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November 17, 2017

MEMORANDUM

To: Bach Tsan (SCE)

From: Abhijeet Pande, David Douglass-Jaimes, Yamani Arab (TRC)

Re: California Compliance Software Symposium Meeting Notes - FINAL

SOFTWARE SYMPOSIUM MEETING NOTES

The following sections summarize the discussions during a two-day California Compliance Software Symposium, held at the Crocker Art Museum in Sacramento, California on September 18 and 19, 2017.

The goal of the symposium was to gain insights from a variety of stakeholder on key software improvement needs and to help the California Energy Commission prepare for future compliance software improvements. The first day of the symposium focused on the residential market, and the second day focused on the nonresidential market. The following two sections document the discussions from the symposium, and the final section provides high-level action items and next steps.

Symposium Day One, September 18, 2017 – Residential

Attendees

- CEC – Martha Brook, Larry Froess, Todd Ferris, Mazi Shirakh
- SCE – Bach Tsan, William Vicent, Randall Higa, Christopher Kuch
- PG&E – Kelly Cunningham
- SCG – Adam Manke
- DOE – Amir Roth
- Bruce Wilcox
- Big Ladder Software – Neal Kruis
- Wrightsoft – Scott Criswell, Ethan Croteau
- Bentley Systems – Dru Crawley
- PNNL – Mike Rosenberg
- IBPSA – Mike Wilson, Erik Kolderup, Chip Barnaby

- Peter Simmonds
- Energy Solutions – Heidi Hauenstein
- Frontier Energy – Bill Dakin
- Steve Kromer
- Gabel Energy – Rosemary Howley
- TRC – Abhijeet Pande, David Douglass-Jaimes, Yamani Arab

Discussion Notes

Meeting Goals and Ground Rules – SCE and CEC

- Building on an idea of a visioning event for compliance software improvements and to break down the silos of software use for code, programs, etc.
- Keep it positive and forward looking. No dwelling on the past.
- If we are going to meet our big policy goals we have to come together and collaborate on energy modeling policy
- If you do get on a soapbox, remember to get off of it again
- Subject matter is somewhat focused on residential today, but we don't want to inhibit input. But if we feel like we're veering too far off topic, we will put the discussion item into the parking lot for later discussion for a later conversation

Overview of California Compliance Tools – Martha Brook, CEC

- Title 24, Part 6, is the Building Energy Code for California, CBECC-Res software is used for performance-based code compliance. CBECC-Res is not part of the standard because it's important for the software to be able to evolve and improve, rather than being locked into standards language.
  - It is the state's obligation to support the code through compliance
  - We have a performance based code compliance, as implemented through the software
- CBECC software has a simple architecture, no frills interface, ruleset (inputs for simulation engine)
  - Rulesets establish constraints/limits based on uncertainties in savings expectations for different technologies/approaches. Separating the rulesets eliminates physical constraints on the simulation
  - From software we go to a report generator which goes into the HERS registry
- The architecture also allows for vendor software in addition to CBECC software
  - Every release includes an API/compliance manager, each vendor gets a security key that goes into the reports. The security key is used to encrypt results into the report generator, so that report generator validates the results
- Two types of testing:

- Software testing every time we generate a new release (to confirm that the tool is generating the correct results every time)
- Validation with vendor software integrating the compliance manager, supplying a number of test files to make sure the vendor software are generating the expected answers (within an error bound)

- Trying to limit updates/releases to twice a year, unless there are major glitches that we become aware of
  - Every release of CBECC is available for download
  - Report generator does not police versions, but does notify building departments ("report valid for permits before X date")
- CEC uses sourceforge tracking system to identify every error or bug in the system, and the CEC identifies how to deal with each of them.
- Heidi: Is CBECC-Res used for purposes other than compliance?
  - CAHP uses it with alternative rulesets to test program performance
  - Title 24 rules are the most complicated part of the rulesets so that energy analysts can help meet code
- Working toward a California HERS version of CBECC-Res, working with alternative ruleset. Not public yet, but in development. Full HERS ruleset, and one with simplified version for more affordable rating approach.
- Question: Is there a list of certified vendors?
  - CEC posts certified vendors on the website (currently two for Res, Wrightsoft and EnergySoft). Around 80% of traffic to HERS providers comes from private vendors

CEC Status and Development Needs – Larry Froess, Todd Ferris, Martha Brook; CEC

- CBECC-Res is in a good spot right now, but looking forward there are needs for improvements:
  - PV modeling doesn't include shading
  - Accurately representing solar thermal
  - VRF, mini splits, etc., forced to model as minimally code efficient heat pump system
  - Focus has been on single family, so now it's time to improve on low rise multifamily

    Low-rise multifamily is another topic for improvement, there is difficulty modeling systems for multiple units/different unit types in small multifamily

    Additions/alterations in multifamily
- Opportunities/needs for potential multifamily (unifying low rise and high rise into single multifamily code)
  - Does this require a whole new version of CBECC? More complicated, but also similar in a way
  - What is the performance metric? EDR, TDV?
  - If it's not a new version, does it go in -Res or –Com? Res is better at modeling interiors, but Com is better for modeling HVAC complexities
  - Or do we combine everything into a single CBECC version?

- User input:
  - currently tree structure, but with AutoCAD and BIM systems, are there opportunities for better integration? Push a button in AutoCAD to run compliance model. Need for more graphical user interface
  - Ethan: Wrightsoft is working on "Right-CAD" fully three dimensional software that is aware of building components, competitor to AutoCAD
  - Neal: GBXML is something that we (big ladder) are already semi-compatible with for the PV components
  - Martha: CEC can't just put a button in someone else's software, and can't take responsibility for the other software's outputs
- Peter: Can we look at where the market is going, for high rise residential, programs are limited in this portion of the market
- Martha: Working on getting mini splits in for quite a while, working on getting a reasonable performance model for mini splits in residential
- Chip: CEC should be participating in the process of developing file format standards. If there are problems with GBXML, what needs to be done to fix it? How can we make it work better? Are there metrics to be developed to make an acceptable file format
- Neal: People are eager to participate in this process and provide those inputs
- Ethan: NREL also has HPXML, and working on HERS version of HPXML, one of the paths they are pursuing is a common data format, pushing in the direction of an HPXML that is specific to HERS rating. This hasn't been proposed to the RESNET board yet, but they are trying to get some consistency between vendors
- Martha: Policy development/analysis/implementation.
  - Programs are using separate analysis for incentives that do not tie back into code compliance
  - Energy Commission interprets code for the state, and we want programs to use CEC's code interpretation
  - How can we make changes to the software to support those program needs
    - More flexibility in ability to change metrics, as a research tool (not for code compliance)
    - Should be able to be flexible with ruleset changes to see what they do
    - Problems with data collection to understand how the code is working on the compliance end

CBECC-Res Developers – Bruce Wilcox

- CBECC-Res is a state of the art analysis tool for residential buildings, and we're proud of what we've been able to develop
- What we've been working on lately:
  - Converted whole software package to open source, achieving a long-term goal

- Integrated an open source heat pump water heater simulation developed by ecotope (funded by NEEA), using field data from California homes
- Integrated high quality PV performance simulation capability, can handle multiple arrays and orientations, as well as shading (currently in beta format for the 2019 standard development)
- Capability to model batteries (likely to end up with battery items in 2019 standards as a result of this capability)
- Demand response measures in 2019 research version, including pre-cooling
- Working on also adding a DR heat pump water heater measure

- What we're planning to do next
  - Want to expand on the PV shading capability
  - Keeping moving in the direction of ZNE
- Martha: Aren't there still some constraint on the open source?
  - Bruce: The Commission wanted to hold off until they had reviewed the management rules for the open source process. Working on finalizing the rules on who has access, what they can do, etc. We think we have it worked out, but CEC has not confirmed yet.
  - There are three separate repositories: CSE, CBECC software, rulesets repository. The combination builds CBECC-Res
  - As a visitor you can't make changes to the code and the CEC needs to decide how to manage the open source license
  - Bruce: Open source is becoming a bigger project as components like the ecotope water heater model
- Martha: CSE is doing all the physics, making things like mini splits work in CBECC is really about setting the rules?
  - Bruce: It's both, the rules and the performance. Initially trying to gather data on how these things actually work, still looking at testing in different scenarios, sizing, etc. Working on rules for how you describe these things, and there are test standards under development in Canada for reference. Also mini splits don't work the same as a typical single speed American style air conditioner, which is what we can model in the CSEs, so we need a different approach.
  - Martha: This is a good example of the modeling that has to happen within CSE, in coordination with the rulesets
- Bill: PV shading is integrated in the tool?
  - Bruce: In the 2019 research version
- Bill: How often will there need to be updates for something like the heat pump water heater model as manufacturers update their products?
  - Bruce: We are collaborating with NEEA, and CEC is using their ratings to qualify for our standards, a good model for the future. But we don't have much control over the updates since it's NEEA's. We're working on trying to come up with a technology where we can update something like that without having to change the software. Looking into a server solution so that you can update the technologies available without having to update the software

