NREL
NATIONAL RENEWABLE ENERGY LABORATORY

BEopt Multi-Family: Proposed Features Webinar

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Acknowledgements

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- **California Solar Initiative** (CSI) RD&D Program (California Public Utilities Commission)
- **U.S. Department of Energy** Building Technologies Office

Project roles:

- **NREL:** Lead modeling / software development
- **Davis Energy Group:** Project management, model development support, testing

Objective

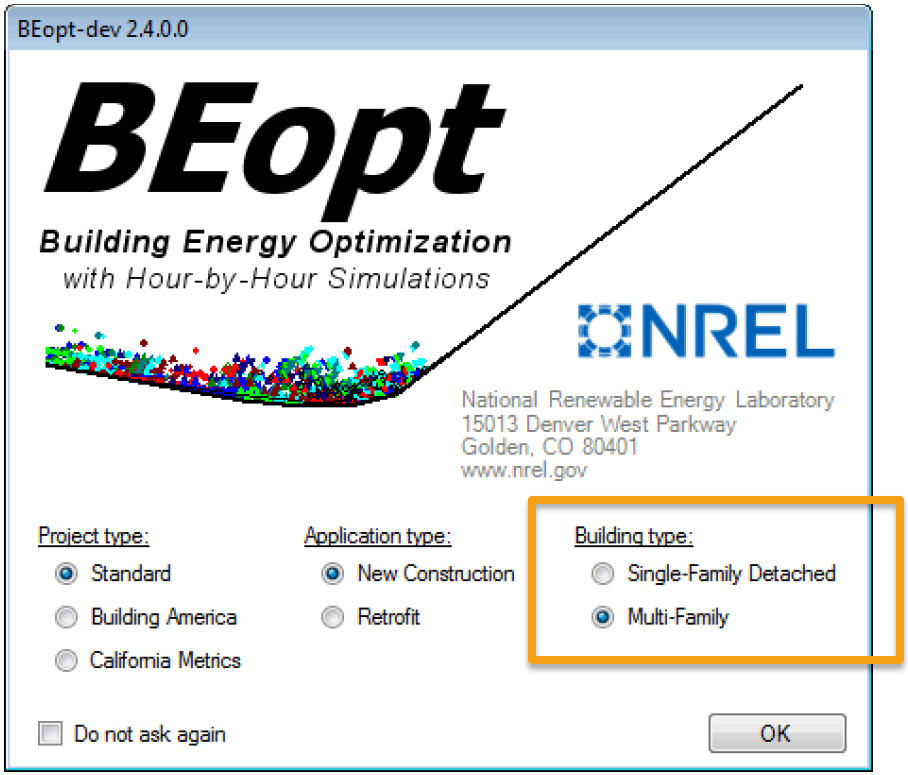
The objective of this webinar is to:

- **Communicate** the user interface and modeling features proposed for BEopt Multi-Family
- **Obtain feedback** from current and potential users and other interested parties

Please hold questions and comments until the end (Dial *1).

Project sponsors will have final say on prioritization of features.

