Proposed Modeling Categorization Matrix v.2.

Mahone version 2 – 4/22/19

The intent of this matrix is to identify and explain the different purposes for whole building modeling, and how these inform the processes and capabilities of the various building energy modeling (BEM) tools and their applications. It is not exhaustive in identifying all the multitudes of differences, but rather to focus attention of on the major ones so that non-experts can readily grasp the distinctions between applications.

Purpose of Model	**BEM tool used**	**Base case for comparison**	**Weather data**	**Operating conditions & occupancy**	**Other constraints**	**Limitations on measures**	**Caveats**
Energy code compliance – demonstrate that building meets code under standardized conditions	Special purpose tool specified and certified by CEC (CBECC-Res, CBECC-Com, EnergyPro, etc.)	As-designed building, but standardized & minimally code compliant. Compared to as-designed building	Standard weather year for climate zone. Does not include extremes needed to size systems	Standard schedules, operating conditions, occupancy, specified by Title 24	All non-compliance aspects of model must be identical in both base case and as-designed case models	Can only analyze options that qualify for code compliance; doesn't do renewables, DR, chilled beams, etc.	BEM will not predict actual energy use or cost. Model has limited utility as a design tool
Energy efficient building design tool – explore trade-offs and evaluate cost effectiveness of options	Designers' choice – based on familiarity, and ability to model options of importance to designers	Designers' choice – starting point for design and evaluation of options	Designers' choice – weather year (average, extreme), climate zone or local (if data available)	Designers' choice - as-anticipated, worst case, best case, etc.	Designers' choice – May use actual rates/structure, may include renewables and storage, or not	Limited only by capabilities of modeling software, designers' assumptions; tools need parametric capabilities	BEM informs designers and owners about questions they choose to address; may provide decent estimates of cost effectiveness
Utility new construction programs – demonstrate that building meets program requirements	Specified by program, based on program needs; may be a special version of code compliance software, or of commonly used design tools	Specified by program – typically energy code baseline. Program may require specific baseline conditions	Specified by program – typically standard energy code weather for climate zone	Specified by program –use of anticipated occupancy/operation rather than standardized;	Specified by program - may limit choices of efficiency measures or fuel switching	Similar to code compliance, but with may allow innovative or new measures encouraged by programs	Use of BEM specified by program, which does not necessarily meet other needs for modeling (e.g. code compliance, design options, LEED, etc.)

Purpose of Model	BEM tool used	Base case for comparison	Weather data	Operating conditions & occupancy	Other constraints	Limitations on measures	Caveats
Evaluation of utility whole building new construction programs – accurately estimate real-world savings performance of as-built participant buildings	Chosen by evaluators – may be same tool used by the program participants, or other choice believed to be better for evaluation	Chosen by evaluators – typically same baseline as used by program (code), but may use field measurements to confirm as-built assumptions	Chosen by evaluators – typically use standard weather data for final savings estimates.	Evaluators may adjust occupancy and/or operations to match actuals. May adjust equipment operating parameters based on field measurements vs. assumed.	Evaluators may try to calibrate model to actual building energy use before estimating actual energy savings due to program.	Can only use measures recognized by program and CPUC, but some new measures may strain capabilities of BEM. Can be difficult to tease out savings by measure	Choice of BEM specified by evaluators; may not suit other uses for BEM.
Estimate efficiency measure savings using before/after metering data – use models to normalize metered data, and to control for non-measure variables	Chosen by program (and by evaluators) based on available data and on model capabilities	Building energy use before program treatment, compared to energy use after program treatment	Must account for weather differences between the before and after timeframes. Final savings estimates typically based on standardized weather.	Need accurate data on actuals, and must account for any significant differences before & after.	Must calibrate both before and after models to the metered energy use	Program/CPUC may constrain allowable measures. BEM must be capable of handling all measures, including old measures in the before building.	Collecting sufficient information on non-measure parameters both before and after measure treatment is often difficult and incomplete; can lead to unknown errors in savings estimates.
Estimate DEEMED savings for new, NON-weather-dependent measures – representative savings used for ex ante purposes (program planning, paying incentives, simplified savings claims, etc.)	Chosen by work paper authors, approved by CPUC Ex Ante Team. May be a BEM tool, but is often a simpler calculation tool, such as a purpose-built spreadsheet. New measures may require new tools.	Chosen by work paper authors with existing guidance from Ex Ante Team, from prior program evaluations, from ET studies, etc. Typically code or industry standard baseline.	Not necessary, unless there are significant interactive effects with weather dependent systems (then see below).	Chosen by authors to characterize parameters affecting measure savings, and to fill needs of the chosen calculation approach	Range of measure applications, building types, vintages, locations, etc. may need to be addressed to develop representative measure savings	Processes for estimating ex ante savings have become complex, as default assumptions and calculation methods have evolved.	If existing data is not available to meet measure calculation needs, additional research may be required to characterize measure performance

Purpose of Model	BEM tool used	Base case for comparison	Weather data	Operating conditions & occupancy	Other constraints	Limitations on measures	Caveats
Estimate DEEMED savings for new, weather-dependent measures – same uses as above	Chosen by work paper authors, approved by CPUC Ex Ante Team. Full scale simulations needed to account for measure performance under varying weather conditions. New measures may be beyond existing BEM capabilities	Same as above, except measures modeled in prototype buildings with all but measure parameters held constant.	Typically standard CTZ weather data, unless measure requires specialized data (e.g. peak conditions)	Typically standardized assumptions set by Ex Ante Team and precedent. Measure specific parameters may vary between base and measure cases	Range of measure applications, building types, vintages, locations, etc. may need to be addressed to develop representative measure savings	Same as above. Also, measure analysis may limit applicability of measure.	If existing data is not available to meet measure calculation needs, additional research may be required to characterize measure performance
Estimate savings for CUSTOM measures or bundles – Same issues as above for DEEMED measures, but limited to measures not suited to DEEMED approaches							

Purpose of Model	BEM tool used	Base case for comparison	Weather data	Operating conditions & occupancy	Other constraints	Limitations on measures	Caveats
Estimate performance of individual DEEMED savings measures – typically weather dependent measures	Either specified by CPUC Ex Ante Team rules, or chosen to meet needs of Work Paper developers	Specific to measure - Typically current energy code; else industry standard practice. All other building parameters held constant throughout analysis	Newer measures may not be handled by existing modeling tools, requiring specialized tools. Measures must be modeled for various climate zones, building types, vintages. Typically use standardized weather, occupancy, operations. These may not yet be specified for all measures	Since applications of measures are not known, many assumptions must be made for the various performance estimates	Effects of non-measure parameters on modeling could skew analysis of measure performance in unknown ways, and result in non-representative savings estimates		
Estimate performance of CUSTOM savings measures – typically weather dependent measures and/or bundles of measures	Either specified by CPUC Custom Measures team, or chosen to meet needs of custom measures programs/applicants	Specific to measure(s) - Typically current energy code; else industry standard practice. All other building parameters held constant throughout analysis	Models may be required to use standard weather, occupancy and operations assumptions. Newer measures may not be handled by existing modeling tools, requiring specialized tools. Bundles of measures require a tool that can handle them all.	Measure performance heavily influenced by non-measure modeling assumptions. Standardized assumptions limit usefulness of model for estimating actual performance or assessing cost effectiveness	Modeling can allow savings estimates for individual measures but need careful rules about how this is done.		