- Bill: What about in scenarios where heat pump water heaters are in interior spaces, which may not be an ideal scenario?
  - Bruce: If that's a capability you want added, we can add it to the list
- Bill: What about heat pump water heaters for multifamily?
  - Bruce: It's on the list of things that we want to work on. There is a question as to how they get implemented from the standards perspective. There needs to be some kind of regulated design.
- Bill: For demand response, is there thought to looking at pre-cooling with hydronics?
  - Bruce: We could add that to the list of asks. We developed a model for something similar previously for Ice Bear, so we could develop something similar again
  - CEC: We are working with them to resurrect that as a compliance option.
  - Bill: We're seeing it as an increasing option for dealing with demand response.
- Bruce: Having to wait for NEEA to see how a heat pump water heater works speaks to the insufficiency of existing ratings, vendors should be responsible for reporting their performance
- Erik: What about hydronic radiant systems?
  - Bruce: Evaporative systems are in there, but the models aren't exactly amazing. There's also the issue with how they could be implemented based on limitation of standards. It's not an insubstantial task to implement an evaporative model. There is a simple one already.
  - Martha: This is the kind of thing that should at least be on the table, because we know you could do it if you switched over to Com, so where is the opportunity to port things across?
  - Bruce: Some of these things take not insignificant resources to implement.
  - Todd: How do we get engagement in how to get others interested in doing these things?
- Bruce: Things that are under development for CBECC-Res:
  - Developing a new crawl space model
  - Working on developing a Resnet rating capability through CBECC rather than having to do a whole separate Resnet rating.
  - Working on an update to the California HERS rules
  - Geometric input using GBXML, so that's certainly a direction we'd like to go
  - Variable speed mini-splits and heat pump DHW
- Peter: Are these models algorithm driven, or is it controllable based on inputs
  - Bruce: In CSE we have a simplified control structure, we do not model behavior, we do not model the location of the thermostat. We have a mixed zone air temperature model, one of the limitations. More complex air models may have an impact, but that's not where we are at this point.
  - Peter: It's important to be clear that it's a compliance model, not a performance model.
  - Bruce: It's also not a comfort research model.

- Bach: what about validation of that performance? How does the model know the right information is put out?
  - Bruce: In the case of water heater, we're working with the NEEA data for those water heaters, based on the laboratory test data.
  - Bach: How is this engaged with the modelers, how do they know it's been updated?
  - Bruce: Right now each release comes with the latest heat pump water heater data, there are scroll boxes to select the model you want to use.
  - Martha: The other thing that's new in the model is that they rotate through a set of occupancies to represent an average, which is the right place to be for a compliance model scenario. That water heater has to serve a variety of different use profiles, and the output is an average of all the different occupancy use case scenarios
  - Mike R.: HPHW is extremely load dependent, so if load patterns change, they can drastically change the performance.
  - Bruce: The water draw schedules are coming from the department of water resources. Efficiencies may be based on oversized water draw models that overstate efficiency, whereas lower water uses may be using the same amount of energy.
- Larry: We track the comments/complaints to determine priorities, and then determine the level of effort in order to choose what our priorities are for development
- Heidi: Bach asked about validation, so this HPWH is the first developed by a third party, and there was a large process of validating that model, is that the model you envision for other third party models?
  - Bruce: Ultimately you're developing a compliance option, which is essentially a new standards interpretation, and has to get commission approval. One of the things we do is develop software support for commission staff to help them address these questions. The commission has to decide whether it gets accepted or not. There is a formal process with public hearings, etc., for major changes. Smaller things can go through a less rigorous process.
  - Heidi: So it's a process to determine what the energy commission is comfortable with?
  - Bruce: If there are no issues and everyone agrees, it's a relatively straightforward process, but if not there is a more rigorous process.
  - Martha: The problem is the process with the commission is broken. Res VRF went through this process more than 10 years ago, and it's still not in the software, so we shouldn't necessarily encourage this path.
  - Bruce: There have been others that have been more successful, but I agree that it could work better

Energy Analyst Perspective – Rosemary Howley, Gabel Energy and CABEC Board Member

- For us the most important thing is that the software is consistent, and that the results are reasonable that we can explain to our clients, and that the software works well.
- What we would like is for there to be clear paths of communication between developers and analysts when there are changes. What are the new inputs, are they in different spots, are there new requirements?

Things that will save us time. Helping people implement the energy code in a practical hands-on sort of way.

- In the past CABEC came up with the idea of an online standards implementation issues clearinghouse where energy consultants, building departments and other interested parties could go to find CEC-approved answers to questions on how the compliance software deals with certain issues.
- We want to be on the same page with the software developers.
- Erik: I've heard about issues with speed of the software. Is that something that needs to be addressed going forward?
- Rosemary: It got addressed to some extent, and people have just gotten used to it. I think that's more of an issue with the nonresidential compliance.
- Going back to an earlier Energy Commission suggestion today, I agree that is would be a good idea to have a code section that concentrates on high-rise and low-rise multifamily buildings separate from other building types. In particular, it doesn't really work to model high-rise multifamily as part of the nonresidential standards since they are residential buildings. This mismatch has led to compliance software problems now being addressed like overestimating high-rise residential energy use when window interlocks are not installed. Even before software issues are resolved, just knowing what's going on is useful.
- Erik: Existing buildings energy questions tend to be related to various special cases. Does that need to be addressed going forward?
  - Rosemary: Without HERS verification of existing conditions you don't always get credit for improvements, but when you do the HERS verification you can actually see what the energy savings is. You want the code to make sense from an energy savings perspective. It is true that existing building projects are a modeling challenge because you have to give a lot of thought to how you do things.
  - Martha: It's an issue with support infrastructure, because it requires an enormous amount of work to support alterations/additions. It's always going to seem like the commission is not adequately supporting the wide range of iterations in those situations. It's a question of how we are meeting our policy obligations supporting the rulesets for these type of projects.
  - Bruce: There's a bigger question here of doubling energy efficiency of existing buildings, which is the major problem with additions/alterations, because the assumption is that the baseline is that you get to use the same amount of energy that you always used, but have to build an addition to current code. Seems like a waste of resources.
  - Rosemary: It's true that existing buildings are the untapped resource for energy savings. There is an opportunity to address those challenges and be able to model the building in a way that can illustrate to a homeowner how the energy savings will work.
  - Bruce: We should really just be requiring people to upgrade their houses. That's what we really need to address energy efficiency needs. State legislature just updated PACE program to facilitate this.
- Rosemary: One last thing, the important thing is that this is just code compliance software, you don't have to get the perfect energy model. It's always an abstraction, unless you do a lot of work to get it just right. That's not really what it's designed for anyway, it's for code compliance.
  - Eric: It seems like a lost opportunity of engaging integrated design. From the software point of view, do we start moving toward making it a design tool?

- Peter: If you want it to comply, then yes. How many users do not understand that it's just compliance tool. But how many people are using it just to see how you need to make tweaks just to comply.
- Martha: One of the visions we haven't realized is that if we changed to this API approach was that we would have designers doing code compliance. We haven't gotten there, but it's absolutely still part of the vision.

Customer Perspective – IBPSA members

- Erik: IBPSA is not just modelers, but also software developers, policymakers, etc. The thing that frustrates users is that the compliance exercise is seen as a necessary cost rather than a value add to projects. It would be nice to get these tools more integrated into the design process, rather than just a compliance exercise. Often times have to make an energy model, and a separate compliance model (this may be less of an issue on residential side).
- Neal: The overlap between IBPSA and residential modeling is relatively small, more on academic/policy side.
  - Erik: There is some overlap here in California.
  - Neal: The conversation about high-rise/mid-rise is very relevant
- Erik: Some of the people who aren't here as much are people like EnergySoft. Putting on that customer hat, for development decisions in CBECC, decisions should keep in mind that those analysts are on the front lines.
- Chip: It seems like one way people get heard is to complain, but maybe a more formal user advisory/user input panel so that they can be more engaged with the process.
- Peter: We need to keep in mind that what clients want is getting compliance. There is a lot of work that can be done to better communicate what it takes to comply and what the compliance options are.
- Mike W.: Understanding the connection between the regulation, and the need or purpose for the regulation. With title 24, the compliance is handed off to someone else to get a check mark. I'm proposing a sort of re-branding of the compliance to better communicate the purpose, since some of this is really great. What's happening now is a frustrating passing of the buck to get the compliance check mark.
- Kelly: To focus on software, it's engaging the customer on what they need next, and the manufacturer to see what they can do.
- Erik: So the priority is to see how software can add value to the process and not just a burden.
- Todd: The CEC has multiple "customers" with varying needs, one of which is consumer protection
- Rosemary: On the point of checking the box, it's not true for all people. We have lots of clients who are very focused on environmental benefits of energy savings. So part of the role of consultants is to help educate people on what the code is, and why they are being asked to do something. But it helps when it makes sense.
- Peter: The dilemma is that many people are not understanding even the basic rules of compliance, and then we push them to go 10, 20 percent greater. For res developers, they could care less because the residents are the ones paying the utility bills. Isn't there a conflict between saying there's a difference

between compliance and performance, and then saying that this is something to sell. What is the salability?