New Multi-Family Mode



Multi-Family Use Cases

1. Analyzing **whole-building**
   (e.g., owner or builder of apartment building)

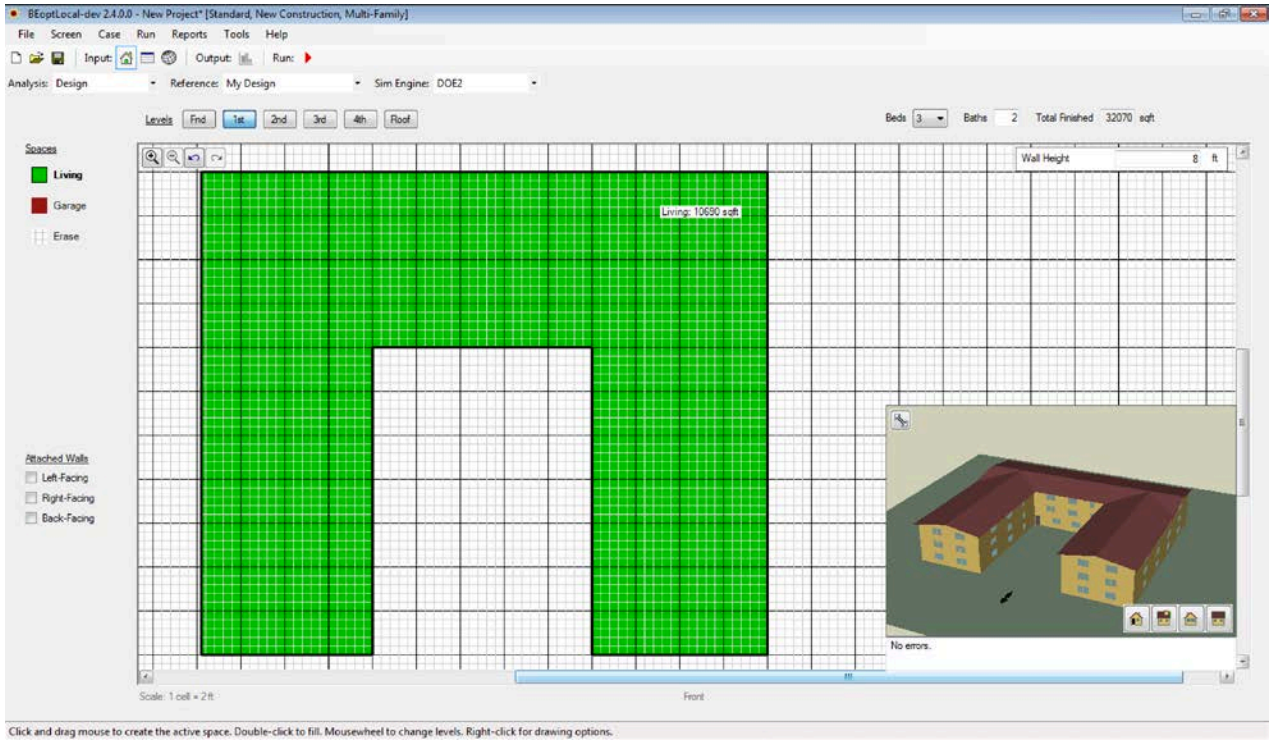
Source: TRC Solutions. California Multi-Family New Homes Case Studies

