**Adopt the 'fixed baseline' approach of Standard 90.1**	
Description	This would allow programs to set their targets and specify metrics based on their goals and objectives. Modelers could develop a single model and use that for compliance and certification with multiple programs. With CA's unique goals and objectives, adopting a national model code would require significant analysis on appropriate metrics and targets.	
Status	NORESCO has been evaluating 90.1 App G for adoption in CA.	
Driving Stakeholders	CEC, SCE, ASHRAE	
Impacted Stakeholders	Private software developers, energy modelers	
Key Barriers	[Barrier] [Additional barriers as needed]	
Milestones	XX/XX/20XX	[Description of milestone]
	XX/XX/20XX	[Additional milestones as needed]
XX/XX/20XX	[Additional milestones as needed]	

Problem Statement D: Complexity of Compliance process

Summary
Energy code has gotten more complex over time - too many requirements have exceptions or are ambiguous and open to interpretation, that make compliance software very complicated. New code requirements do not always translate to energy savings if they cannot be implemented in software as easily. Additional complexity also means most models don't accurately represent the building systems and configuration.

Codes at the national level are evolving to provide simpler formats for compliance, which could be adopted by CA for simplified software tools, compliance and verification.
Simpler code formats require a greater degree of automation in software tools, more robust approaches for software testing and certification and a streamlined approach for reporting and verification.

TSPR approach adopted by WA state is a good example of a simpler code format with an accompanying simplified compliance tool.
A simplified ACM (or simplified Appendix G) would provide a compliance path for small/simple buildings

Relevant Subtopics

10. National Alignment
11. Software interoperability and new developments
12. The future of public and private code compliance software

Actions

Action 1	**Develop simpler code formats and accompanying guidance for implementation in software tools**
Description	[Description of action to be taken]
Status	[Not started / In Progress]
Driving Stakeholders	[Name, additional names as needed]
Impacted Stakeholders	[Name, additional names as needed]
Key Barriers	[Barrier] [Additional barriers as needed]
Milestones	XX/XX/20XX [Description of milestone]
	XX/XX/20XX [Additional milestones as needed]

Problem Statement F: Reporting inconsistencies

Summary

Reporting and verification lacks standardization and is a process not well understood by most.

Relevant Subtopics

15. Software interoperability and new developments
16. The future of public and private code compliance software
17. National Alignment

Actions

Action 1	**[Action Title]**
Description	[Description of action to be taken]
Status	[Not started / In Progress]
Driving Stakeholders	[Name, additional names as needed]
Impacted Stakeholders	[Name, additional names as needed]
Key Barriers	[Barrier] [Additional barriers as needed]
Milestones	XX/XX/20XX [Description of milestone]
	XX/XX/20XX [Additional milestones as needed]