- Chip: Is the average CA taxpayer proud of what the state has done on energy efficiency?
  - Martha: There are definitely people who are proud of it, and then there are people who say this is why everything costs more.
  - Chip: But one motivation for going beyond the code, is that it's a good idea
  - Peter: Why is the cost of housing so much more expensive.
- Erik: To add some value, these tools could provide some results in dollars, rather than abstract TDV energy.
  - Bill: Perhaps emissions is also something that could be an output that people are more aware of.
- Kelly: This is the design/compliance merger so that local jurisdictions and reach codes could use this more effectively.
- Peter: Why can't we put a miles per gallon sticker on a house just like a car? There are similar performance metrics for individual components? CO_2 and EUI together. Then you can use it as a competitive metric. Who has the better performing residence?
  - Mike W.: Is this something that assessors are able to use? Maybe this is something that needs to be reported any time you want to sell a house, having an energy performance as part of an assessment.
  - Peter: Using it as a tool to provide information on choices.
  - Martha: Home energy rating regulations is separate from building energy efficiency standards. Commission does not have the bandwidth to keep it up to date. The 2019 standards will be based on this energy design rating concept, but it's not an EUI. It's just another rating that nobody understands. The energy commission sees the value in property valuation that includes energy performance.
  - Steve: Berkeley is already doing something like this.
  - Rosemary: There are also programs like greenpoint rated or LEED that include energy, but are not just energy. These ratings stay with the house.

Broader Perspective – Amir Roth, DOE

- Stepping away from detailed geometry modeling since SketchUp stopped being freely available
- Automated testing and certifications of automated PRM implementations. Generating a baseline building model for a proposed building (PRM - performance rating method)
  - Idea is to develop an automated method to test a software tools implementation of the rulesets by comparing their translation of a 'gold standard' (CBECC SDD in this instance) to their own implementation (X). As long as the vendors can show that their implementation maps exactly to the same SDD after going from SDD to X and back to SDD, the tools should be considered adequate.
  - This is separate from validating software engines which can be handled by ASHRAE 140 testing.
  - It's application independent, just a process for confirming baseline. This could also be a process for confirming the baseline process for CPUC through Savings by Design, or similar programs. By creating an open source, CEC has seeded this sort of open process. CA is unique in the single point of contact for developing the code, developing the software, doing implementation, etc.

- Martha: If you're not doing the modeling part, why isn't the vendor just sending back SDD?
  - Amir: They get the proposed case, and they have to send back the baseline and their analysis to show that the roundtrip from SDD-X-SDD matches the 'gold standard'.
- Erik: what is the current certification process? Is it just manual?
  - Martha: They have all the files they will be testing against
  - Amir: They aren't allowed to implement their own rules, but if they follow this proposal they could implement their own rules.
  - Martha: We would be testing to see if they are matching our rulesets
- Scott: In this grand model, how do you handle performance characteristics versus rulesets. If test cases include both of those, then you need all subdivisions for passing tests. How you define what you can get from this process into what subset or superset you want to actually certify? This process doesn't have a method for evaluating all the options that the user could get.
- Erik: From the developer perspective, if someone wants to create a compliance tool, the vendor has to do the work, but does that create too high a barrier?
  - Amir: If they don't want to go through this process, they can always just use CBECC.
  - Ethan: We need to be able to produce those files identical, need to write exactly the same file because small difference will not allow us to pass the test. We have to produce the exact text file that the compliance manager can process. But there is some amount of barrier to that. As more vendors go through the process it becomes easier. Once it's done, it's just a matter of continuing to do it, and adapting our software to address any changes. But I like what Rosemary was saying about being more clear about the changes to the software so that the changes are clear.
  - Erik: I want to be clear about how much a vendor can afford to invest, and to make sure we aren't developing a system that no one can play in.
  - Comment: There is a lack of ability to collect information about who is using the software.
  - Amir: One of the frustrations of CEC is programs using non-CEC-approved interpretations of the code. Sometimes these things are easier to solve if you put pieces together and make them bigger, and sometimes it's easier to break it into smaller pieces.

IOU Perspective

- Will: The perspective I'd like to infuse to the group, I'd like to think of our role as ratepayer program administrators is bridging the gap between nation-leading policy, and everyday customer needs. It's a large gap. Part of this is through emerging technologies demonstration projects, partnering with industry leaders to implement and monitor innovative projects. We're partnering with a number of large home builders. The interesting thing about these projects is going through the lifecycle of the project and getting industry feedback. Much of that feedback informs the compliance process. Much of the feedback I've seen is that in CA, simulation capabilities and intent are way beyond the typical user. The average builder and developer doesn't have time/understanding/awareness to keep up with these developments. They are so far removed from the compliance process. People know that we are a leader in energy efficiency, but they aren't aware of how that process works. The average builder wants to do the absolute minimum to determine compliance. In the res world, energy efficiency motivation comes from the energy analysts. Few

participants understand this process and use it to provide value to their customers. Part of the reason we have spent so much effort developing these roadmaps is to note the limited engagement and participation from industry in this process. We need broader industry participation to help disseminate the process more broadly, and differentiate the value proposition. Clearly identifying the asset and operation. IOUs frequently talk about how the automotive industry is ahead of the curve in communicating efficiency metrics. We need to distill our capabilities into something meaningful to the broader customers.

- Peter: How do you market that?
- Will: The first step is to get the smartest people in the room, and determine the best metric to reach the intended goal. How do we get to a consensus toward ZNE?
- Peter: It gets down to who is the end user. Is it the builder, the developer, the tenant, or the municipality? CBECC can give you an EUI. It gets back to whether this is a design tool or compliance tool. How many buildings are just compliant, and how many are going above and beyond
- Mike W.: This is a good example of the wrong way to approach this. We need a universal translator, so like MPG, there is a need for a single measure that everyone gets. But I would say, how do we talk about Title 24 as a goal that everyone understands, so it's a constant baseline. Does this get back to that goal. What is the universal translator? Can we put a finger on a single benefit of energy efficiency?
- Will: We have not done a great job of translating performance into something meaningful in the real estate market. MPG is an absolute metric that will be the same now and in the future. But the real estate market is a moving target, based on comparables. The only way to get something meaningful is to develop something absolute that will be the same today and ten years from now.
- Peter: The metric is there in EUI, and you can easily couple that or translate that to CO_2. You have to translate that into marketing so that it's present in their minds.
- Mike W.: Most people don't know what EUI means, so how do we make it relevant to home buyers?
- Peter: The CEC could set EUI as the metric. It's not just about compliance but going beyond it. To get to net zero, you have to have EUI, if you have a positive EUI you're not net zero.
- Erik: If we try to print an EUI on a compliance tool it’s going to be problematic because there will never be an exact match. So do we have uncertainty range to account for that? It's still useful to have EUI, but we need a caveat.
- Peter: It comes back to liability if you stamp a set of drawings that claim net zero.
- Mike W.: In real estate there is some flexibility in terms of valuation, people can offer more money.
- Martha: Does it have to be an EUI? There are other workable schemes in the market.
- Peter: But it still goes back to an EUI number.
- Mike W.: Maybe give it a name like a standard operating use, so that there is a caveat to what it means.
- Martha: The point about relative versus absolute metrics is important. There is a 2006 baseline for EDR, but this is the first time we've used EDR, so it’s still new to everyone.
- Kelly: This is a timely discussion in relation to housing availability. And how does energy even remain relevant when people are so concerned in just being able to afford a house, and scarcity is such a major issue. So how do we get affordable comfort in an energy efficient system for all homeowners and renters? We need to move quickly to be in the conversation and keep energy efficiency prioritized. And then determine what metrics to use.

- Peter: The way to do it is increase utility costs. When the price goes up everyone gets energy conscious. But where does our energy come from? If it doesn't affect us, we're not concerned.
- Mike W.: If there's an opportunity for low income energy efficiency services, the metrics could help inform that.
- Kelly: We have to start to socialize it the right way.