2. Analyzing **single unit**
   (e.g., owner of single condo or townhouse)

Source: NREL Image Gallery #15966. Photo by Open Energy Corporation

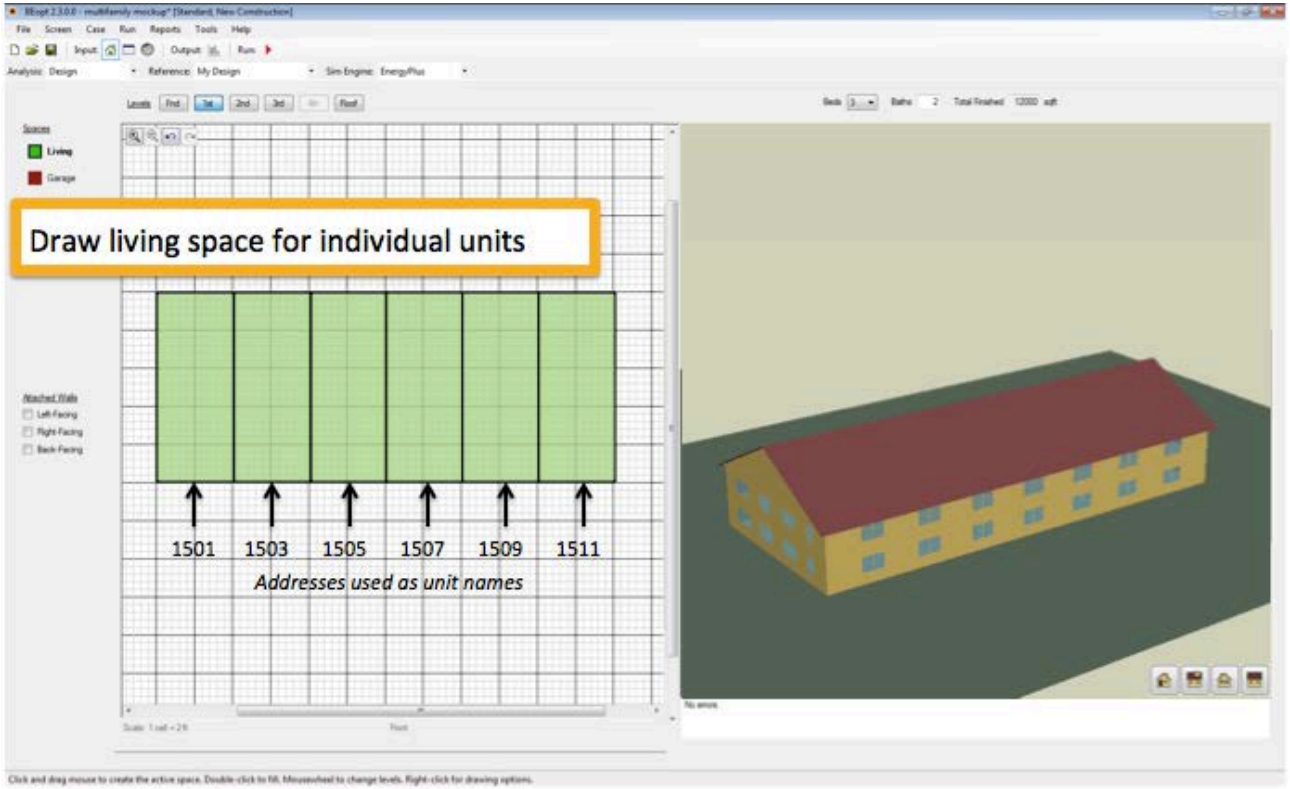
Drawing Tool Enhancements

1. Increase size of drawing area to 400 ft. x 400 ft.
2. Allow maximization of drawing pane, with picture-in-picture rendering

