DOCKETED

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Recommended Changes to Prototypes and TDV Life Cycle Timeframe

Recommended Changes to 2025 Prototypes and TDV Life Cycle Timeframe, see attached memo.

Additional submitted attachment is included below.

Memorandum

To: CEC

From: Neil Bulger, PE, Red Car Analytics

Date: 08/1/2022

Subject: Recommended Changes to 2025 Prototypes and TDV Life Cycle Timeframe

To the staff of the CEC and supporting sub-contractors,

Red Car Analytics appreciates the opportunity to comment on the California Energy Commission (CEC)'s presentation in development of the 2025 Energy Code Pre-Rulemaking title "2025 Energy Accounting Workshop Presentations and Retail Rate Adder Analysis".

As practicing building energy performance consultants assisting in developing energy efficiency code recommendations, and building projects in design, construction, and operation, we have a high appreciation for the challenges involved in making coherent enhancements to energy codes. As California continues to lead the nation in using a performance-based analysis approach to energy codes, a tool emulated by few states and yet with the means to increase efficiency standards, there are times when enhancements can lead to unintended counter-productive consequences if not.

In review of the content shared in the workshop on 7/20/2022, we recommend two areas for further consideration and research:

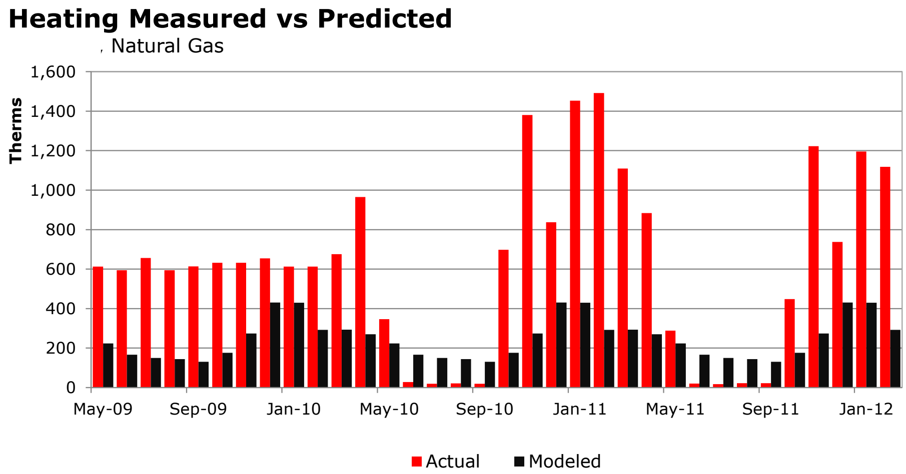
1. Commercial prototype additions and enhancements should include adding low density spaces into all models, such as corridors, lobbies, storage, electrical, stairwells, and lowering load assumptions in general spaces such as offices, classrooms and conferences, to properly predict building energy needs and areas for energy enhancements.

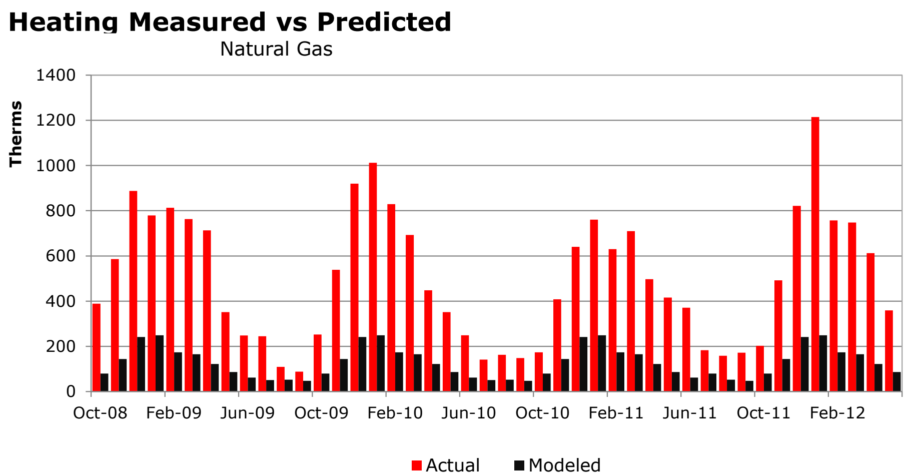
2. Life cycle energy cost metrics for non-envelope energy end uses should remain at a 15-year time period to protect the public from precarious, and at times volatile, market changes that can affect cost estimates for future energy enhancements as compared to or projected from today.