- Kelly: Looking at the construct of what we already have with the software, the EDR, etc. We need to focus on planning for research that is relevant or useful. Sometimes we have a divide between programs and codes teams, so trying to provide information that is useful to those teams. Making sure we plan demonstration projects that have useable results. We have to deliver these things in a useful package. What can the utilities do to take the research results and package in a useful way so that they have consideration in a more useful timeframe. Do what we can to support storage and collection of data. Need the data to support the success of efforts of demonstration projects. Plan good research, deliver results in a useful package for implementation, support storage and sharing of that data.
  - Chip: These priorities are actually difficult to do, a lot of research languishes. It's amazing how long the lag is between research on something and when it gets into real world / software. One of the raps against IBPSA is that there's a bunch of grad students presenting papers, but what does that have to do with actual modeling. Models that are working their way into CSE now were first presented 15 years ago. It's hard to draw a straight line from research to payoff.
  - Kelly: Some of this is aspirational. Some of this is beyond our control. But understanding our role, and figuring out how to fill the gaps that we can.
  - Chip: Focus on things that are intended for implementation soon, and support that to accelerate the process.
  - Bill: Through collaborative process, CEC is finding out from industry what's missing, where the gaps are, and supporting research to advance it.
  - Kelly: Maybe there is some information that is ready to get across that divide, and find out where those aspects are.
  - Abhijeet: What would be a good process to move this forward now? How do we do it more seamlessly?
  - Kelly: Some of that is already happening, collaborating between the people in this room Assembling a team to look at some of these technologies that may be next on the list to see if we can move those forward.
  - Martha: On the data collection issue, being able to report back, it seems like there's an opportunity to do this without waiting for the CEC. The software is open source, so why can't someone outside of the CEC fund something to scrape the relevant information (without confidential details) into a database. Just use the open source software.
  - Kelly: That was going to be my follow-up, is that useful in feeding back into the process?
  - Martha: Yes, don't wait for us to do this. If there are ways to get agreement for collection of the non-private information.
  - Bruce: There's no way for people working in the field to get that information.

- Martha: And even though we know we should do it, doesn't mean we have the ability to do it. If someone else can build the infrastructure.
- Todd: The problem with using the report generator is that there are multiple models before there is a final selection, and report generator is collecting all of them, even though they aren't real projects. There is support for this type of idea, but there is resistance higher up.
- Erik: This idea of a collaborative research process, is there a higher level convener to set this up and actually send these things out to implementation? Setting statewide priorities.
- Bruce: Emerging technologies framework.
- Erik: Seems like you want to bring in some of the parties in this room.
- Abhijeet: What is the forum for that?
- Bach: On the repository, the statewide codes and standards team has discussed that a lot. Interpretation is the area we can start with, not having rulesets to define both means there is no avenue to bridge the gap. Part of this forum is to look at roles and responsibilities and where we can spend more effort to develop these priorities. The IOUS have certain areas we can work in, and the state has to work from more of a policy perspective they have to work from. Once we get the notes out, we should probably start identifying where those priorities are best addressed.

Recap and Next Steps – Abhijeet Pande, TRC

- CEC's perspective, need for compliance structure.
- Question of who maintains and prioritizes the wish list.
- Information sharing: compliance data, issues with the software.
- Disconnect between compliance and design.
- Multifamily and additions/alterations – big topics that need further discussions.
- What are the key next steps?
  - Larry: The strongest thing I've heard is the marketing of the EUI portion, coming up with a baseline. One of the challenges is the sixteen climate zones and the inherent differences in performance there that would need to be resolved in defining a simple metric.
    - Amir: That's what the DOE's two scores try to do, normalized to climate zone.
    - Chip: One of the simplicities of Peter's proposal is that it's just putting out the number, and let it get socialized so that people will learn.
    - Amir: Or when people go house shopping they can compare their options within the same area.
    - Peter: One step at a time, collect the data and figure out what it's going to be.
    - Chip: All of these asset rating projects become a huge project because they try to normalize it. Why not just drop square footage, just report energy use?
    - Will: When in doubt, follow auto industry, MPG is not normalized to car weight or climate.
    - Amir: DOE home energy score is energy use, not EUI.

- Peter: Isn't the goal to get EUI's to zero?
- Kelly: But it needs to be a rational zero so that it's not just a huge PV system to support huge energy uses.

- Martha: To add to the takeaways, the need for a vendor clearinghouse to inform people of changes with every new release. Talking a lot about metrics. The first step is to just get the software to actually report the necessary energy metrics (site energy, source energy, emissions, etc.) so we can actually see what's useful. Some of it is already there, we just have to bring it out.
  - Randall: Earlier versions of Title 24 were based on EUI, but it was dropped because of gaming. So there's a lot of interest in going back to an EUI or energy budget approach, but what was it that caused CEC to move away from it previously?
  - Chip: All these suggestions about publishing EUI, given the information can't we publish some comparative data. But the compliance would be relative to standard design. It's a leap if you are going to use the EUI information for anything meaningful.
  - Rosemary: Anything reported will be limited by the particular rules (climate zone, etc.), which may not be representative.
- Abhijeet: In relation to existing buildings, what is the thinking behind where we want to go with these? How do we straddle the priorities of compliance with efficiency upgrades?
  - Martha: My opinion is that for alterations you shouldn't have to use software. Our prescriptive requirements are so constrained that people run to software, but that's bad policy. It should be a compliance approach, but it shouldn't be the only option. How do you sustain that level of resource commitment? If I was a building owner, why should I have to pay an energy consultant if I want to do a simple retrofit? The prescriptive standards have made it too hard. Software shouldn't be there to solve all of our problems. Some of our problems are standards problem.
- Abhijeet: If there were software capabilities to be added, what format can be established to get more participation from others to support software improvements?
  - Larry: Someone mentioned a public communication page to get more feedback. An interactive website to pose suggested improvements, and then get feedback.
  - Martha: We wanted open source so that we could get more participants, but we haven't finalized the management rules, so it's not actually open. We need to actually get to the finish line on that. Some of these things are so doable, but aren't necessarily on the radar.
  - Abhijeet: Like CAHP score.
  - Bill: Is there an avenue where industry says "we want this implemented in the code, and since the software is open source, we'll develop it and send it in for testing."
  - Martha: That's definitely the end goal, so the that it doesn't get bogged down. Obviously not everything can go that way.
  - Amir: There's not a lot of code that's "donated" to EnergyPlus. But you can bring in other resources if the software is open source.
  - Neal: There are significant barriers to entry. Some are real and some imagined. One of the challenges, even though it should be an easy process to get involved with code, there are a lot of lawyers that want to get involved in the process.

- Erik: Supporting the software vendors somehow. There's not a good solution on the nonres side, and how is that the case? Are there mechanisms to provide better support.
- Todd: Part of our contract is to support vendors, but we aren't going to do the work for them.
- Scott: Money is not on the table, but there are support services available to vendors. The call for that kind of help is usually relatively minor, but it's still a lot of work for vendors.
- Martha: We heard from Wrightsoft that they've committed to getting in, and they only have a small portion of the market, so that serves as a barrier because we haven't solved the design versus compliance problem
- Ethan: We're integrating CSE, open to helping contribute to the design vs compliance aspect.
- Mike R.: That's one of the things that the new ASHRAE approach (Appendix G or addendum BM to 90.1) is meant to address, using the same baseline.
- Martha: If you're trying to get mechanical engineers to do their own code compliance, they need the tools to do that. But for now they're still passing to others. But if they have to do it the same for all the other states that might help.
- Peter: At least the ASHRAE base case is stationary. It goes back to the design vs compliance discussion. The ASHRAE is much more open to trying different iterations.
- Erik: For LEED calculations, even in CA, I use ASHRAE baseline because it's easier to control that CBECC.
- Chip: Mech Engineers don't do their own code compliance because it's a specialization.
- Comment: It seems like outside of CA most of them do.
- Comment: The building industry is becoming increasingly specialized, so that might be the answer.
- Rosemary: Any engineer could do compliance, if they chose, study up on code, but they'd rather hire it out.
- Martha: It just seems like they're not meeting the intent of the job.

- Next Steps:
  - Seems like we have momentum on the idea of the software providing multiple metrics (EUI, energy use, TDV, source energy). That seems like an immediate next step that can be done relatively quickly.
  - Need to establish a online repository for compliance software improvement ideas so that we can start prioritizing needs by the CEC.
  - Setting up regular feedback/discussion process that can focus on software discussion.
  - SCE/TRC will develop a roadmap for compliance software based on today's discussions and action items.