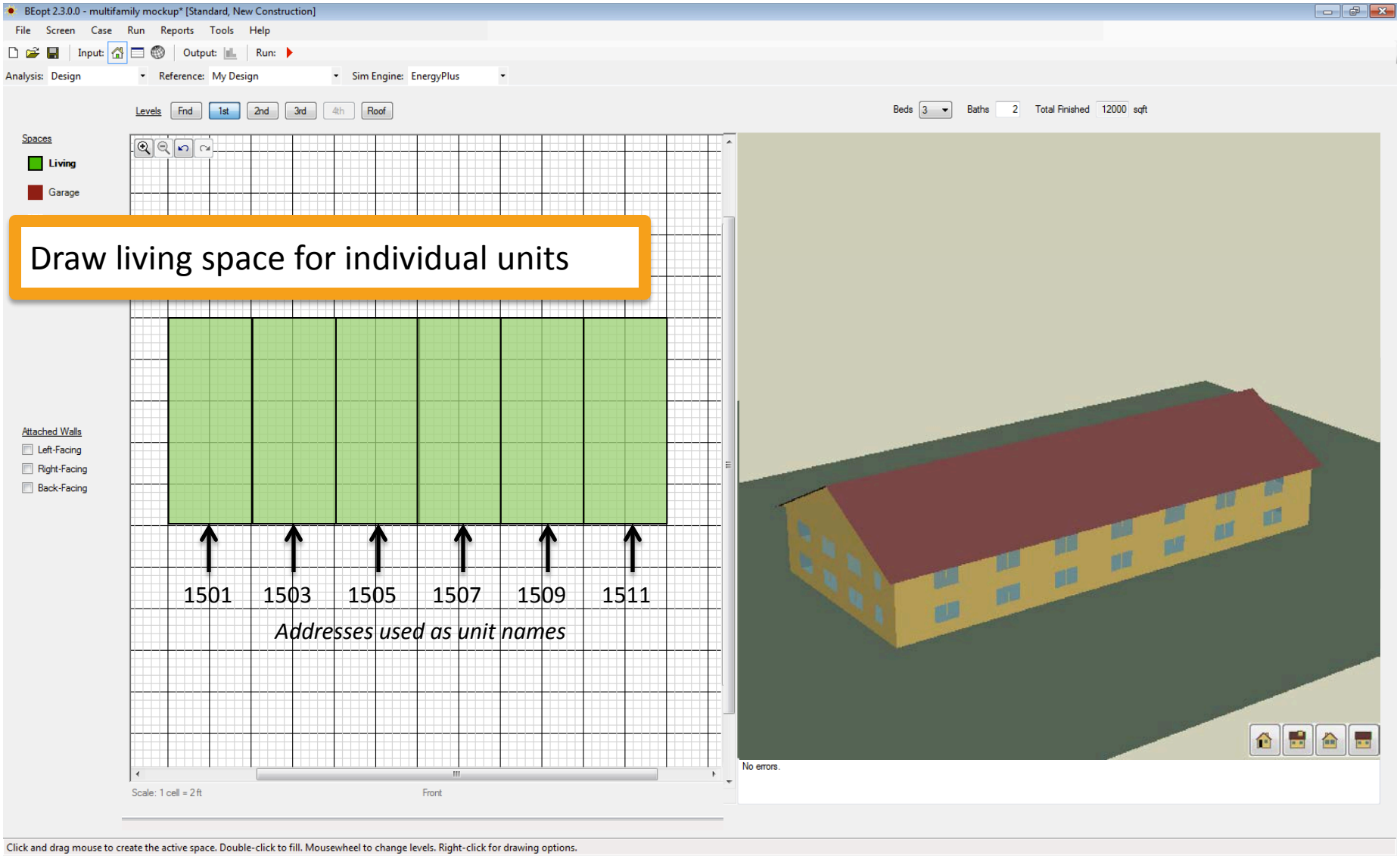


Drawing Tool Enhancements

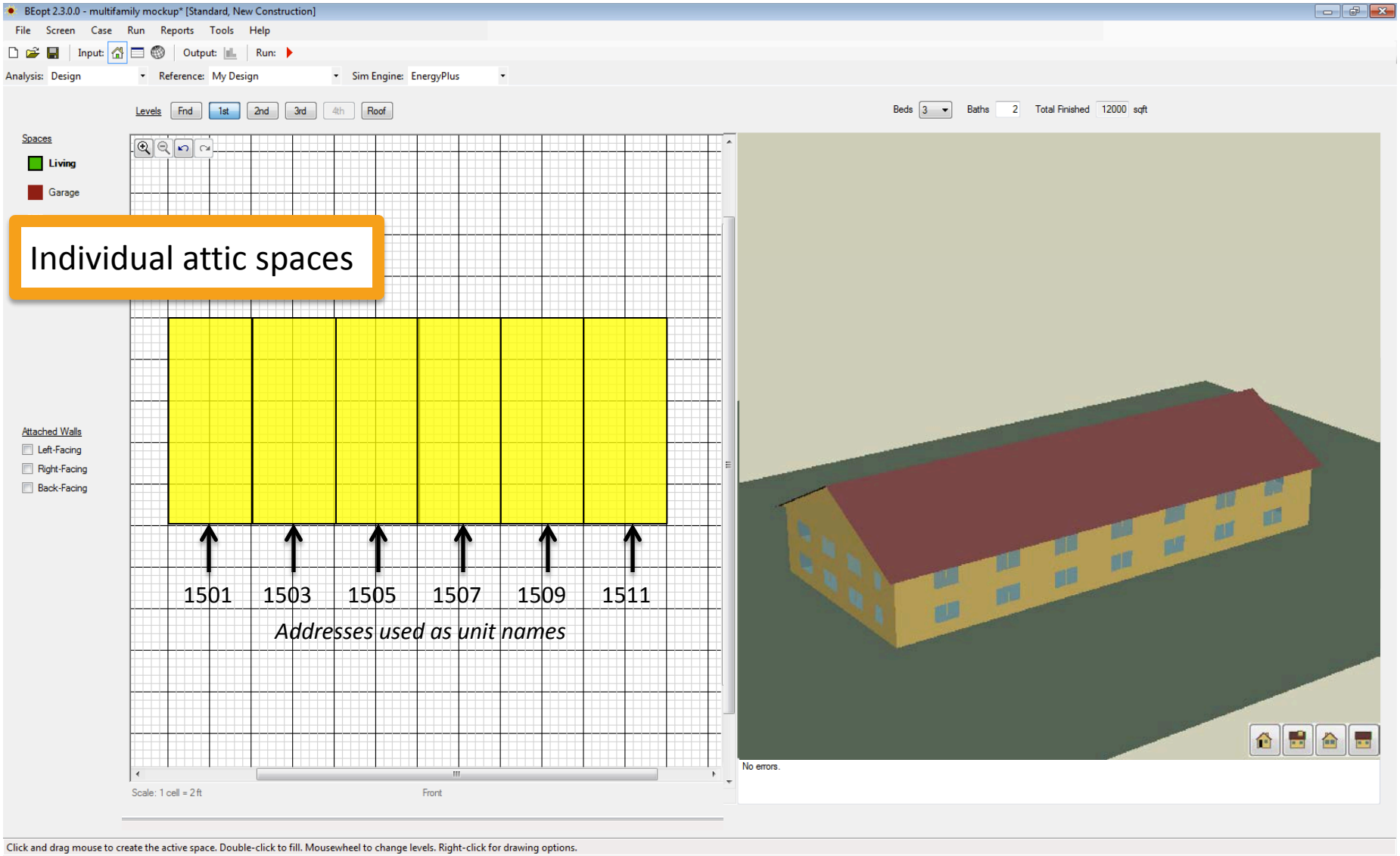
3. Enable drawing living space for multiple units
   - Allow naming units (e.g., “1505”)
   - Inputs for # beds, baths for each unit
   - Shortcut to divide space into identical units based on # rows, columns