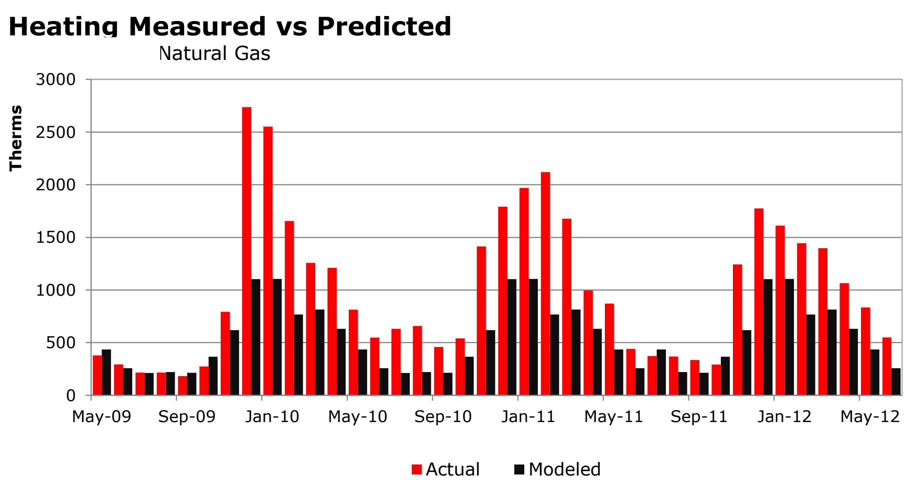
Prototypical Buildings

In slide 14 of the presentation, the planned changes to commercial prototype buildings add space types to office buildings for conference rooms and private offices and adds laboratories to large schools.

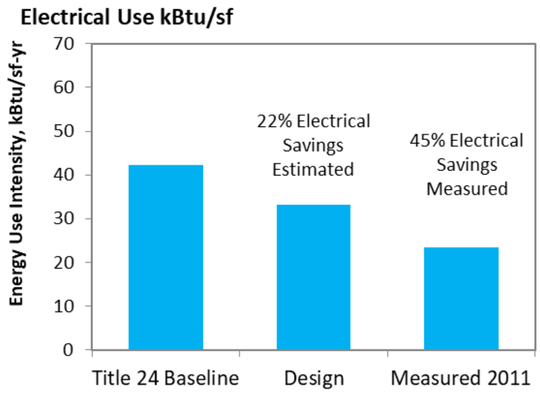
The assumptions in the changes noted an increase in the internal heat gain to these buildings coming from people and equipment. In this assumption, however, as we have observed, and as anyone working in these buildings also observes, there are far fewer people and far less equipment producing heat compared to current space use assumptions in T24 compliance software. This was true prior to COVID and amplified in the post-COVID era. The overestimation of internal gains is unrealistic, with no basis in actual building operations and creates a tremendous blind-spot for energy code enhancements to understand today's buildings' thermal heating and cooling needs. Most commercial prototypes anticipate a very large cooling need with little heating need, when in reality, most buildings use far more heating than anticipated. The examples below of measured building heating energy versus building heating energy predicted by a compliance model show this trend and the impact on heating energy:

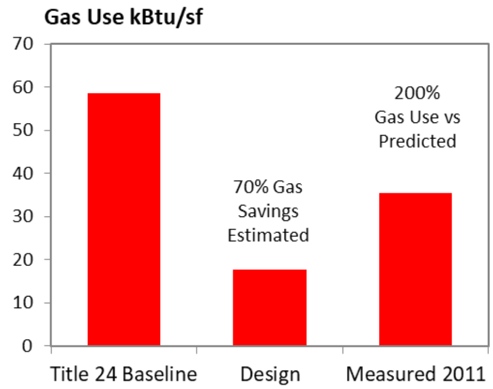


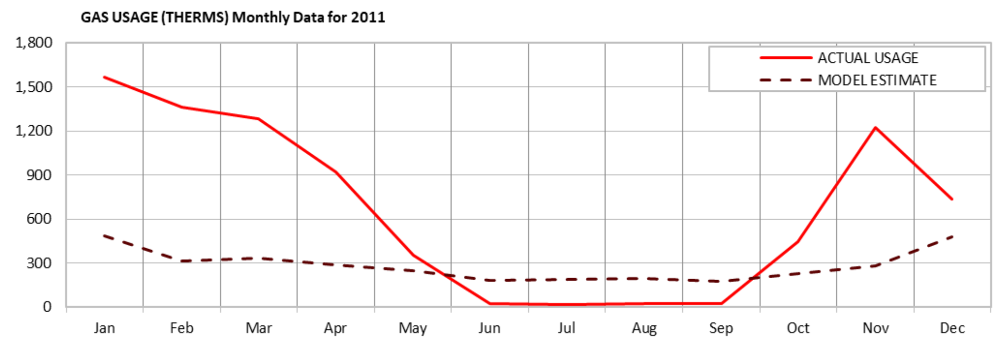


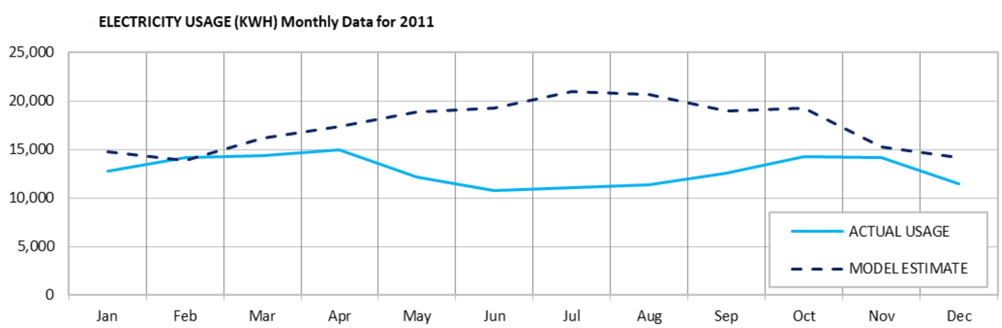


The example building shown below further demonstrates this concept; its measured electricity use was much lower than modeled and its measured heating energy was twice the model's prediction.









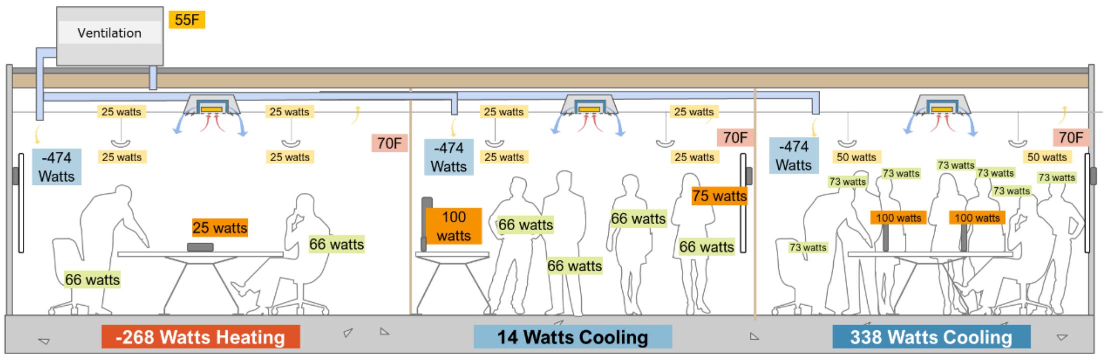
The access to detailed end uses was limited at the time of this monitoring; however, the overprediction of the internal loads proved the theory predicted, i.e., over-predicting internal loads directly leads to under-predicting the true heating energy.