Symposium Day Two, September 19, 2017 – Nonresidential

Attendees

- CEC – Martha Brook, Larry Froess, Todd Ferris, Mazi Shirakh

- CPUC – Peter Biermayer
- SCE – Bach Tsan, William Vicent, Randall Higa, Christopher Kuch, Andres Fergadiotti, Charles Kim
- PG&E – Kelly Cunningham
- SCG – Adam Manke
- NORESCO – Dimitri Contoyannis
- Bruce Wilcox
- Big Ladder Software – Neal Kruis
- Wrightsoft – Scott Criswell, Ethan Croteau
- Bentley Systems – Dru Crawley
- IES Ltd. – Liam Buckley
- PNNL – Mike Rosenberg, Supriya Goel
- NREL – Andrew Parker
- LBNL – Tianzhen Hong
- Charles Eley
- IBPSA – Mike Wilson, Erik Kolderup, Chip Barnaby
- Peter Simmonds
- Energy Solutions – Heidi Hauenstein
- Frontier Energy – Bill Dakin
- Steve Kromer
- Zero Envy – Greg Collins
- DOE – Amir Roth
- TRC – Abhijeet Pande, David Douglass-Jaimes, Yamani Arab

Discussion Notes

Overview of California Compliance Tools – Martha Brook, CEC

- CBECC is a compliance approach, not a standard on its own. Baseline building does change every three years with code updates.
- Software is: User Interface > Rules > Engine > Report Generator (does not go to a registry).
- All the constraints are housed in the ruleset that is the implementation of code to keep it out of the simulation engine
- Part of testing is confirming the security key functionality

- Vendors submit software for verification

DOE BEM Roadmap and an Idea – Amir Roth, DOE

- Idea: Automated Certification of Automated PRM (see notes from day 1)
- Martha: How would this option work better for the vendor? They have to build the translator the way we do it now, and they have to do it this way as well. Do they want to be in the business of interpreting code?
- Amir: Yes, they do. I think this will help address some of CEC's concerns of vendors misinterpreting CEC's interpretation of the code. You're saying use this process to prove that your interpretation matches ours. Decoupling the engine and the rulesets. This process will be able to identify where discrepancies are coming from.
- Scott: Who polices if the test passes? Or if the CEC model is incorrect?
- Amir: The vendors can use the results to argue for your interpretation if you think CEC's interpretation is incorrect. Presumably CEC has a process for this.
- Erik: This is comparing two SDD building models, not simulation results?
- Amir: Correct, you're only testing the baseline generation procedure. You want to do this test in two steps because you want to know whether the discrepancies are from the baseline procedure or the simulation engine.
- Martha: Presumably there would be a similar process for confirming the proposed building process?
- Amir: Yes, presumably there is a similar set of rulesets for the proposed building
- Amir: It's application independent, just a process for confirming baseline. This could also be a process for confirming the baseline process for CPUC through Savings by Design, or similar programs. By creating an open source, CEC has seeded this sort of open process. CA is unique in the single point of contact for developing the code, developing the software, doing implementation, etc.

CEC Perspective – Larry Froess

- Looking forward at CBECC-Com, it's still missing some pieces, always looking for new features to bring in to the software.
  - What is the future baseline, how do we approach it?
  - Questions about how to address high-rise multifamily going forward within CBECC ecosystem, does it become res, or com, or is there just a single CBECC for all applications?
  - Input for CBECC-Com is a tree structure, SketchUp as GUI for that, but it's only a matter of time before that's no longer a workable option for detailed geometry inputs, so we are on the lookout for other options for that.
  - Detailed or simplified geometry versions of CBECC. Are we ever going to create a threshold where simplified geometry is not allowed? Moving to ZNE, detailed geometry does a much better job of accurately simulating energy. Maybe simplified geometry can't be used for ZNE, so it's really important to have a good detailed geometry process.
  - The lack of a registry in CBECC-Com.

- Speed, are there ways to make it more efficient, faster?

- Martha: I would just add from CEC's perspective, for ZNE we really need to focus on nonres, have to get on the path to ZNE for commercial. We have a great opportunity to establish a fixed baseline or standard EUI or performance metric to track progress toward ZNE. Now is actually the time because it takes a lot of time to get the momentum.
- Abhijeet: Any thoughts from the CEC on what you would like to see in terms of engagement? How can people help CEC with this process moving forward?
  - Larry: Mentioned yesterday setting up regular feedback/discussion process that can focus on software discussion.
  - Martha: And maybe there is actually a plan that gets established, with milestones every six months or so to track progress. Can't underemphasize the importance of formal comments into the docket. Opportunities to go on the record with what they want to see from the CEC on the software. Otherwise it's just he said-she said.
  - Bach: As far as engagement, IOUs have opportunities to get people together, but we can't always get everyone in the room, or don't have access to all the stakeholders. So having some more engagement, working with IBPSA on getting more engagement.
  - Kelly: There are resources like the Title 24 stakeholders platform, as well as Energy Code Ace, so that might be a platform that can facilitate some of that.
  - Larry: ACM workshops should be in the early spring so there will be opportunities for docket comments then.
  - Kelly: Comment on docketing letters, that docketing process does seem to be really critical to the process, so stakeholders should really utilize that process.
- Liam: To reply to Larry's perspective on future detailed geometry inputs, IES are interested in providing our geometry tool to CEC as a free solution. Note that our detailed 3D geometry tool already integrates with CBECC-Com.
  - Larry: Yes, we've discussed that
- Will: To reiterate Abhijeet's question, do you see other types of stakeholder engagement that would help with the process?
  - Martha: I can think of all sorts of stuff, why doesn't someone fund ASHRAE Appendix G implementation in CBECC-Com.
  - Supriya: For 90.1-2010 we started working on it, but there is still more work to be done.
  - Martha: So that gets into the realm of governance on who can fund that, but with open source it gets easier. There's also an opportunity for writing specs for getting on the path to zero.
  - Dimitri: Yes the specs are part of what we will suggest.
  - Mike R.: A number of entities are already implementing Appendix G, if there was some way to coordinate with those other states, funding could be pooled to create less of a burden on a single source.
  - Andrew: OpenStudio has an implementation (not yet 90.1-2016 version)

  - Mike R.: There are other entities that are piloting or using it. It would be used more if there were these kinds of tools available. This is the whole reason for this approach, to make these systems and approaches more available

- Amir: Using CBECC not only as compliance, but also as LEED tool.
- Martha: We're already mostly done implementing 2019 code in software, so the next software update is for 2022 version. So there is a limitation of the number of large things we would do. Potential for comparing to Appendix G is there, not changing the code, just establishing reference.
- Chip: If there is an agreed file format, there could be one baseline generator that everyone could use. So why have to compare and test? Why not just establish an agreed standards, and everyone uses it.
  - Martha: Right, just a standard evolution.
- Kelly: If everyone could answer when they get a survey on CBECC-Com and standards improvements in the their inbox of what people would like to see. It's a tiny thing that would be hugely helpful.

CBECC-Com Developer Perspective – Dimitri Contoyannis, NORESCO

- Working to get to a ZNE code in the future, these tools are a means to an end.
  - Important that code and software is implemented properly.
  - CBECC-Com is a full implementation of Title 24 Energy Code.
  - Found numerous issues with how code is implemented through software, working to address issues in the software from stakeholders.
  - Continuing to release two major updates each year.
  - Developing "feature specifications."
  - The software code is the easy part, the major portion of work is making sure we know exactly how the function works, and how it fits in the compliance framework.
- Andres: From a resource perspective, why should we support enabling new features in CBECC if they are already available in EnergyPlus?
  - Dimitri: There are number of tools that can model more things than CBECC-Com, but most of those tools have not been analyzed for compliance. A lot of these new features that people are asking for are advanced technologies that need to be vetted before they get plugged into compliance.
  - Andres: Would that include validation? How are you evaluating those features?
  - Dimitri: Sensitivity analysis to see how the inputs impact the results, perform comparisons with real world information where available. It's important to know what's going to happen when we implement these features in CBECC-Com.
- Greg: Vetting the sensitivity and the defaults for each and every measure before they can be implemented in CBECC is not the highest priority. People are using many work-arounds now to get through the compliance process, which is probably less desirable than a default input that hasn't been fully vetted.
- Erik: Is this feature specification also writing ACM rules for modeling?
  - Dimitri: Yes, there have been extensive efforts on developing performance curves.

- Peter: You're saying features are in EnergyPlus even if they haven't been vetted?
  - Dimitri: The algorithms are, but the inputs and the defaults are not. It's up to the user to make sure they put in the appropriate defaults.
  - Tianzhen: Trying to get real measured data to validate model in EnergyPlus so these efforts are happening outside of CBECC-Com as well.
- Peter: Are there any efforts for including water consumption in HVAC modeling?
  - Larry: We don't look at that at the moment.
  - Martha: We have a mandate to consider water efficiency, but it's not currently in our modeling.
  - Tianzhen: In EnergyPlus we do calculate water consumption from HVAC processes. For data, we are working on developing standard data sets to simulate VRF in our modeling. It's tough to get manufacturers to open their data.
- Chip: ASHRAE 205P "Standard Representation of Performance Simulation Data for HVAC&R and Other Facility Equipment" is now nearing completion. The standard specifies data formats that can be used by manufactures to write equipment performance files that can be read by simulation engines. That will capture off-design and part-load performance of specific pieces of equipment more accurately than curve-based models.
  - Neal: 90.1 committee also very involved and interested in updating these models.
- Dimitri: Looking forward, we are focused on achieving ZNE by improving energy code, not software code
- Liam: What is the funding associated with these efforts?
  - Dimitri: It's all in public record, about $3 million every three years combined for standards development and software development. About half of that is for compliance software development and the other on standards development.
  - Martha: Maybe that needs to be a recommendation that those two things are separated to provide a better pool of vendors available for each piece.

