Handout #1: Modeling Categorization Matrix

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

It is useful to think of these as different **use cases**, and of the different approaches to modeling required for each use case as **rulesets** that the modeler must apply.

Use Case (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**. Thus, model has limited utility as a design tool. Not usable outside CA.
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, may explore fuel switching, etc.	Limited only by capabilities of modeling software, designers' assumptions; tools need parametric capabilities.	Model may not meet other needs (e.g. code compliance or programs.) May provide decent estimates of cost effectiveness, but only if cost estimates for measures are accurate.

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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 –standard energy code weather for climate zone, to get "typical" energy savings.	Specified by program –use anticipated occupancy/operation rather than standardized.	Specified by program - may limit choices of efficiency measures or fuel switching.	Similar to code compliance but emphasizes 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.).
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. Rules for how to do this are still being developed.	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.	May need to calibrate both before and after models to the metered energy use; for small projects, simplified methods may be used.	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 (such as changes to occupancy patterns and use) before *and* after measure treatment is often difficult and incomplete; can lead to unknown errors in savings estimates.

Use Case (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.	DOE 2.2/eQuest and MASControl. Full scale simulations needed to account for measure performance under varying weather conditions, building types, building vintages. WP developers generally can't develop new and innovative measures given existing DEER suite of modeling tools.	Base case: DEER assumptions. Captures interactive effects between the measure and other building energy systems through external application of "interactive effects" factors contained in the DEER database.	Must use DEER climate zones and weather data.	WP developers must use DEER assumptions.	DEER fixes allowable, building types, vintages, climate zones.	Existing DEER suite of modeling tools does not allow development of new/innovative measures.	If existing data is not available to meet measure calculation needs, additional research may be required to characterize expected measure performance.
Estimate savings for CUSTOM measures or bundles – use models to estimate savings for a specific set of measures in a specific building.	Implementer's choice from program-accepted list of tools; tool choice based on measure type and number of measures, up to and including whole-building energy modeling tools such as eQUEST and EnergyPlus.	Appropriate baseline selected based on program rules; may include standard practice (code), industry standard practice (ISP), dual baseline (for accelerated replacement), and others.	Typically, model is calibrated reporting period weather conditions (AMY or equivalent), then normalized using standard CTZ weather data.	Actual conditions are modeled where possible. Otherwise, assumptions may be used based on standard/typical values. If neither is available, model defaults may be used.	Custom modeling applications allow for a wide range of modeling methodologies and it is important to ensure that methodologies and measure treatments are consistent across implementers.	Custom encompasses likely the widest variety of measures, but measure eligibility is constrained by program and CPUC rules.	Due to the endless combination of inputs available in custom models, it is important to ensure that the inputs and modeling approaches used best represent actual conditions.