Today's commercial buildings are made up of spaces that are increasing diverse from one another in their internal uses. Much like the hospitality sector, where large areas are devoted to a small number of people and functions, today's office buildings tend to include more collaboration spaces and smaller conference rooms, which offer flexibility, although are seldomly used at full capacity or even half capacity. Even in areas where occupancy remains high such as open offices, classrooms, and even laboratories, the equipment needs are decreasing and often become specialized and moved into dedicated IT or equipment rooms.

An example of three scenarios using a conference room is shown below to portray how this can dramatically change a building's predicted thermal loads.

Scenarios of Thermal Loading

Floor Area: 200 sf
People Capacity: 7 people (30 sf/person)
Ventilation Airflow: 100 cfm (0.5 cfm/sf)



Typical Low-Load
Outdoor Air 55F
2 People, Web Call, Speaker, Lights on

Typical Use
Outdoor Air 55F
4 People, Laptop, TV, Lights on (half heat)

High Use (T24)
Outdoor Air 55F
7 People (active), (4) Laptops, Lights on (all heat)

In the one conference room example, the balance of internal gains + ventilation could vary from -268 watts to +338 watts. In energy models and particular prototype energy models, the assumptions of both density factors and operational run-time or schedules are conservatively high, assuming everyone is in every room for extended periods of time.

If the intention is to better represent more building types and spaces, with one building type noted as government buildings and financial gathering spaces, banks and post offices, are rarely at full capacity.

In more recent measurements of densely seated office buildings, circa 2016 to 2019, where space by space patterns of occupancy and plug loads could be evaluated, most office spaces averaged 0.6 W/sf, where 0.15 W/sf of power across the whole building area was concentrated in one small IT room.

Ultimately, prototype models are meant to be a reasonable representation of buildings being used and built, and until more diversity of use is considered, they are misrepresenting the needs. We recommend that prototypes be enhanced to be based on a representative building. Not only will this change how thermal loads are predicted it can significantly impact other estimated energy uses these models inform.

Life Cycle Cost Metrics and Potential Public Risks

The proposed language recommends a shift in calculating energy cost savings to reflect a 30-year period for the cost of energy. The rationale was presented as a way to simplify how different efficiency measures are evaluated between envelope enhancements and non-envelope enhancements.

A comment also stated that this would not include HVAC systems in non-residential buildings and it should be noted that this was not stated on a slide. Given that HVAC is one of the largest end uses, it would be helpful to see an example of how this would work to compute total building savings in a mixed use construction project in order to fully understand what the CEC is proposing. Further, examples of the differences in calculations for other electrical regulated end uses, such as lighting and any others which can easily be defined, would be helpful.

These life cycle cost metrics, referred to as the Time Dependent Values (TDV) over a set period 15 or 30 years, in this case, were noted as being used to determine when energy code enhancements were cost effective. The record stated the intention of a shift to using the same 30-year period would result in code change proposals just estimating measured life over a longer period, accounting for any replacement costs and maintenance costs. While this sounds rational, it is also very prone to error due to the fact:

1. Estimating is difficult, especially when estimating the future.
2. Authors researching code change must analyze with limited time and often limited experience in dealing with indirect construction costs such as labor of multiple trades, project phasing, and coordination time, all of which can impact efficiency measures.
3. Few public actors are aware of the code change process, have time to participate, or have enough knowledge of the formulaic process to appreciate the impact that small details, like cost estimating, may cause.

While it is challenging to separate or estimate the portions or segments of energy savings from an energy model using multiple measures of different types with different life spans, the risk of moving to a longer time horizon to solve this issue will lead to indirect consequences to the public and to construction costs. A more rigorous framework for cost estimates or a higher threshold of cost effectiveness should be used if all measures are to be evaluated over a 30-year time horizon.