IBPSA Perspective

- Erik: IBPSA and its members are interested in being stakeholders in the process. We want to support this process
- Neal: IBPSA Advocacy committee formed a few months ago with awareness of CA and DOE as major players in building simulation industry, with objective of supporting simulation industry through advocacy. Formed out of concerns over how decisions were made, and how those decisions impact software companies. Want to make people aware that IBPSA is taking this advocacy role.
- Abhijeet: Is the goal to have the advocacy committee represent the industry at events like this, or to have your own?
  - Neal: A little bit of both.
- Greg: I'd love to add a goal of representing practitioners, following high performance energy efficient design process, the code compliance should fit within design process. Currently it is more of a distraction. We have our own tools that provide feedback on systems and strategies, but the compliance process comes

later. It's not a smooth process. I understand the intent is to work toward that, but it hasn't worked out that way.

- Amir: Isn't there a way to integrate that within IES-VE?
- Greg: There is a Title 24 module you can use with model geometry, but the integration with the rest of the software is very limited.

- Martha: CEC needs to be encouraging the people with design tools to have almost a push button interoperability. Needs to be an ability to just say give me a T24 compliance run.
  - Greg: I'm happy with a few more button pushes, but right now it's like starting from scratch.
  - Mike R.: Is the problem that you can't use the building you've designed in CBECC?
  - Greg: Ruleset is a problem. If it's not in CBECC it can't be used for compliance.
  - Dimitri: The original intent in developing SDD was a one-button click option from your native tools, but not sure we're there yet. I still think that's a good vision, and something we should continue to discuss, making it less of a chore.
  - Martha: The vision has not been realized. Let's not throw the one vendor who tried under the bus, when the other options have no integration. We need to own the back office stuff of getting more functionality in CBECC. We can't own how vendors implement compliance manager. How do we work as a whole community? We seem to have similar goals, so how do we get there. If IES doesn't have the market share to see the value in integrating compliance. CEC can't do anything about the inertia of analysts using Energy Pro. I want you to be able to do it in your design tools.
- Erik: There was a huge underestimation of the effort to take a legacy software and write the SDD. Everyone has their own inputs, but SDD needs other stuff. It adds a lot of overhead to the legacy interface to populate the SDD with the proper information. You almost have to create a whole new platform to support SDD format. It requires much more input to actually run the SDD
  - Chip: Every entity defines all sorts of things, varies by state, so if you want a unified input screen, you have to resolve all those inputs. It's data modeling.
  - Martha: Maybe it's also code development. Maybe that's the ask to write better code so you don't have to deal with all these arcane issues with defining space types.
  - Mike R.: But if we were using a national model code baseline, some of these code issues wouldn't be a problem.
  - Liam: To reply to Martha's comment about the interoperability and vendor integration, it has nothing to do with market share. The reason that IES doesn't do a better job of integrating CBECC-Com is because doing so promotes our competitor, and that competitor is EnergyPlus.
  - Neal: There's a long history of competition between CEC and DOE, and it's not always healthy. We really want to support a self-sustaining software industry without state/federal competition.

National Labs Perspectives

- Tianzhen: How do we improve processes to get credit for innovative/advanced solutions? Supporting codes and standards and making sure that EnergyPlus can model new technologies. Making sure the tool is neutral and can be used by everyone.

  - Amir: The way EnergyPlus supports other engines is as a reference that other implementations can look to, either implementing it directly, or just look at how it works and do their own thing.

- Dru: One thing that would help developers is to understand what technologies CEC is seeing that are driving buildings toward ZNE. That way we can focus on CBECC and making sure our tools are covered. And quit trying to focus on third level effects of the things that are not really effecting ZNE.
  - Peter: But there are differences between compliance and ZNE, unless we make just ZNE equal compliance. It's a moving target. How do we solidify it to a simple set of talking points? Are we talking about the mainstay technologies to get to compliance, or are we worrying about the periphery?
- Bruce: There's a big difference between where we are with res and nonres. ZNE for Res is 2020, which is right around the corner, but we have until 2030 for Nonres.
  - Dimitri: The goal for 2030 is ZNE, so we are trying to identify the factors that will be most impactful.
  - Liam: We actually are working together for the goal of ZNE, all we're asking for is an alternative approach to let industry decide how to do it. Ultimately working toward the same goal.
- Greg: Is it a truth that you won't be able to take credit for technologies that aren't implemented in CBECC-Com? If that's the case there are a lot of technologies that aren't in CBECC that are being used in highly efficient buildings, so there is a lot of effort to get them into the software.
  - Martha: For better or worse, we don't trust that modeling will correctly portray all technologies. But there is an understanding that there are workarounds. We get nervous around how the tradeoffs work. There are two approaches, allow lots of tradeoffs but constrain modeling, or allow freedom in modeling, but constrain trade-offs.
  - Mike R.: Is there some consideration given for lifecycle of measures?
  - Scott: On one end there are tech that aren't in software, on the other end, tech that has been through enormous amounts of analysis and testing. Assuming we have to cover a lot of tech to get to ZNE, is there consideration being made for compromises. VRF has been implemented in rules, but still isn't in modeling. If we can set some reasonable amount of time or effort to allow for some of these technologies, it might allow us to move on to other technologies.
  - Bach: It's not just CEC and policy, but manufacturers need to get involved.
  - Bruce: In Res we explicitly muddle things, and it works in Com too.
  - Dimitri: We know there are gaps to fill, we need to understand how to prioritize those things. We need a way to come up with the list, and how those things are prioritized.
- Neal: Just want to caution against the idea of consolidating around one simulation engine. No tool is safe to be considered good on its own. The ability to compare against other tools is vital to improvements
  - Amir: True that DOE does not provide user support for EnergyPlus, but other software developers do provide those types of services.
- Mike R.: PNNL provides support to DOE's building energy program, ASHRAE 90.1. Performance based compliance worries people because of robustness and reliability of tools. We decided to put our eggs in the Appendix G basket because the baseline is more independent, based on the program of the building, rather than the proposed building. It better reflects the design decisions you make. To establish a stable baseline, for App. G, decided to use 90.1-2004, but the reality is that it doesn't really matter because the target is

relative. The hope is that this will incent software makers to automate the baseline, and to get reports that jurisdictions can use. Performance path is growing in other jurisdictions where it has been far less common that in California. We know this doesn't work great for some projects, like small retrofits, or buildings with district energy systems, so there may need to be some adjustments for that.

- Bach: Can you speak a little bit about Addendum BM?
- Mike R: Addendum BM made two big changes to 90.1, Appendix G can be used as a compliance methodology, and set the baseline as 90.1-2004. We also developed a performance rating method manual that focuses on how to implement the rules from Appendix G.
- Greg: When someone submits using App G, how does that work?
- Mike R.: NY has nice compliance forms that build on LEED spreadsheet, but it is a pretty burdensome list of documents that you have to submit.
- Supriya: This is where CA is so uniquely positioned because you already have all the infrastructure in place, and you've already established the defaults, so it's just a matter of moving forward with a fixed baseline.
- Chip: One thing that would help the implementation burden would be to have a single baseline. Every state doing its own thing has a huge burden.
- Martha: Is it just the baseline, or does it also constrain the proposed design?
- Mike R.: It shouldn't, but there might be some issues. It tries to limit gaming.
- Martha: Does it also address prescriptive vs compliance?
- Mike R.: We kept all the compliance stuff out of App G. It's all rating system and rule set.

- Andrew: Transparency is a key theme for state and national level policy decisions. And when the results of simulation effect money transparency is important. This has been interpreted as a requirement to use open source software. There has to be a way to quality check inputs and review inputs for incentive programs, code compliance, etc. CBECC-Com is pretty good approach to achieving that (assuming you have all the necessary inputs).

  Looking at SCE roadmap, you have to zoom out from code compliance. How do you handle incentive programs (Savings by Design), how do you deal with work papers for prospective technologies (by definition not in the engine), how do you simulate code enhancement proposals, how do you simulate emerging technologies that may only exist on a lab bench somewhere? These things need to allow for more technologies, need to be able to run things at scale with thousands of simulations. There are needs that go beyond just looking at the scope of code compliance. Preserve all of the modeling methodologies. OpenStudio has a user interface. DOE and NREL don't want to be in the position to have to support a user interface.

  It's possible to decide on a modeling platform, and then build quality control, baseline automation, report generation on top of OpenStudio, and then use whatever interface you want to generate OpenStudio models. Then say this is the platform for compliance, code development, incentive programs, emerging technologies.

  - Andres: OpenStudio instead of CBECC?
  - Andrew: If you want to do ZNE in CBECC-Com there are a lot of things that need to be added, and CEC knows that. CBECC is not necessarily a bad choice, but you have to do a lot of work to get it there.

- Dimitri: Whatever tool you use, you have to run a lot of scenarios/tests to make sure it works, and that's where the bulk of the effort is.
- Andrew: Agreed. What I suggest is using the platform that DOE has developed and build on top of that.
- Erik: SDD has a lot of overhead in compliance information that goes into it. If an OpenStudio model can represent the building, there's still all the stuff that has to inform the rules processor. So does all of that have to be built into it, and then do you have to do the same thing for every other state?
- Andrew: For four different versions 90.1, only had to add types of window frames, and what types of space types. There are probably additional things for CBECC that you would have to add, but I don't think it's a ton.
- Scott: Along those same lines, two years ago, NREL was working on an effort to enable OpenStudio to collect all the inputs to connect to CBECC-Com, and get OpenStudio on the certified tools list. There were a lot of missing inputs that would have to be added. Do you know what happened there?
- Andrew: Not sure what happened with that.
- Erik: Some input fields in OpenStudio are California related.
- Neal: Scalability is an important thing going forward. There are platforms beyond OpenStudio that can handle that. It's a problem that's been solved in other ways too.
- Andrew: In CA there are two sets of prototype buildings, and one set of implementations.
- Dimitri: We started with PNNL prototypes, and made some modifications.
- Andrew: There is an opportunity in CA for a separation of responsibilities. You have to be able to run the system that generates the models, and then be able to run the models that have your measures, and the models that don't have the measures. Opportunity to simplify that process without having to generate the baseline models from scratch.
- Martha: That's consistent with what I've raised for statewide infrastructure development.
- Dimitri: CEC does generate code minimum prototypes every code cycle. There is pretty detailed guidance on how to use those prototypes to apply the proposed measures. A lot of this already has a workflow.
- Martha: But that process is not used in work paper process.
- Dimitri: You're right that code compliance is not the only piece of the software equation. But where they have attempted to produce similar functionality with their implementation of ASHRAE 90.1, the result is incomplete and unproven, with major functionality gaps in the areas where the code is complex such as exceptions to specific code requirements, and therefore the most important areas to have a fully vetted ruleset. Characterizing the process of developing automated baselines as being “easy” seems to trivialize the effort involved and shows a lack of understanding in what is needed for adoption at scale.
- Andrew: There is value in using the OpenStudio platform to meet statewide goals, and using it for compliance would make it a more attractive option.
- Dimitri: That doesn't address verification and does not address the real issue which is the time and effort needed to validate that algorithms are correct and represent code correctly.

- Scott: What we're talking about doesn't reflect the effort that went into getting to where we are now, we aren't spending a lot of effort today, because we're building on a major effort that already happened.
- Andrew: It would be worth comparing it to the real costs of approaching this from different approaches. Compare the cost of implementing CBECC in OpenStudio, versus building capabilities of OpenStudio into CBECC-Com.
- Erik: Think about the users in this case. What I want is something that works for me, and I want something that has way more testing than went into CBECC. It was a major pain to deal with the transition, and we don't want to do it again.
- Martha: And we don't know where the pain was coming from.
- Erik: Whatever we do going forward, double the budget for testing.
- Andrew: The people you should ask are the people who are actually doing these compliance models all the time.
- Martha: We have to take the risk of doing something or nothing changes. I know it was rough, and even it was perfect, change is so hard within a government process. To think that we could have proprietary software that we would have to buy and don't build, and does what we need, it was untenable, it was impossible.

IOU Perspective

- Bach: Three general buckets: roles and responsibilities, industry, development, research, and then CEC has task of making changes and creating and developing changes for California, putting it the right bucket, discussion of technology, discussion of getting to ZNE, which is a policy goal. It's not that far away, 2030, we're looking at 2025 for GHG-free goal, we have to have an infrastructure and products to support that initiative, and then 2030, for ZNE new construction. There isn't that much time to implement that. One thing we haven't talked about is metrics.
- Charles K.: Tools are nothing more than tools. Do we need to evaluate TDV in light of considering GHG goals. Do we need different metrics? Looking at hourly, California specific, site to source conversion.
- Andres: Would like to explore the development of rules that can evaluate TDV.
  - Martha: It seems like it would be pretty simple since the 8760 values are available. So would you do that to use TDV as a Savings by Design metric? Just to confirm that you've met or exceeded code?
  - Andres: For evaluating ZNE projects.
  - Dimitri: There is a process for adding new features. There are tight controls, specific to compliance. If you wanted to a similar analysis for another feature, may not be the same priority. Every building has to go through compliance. For programs it's less important to do all that vetting in advance.
  - Andres: I agree for compliance. Feature validation and coordination and checking should be coordinated across efforts, not siloed in compliance.
  - Dimitri: I'm not suggesting that vendors are putting bad algorithms out there, but there are a lot of complications that can introduce problems. There are a lot of inputs and if you don’t make some default, most users have no way of inputting information based on data they have.

- Martha: Has Savings by Design already done the crosswalk between code and EUI?
- Andres: It is still in a brainstorm phase.
- Martha: It's a problem if you're not relying on CEC's code implementation.
- Bach: There is a pilot project looking at different building types and their EUIs.
- Dimitri: Recently we worked with CEC to establish baseline EUI for 15 building types, and can calculate other data based on the available information.
- Greg: Savings by Design is where T24 meets performance rating method. Using non-compliance models for design/LEED. To calculate the actual savings. This is a great place to pilot an alternative compliance approach.
- Dimitri: A lot of the work done to develop CBECC-Com around the buildings being built today. The next couple code cycles will continue to be informed by that, but also need input from IBPSA and others. Walking a tight rope to try and please everyone, and as a result, not everyone is pleased. We need to do energy modeling of buildings, so how do we get to a point where we're doing more energy modeling and less data input.

- Bach: Compliance improvement is a big part of utility programs. This is also part of planning and coordination.
- Kelly: What I'm waiting for is the end of the day when we talk about next steps and what will happen for the rest of this year, and into next year. Something related to the software is important to the entire process from emerging technologies through code implementation and compliance. Make sure we're gathering the data we're going to need later. A lot of this hinges on what is the pathway to get those needs into the software, and what are the decisions that come out of this type of forum, and how are those decisions made. All of that will help set productive work in motion.
- Will: From a customer perspective, SCE corporate policy is to support a clean energy economy. We're in this complicated work environment. The industry wants to participate but has a difficult time participating because of the complexity of compliance. Many ZNE professionals see energy code and state policy as a barrier to ZNE, so how do we work together to increase participation in this space. At the same time, the CEC is the driving force on the process of getting toward ZNE. We are doing something right, but there is still more opportunity to improve and do better. There seems to be a tremendous amount of interest in a fixed baseline as at least an option. We need to be able to identify what the roadblocks are to simplifying the compliance effort to garner broader participation. We have the opportunity to do some collaboration to address those roadblocks. We need to continue this type of format for these meetings, something ongoing to keep the conversation going to address the ultimate goal of climate action in CA. Let's stay focused on that primary goal. And what roles can you play in a collaborative environment. Assume that you don't have to lift the load entirely on your own.
- Will: Ongoing participation. If you could reframe your position in this space, in a collaborative environment, one button push compliance, how would you do that? And how often should we be continuing this conversation, where should we be meeting?
- Erik: From IBPSA perspective, we need to collect more information from energy modelers who are doing the work in CA. A role that IBPSA could take on would be to convene those members and get that feedback to bring back to this group.

- Bach: The carbon footprint of getting everyone in a single room may not be the best approach. It's great to have a physical meeting, but we could also have web meetings. The concern is that participation and focus drops off when we're not face to face. So the venue and the means is an important consideration (especially in relation to carbon footprint). One option could be to combine with other events that many of us are attending (ASHRAE, IBPSA, etc). There is also the question of frequency. Also working on getting the notes out to the participants. But the real action item has to come to fruition from this particular meeting. We need to think about how the increased participation from today's forum can turn into some action.

Recap and Next Steps – Abhijeet Pande, TRC

- Abhijeet: Appendix G discussion - if we all think this is a good idea, what is the next step, and who needs to do what? And what will it take to make it happen?
  - Will: I can take responsibility on follow-up on that item.
  - Erik: It sounds conceptually like a good idea, but I would want to see some testing of the idea on real world buildings to see how it works and how it impacts. Needs a testing phase before jumping in.
  - Mike R.: Rules for App G don't really impact that because you'll create custom CA targets. You'll decide what the prescriptive values and design parameters are for the appropriate baseline. That has to be worked out. The other part is more a question of simulation software.
  - Erik: Is it really true that the baseline doesn't matter?
  - Chip: Under the current scheme the baselines for two different buildings are different, but for a stable baseline the delta is different.
  - Mike R: So that's really the question of are you comfortable with the parameters that you set for your baseline?
  - Charles E.: In my opinion, the advantage of App G approach is rolling back to a baseline standard where coming up with a baseline is much closer to being deterministic, as opposed to more recent standards which offer many options for compliance that many not all offer the same level of performance. By rolling back to a simpler standard much of that goes away. The rules in the performance rating method, really do make a deterministic problem. Creating the baseline building is a simpler process and it's less depending on the proposed design. It used to be the baseline chased the proposed design, and in CA that's still very much the path. The standard baseline cleans up much of that.
  - Martha: But compliance users are going to have issues because there are things that used to comply but won't comply anymore.
  - Erik: Yes, that's what we need to determine.
- Chip: Is a fixed baseline even consistent with the regulations in CA.
  - Martha: I believe it is because we have a performance compliance approach.
  - Chip: My understanding was that the basis of the performance path is a prescriptive building.
  - Mike R.: But the prescriptive path does not describe a specific energy use. Considering next steps, we have to develop those targets. Have to sell it to energy modelers. And it helps if the baseline is the same as what everyone else is using. Is there an opportunity to work with ASHRAE to improve App G to get what Title 24 needs

- Dimitri: As long as prescriptive is on a widget by widget basis, people will complain about how performance approach works. One of the approaches is developing a prescriptive bundle of measures that achieve a certain performance. Unless you do both of those things at the same time there will be grumblings.
  - Will: Can we reverse engineer that to get EUIs?
  - Dimitri: We developed that for 2016, but that target needs to be consistent whether using performance or prescriptive. If you give someone an easy out they will take it.
- Mike R.: We've been trying to push prescriptive packages, and having problems getting traction, maybe the better path is through programs
  - Martha: I think that would be great for the evolution to get a good approach to 2021.
- Charles E.: As we move towards ZNE we need to reverse the process. Right now everyone brings their favorite widget to the table, and you evaluate them all and if they pass the cost effectiveness test their in the standards, and only in the end do you know if you've achieved your goals. To reach ZNE we need to reverse the process and start with performance goals. We can set those goals today. With each successive code we ratchet down energy use. One of the challenges is that prescriptive approaches have to be cost effective in any context, but we know that the results of these things depend on the context, and until you take consideration of that context you can't come to the most cost effective solution. Maybe there are a number of bundles of prescriptive requirements that achieve a performance goal. On the common baseline, it doesn't change until you expand the scope to include something that wasn't previously part of the standard. One thing we're considering in 189 is a requirement to use the performance approach on buildings over a certain size threshold, which would ease the process of coming up with prescriptive packages. The final point is that the primary test for ZNE is looking at the meter, and TDV doesn't work for existing buildings, it only works in a simulation context. I think TDV has a lot of advantages, but you can't apply it to the energy bills in an existing building. I don't know if we abandon TDV, but I think the DGS went back to source energy as a metric since it can be applied both to existing buildings and simulation.
  - Charles K.: For Title 20 we have what we call "adders" so that we don't have to address fixed baselines.
  - Charles E.: The baseline doesn't have to change, but the rules would have to adjust.
  - Charles K.: That's part of the adders.
- Abhijeet: Once you have a fixed baseline there are things that used to comply that may not comply now. There seems like we're missing a step in between. Maybe there needs a gap analysis or something.
  - Martha: Yes, the question is that there needs to be a lot of testing before something like that is implemented.
- Abhijeet: If we have the EUIs, lets translate them to TDV, source, etc.
  - Dimitri: Yes, we could do that.
  - Liam: It's common in other parts of the world to report a number of metrics.
  - Greg: LEED also has a pilot credit for accepting alternative metrics, so there may be data there.
- Abhijeet: So is that something we should do before the next discussion to crosswalk those metrics?
- Martha: To get all the way to zero without unacceptable tradeoffs, we have to put limits on the tradeoffs

  - Supriya: Other standards in places like Canada that have an system in between prescriptive and performance.
  - Mike R.: We have a system performance ratio metric that looks at the overall system, and you set a threshold based on what the overall load is. Working with WA to implement as part of energy code. If you start writing everything out in prescriptive code, there is "picking winners/losers" etc. Right now envelope is the only trade off but if you have that for HVAC or lighting.
- Erik: Under current code there is a lot more prescriptive than there used to be because performance got harder.
- Tianzhen: Baseline buildings are designed to operate differently, so it's important to define baselines that are fair for different types of uses. For long term we also need to think about embodied energy of how we build buildings, and as we move toward ZNE, embodied energy becomes a bigger and bigger piece of the equation.
- Erik: In terms of next steps, and EUI coming out current tools is only accurate for average building, so we need to allow for more flexibility.
- Will: If we just focus on the asset factor, we don't take into consideration variations in building uses.
- Mike R.: But if we take that approach, you may be making poor decisions that don't reflect the uses of your building, spending money that doesn't save any energy.
- Peter: The next step is to think about how far away are we from zero? We don't really know, so we need to start collecting that data.
- Dimitri: The big problem with trying to figure out where we are today, the answer is "it depends." That's a problem that can be solved. There are some structural issues that need to be addressed.
- Peter: Nearly every building is different and unique. You cannot compare them, but what you can do is quantify for each specific building how it performs. And then work to bring it down to zero.
- Dimitri: And then we need to set a code that says the quantity needs to be lower.
- Martha: What if programs like Savings by Design start requiring donation of data to database so we can start quantifying this, and we can start collecting this data.
- Peter: There are some cities that already requiring building owners to provide this data, and we can already start looking at it.
- Amir: Large cities in CA are already part of that collection of cities that require those disclosures depending on building size.
- Erik: Do we want to evaluate that data to change the CBECC-Com schedules and plug loads?
- Peter: No, but for determining how far we are from zero.
- Erik: Can we use that to validate the outputs of CBECC, how close are we to the real buildings. Historically we haven't cared that much
- Charles E.: I think EUI is a bad metric to set a standard. I think ZEPI or cost of performance is a better metric. That's why we recommend the ratio rather than absolute EUI. When our true test is at the meter, all of that goes away. We have to adjust the assumptions to best match what we think is going on. What

I've suggested is a cost scenario analysis. Uses change so you should look at a variety of scenarios. Energy services index, comparing actual usage to a "standard" usage. If we could implement something like that in standards, there might be a way to adjust the standards for uses. But the Title 24 test is going to be an asset test. If you operate under standard operating assumptions you will achieve ZNE, and that needs to be made clear.

- Will: The recipient of the asset score is going to be the real estate industry. So you can't give them an asset rating that is occupancy dependent. You can't account for the instability of occupancy in underwriting process. Then the meter is where the occupancy conditions come into play.
- Mike R.: What happens with unique building types like data centers?
- Todd: You can't go under a certain level, but you can add process load to accurately model your usage.
- Supriya: What about operation? Is there any consideration of that?
- Will: There's a tremendous amount of opportunity there, but we have to decouple from the asset rating. In CA we have opportunity to incent things like operation, but it has to be decoupled from asset rating.

Parking Lot Items and Closing – Abhijeet Pande, TRC; Bach Tsan, SCE

- Abhijeet: What are the capabilities we need to add between now and ZNE? What are the priorities?
- Abhijeet: Ongoing roles and responsibilities question. If this is collaborative, what is your contribution?
- Bach: We will collect the notes, and distribute those to everyone. How can we keep the momentum of the discussion going? We try to get the right people in the room, but there are people who aren't here or couldn't be here. We have to reach out to those people as well. As the notes come out, we'll also send out a survey and we invite your brutal honesty about the usefulness of this forum. We'd like to continue the tracking of this conversation by looking at what comes next, and what develops from what was said here.
- Mike W.: As an outsider, for everyone not in this room, people came here today out of a sense of fear of missing out, and that can be a very positive thing. The next meeting has to have an element of that. For me I don't have a good take away in terms of what we've accomplished at this meeting today. And if we can't do that from today, we have to have something like that for the next meeting.
- Amir: Just a general comment, I think there was this initial vision of interoperability, but in truth it's hard to actually get that done. People are wedded to their own implementation of things. We don't have to converge on a single implementation, but to converge on consistency between implementation. Use APIs and file formats to convince ourselves of equivalency of multiple options.
- Martha: We're grateful for this event. Our next thing is that roadmap, which is actually a very meaningful outcome from this event. And then the CEC gets a briefing on that roadmap, and it's something that is statewide and we've all bought in to.
- Larry: Next steps is definitely meeting again in a couple months, coalescing around some goals. 2030 will be here real fast, it's only three code cycles and that will happen quickly. It's a great time to get started, and looking forward to hearing more input.

High-Level Action Items and Next Steps

- SCE will convene a follow-up web-based meeting in December to re-cap the symposium, discuss next steps for this process, and progress to date.
- Portions of this discussion (e.g., metrics, and baseline issues) will be incorporated into existing work through the statewide codes and standards team at the IOUs and their coordination with the CEC codes and standards staff.
- SCE and TRC will update the Software Roadmap report to include the results of this Software Symposium, and the report will be shared with CEC.