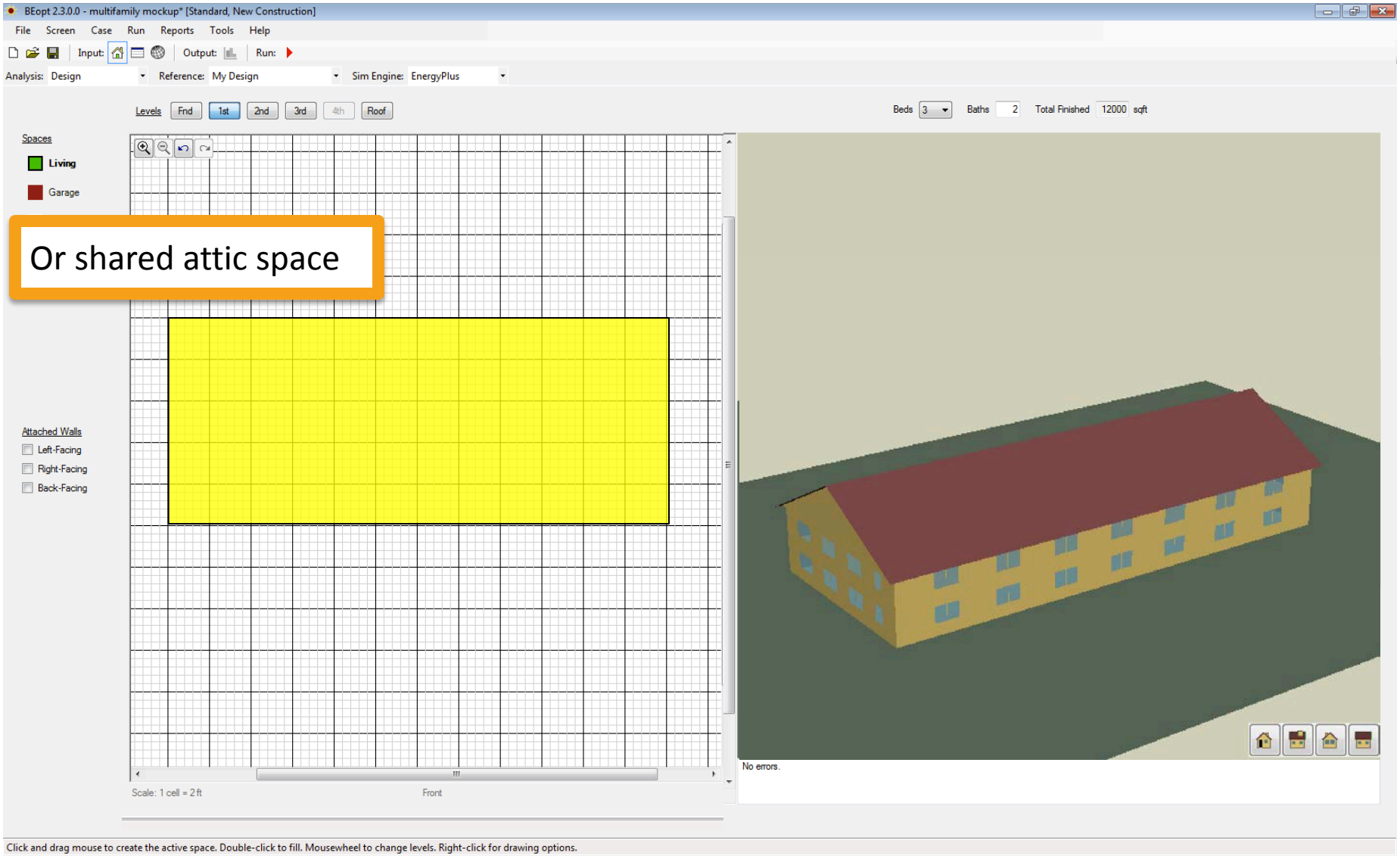
Drawing Whole-Building Model



Drawing Whole-Building Model

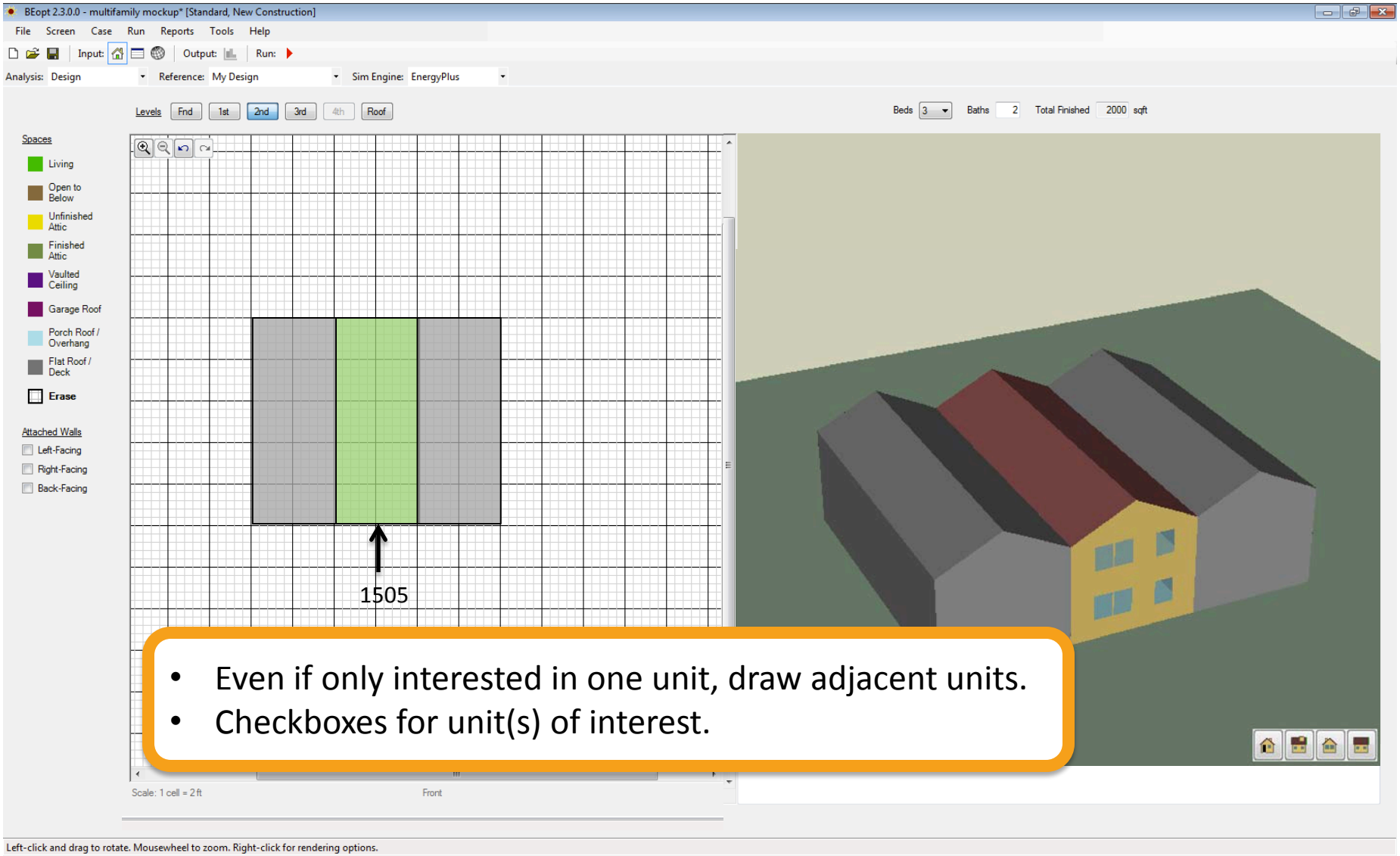


Drawing Whole-Building Model



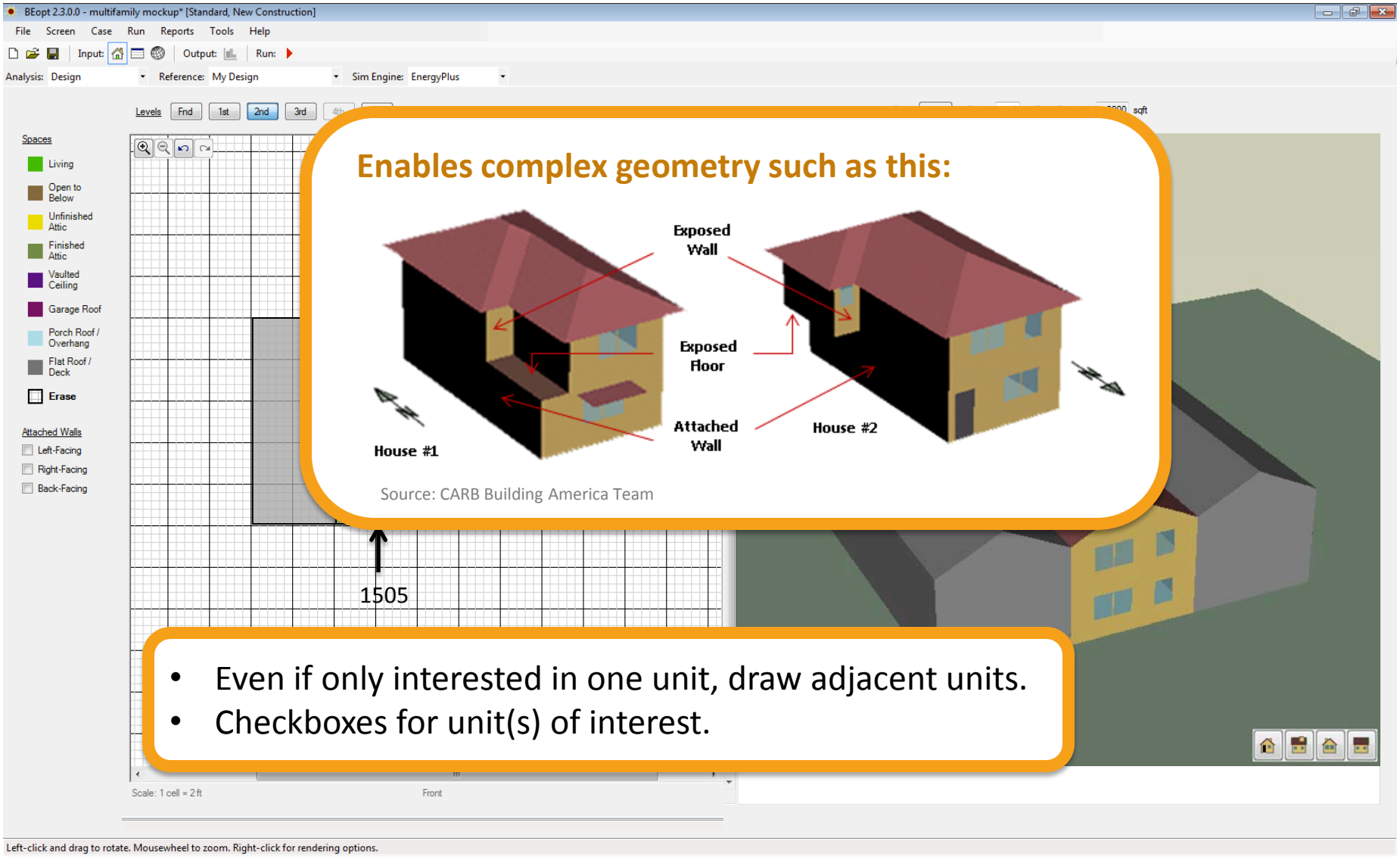
Or shared attic space

Drawing Single Unit



- Even if only interested in one unit, draw adjacent units.
- Checkboxes for unit(s) of interest.

Drawing Single Unit



Enables complex geometry such as this:

Source: CARB Building America Team

- Even if only interested in one unit, draw adjacent units.
- Checkboxes for unit(s) of interest.

Drawing Tool Enhancements

Additional potential enhancements (lower priority):

6. Corridors, elevators, and other common spaces
7. Allow up to 4 or 5 stories
8. Allow units to be partially below-grade (garden-level)
9. Underground garages

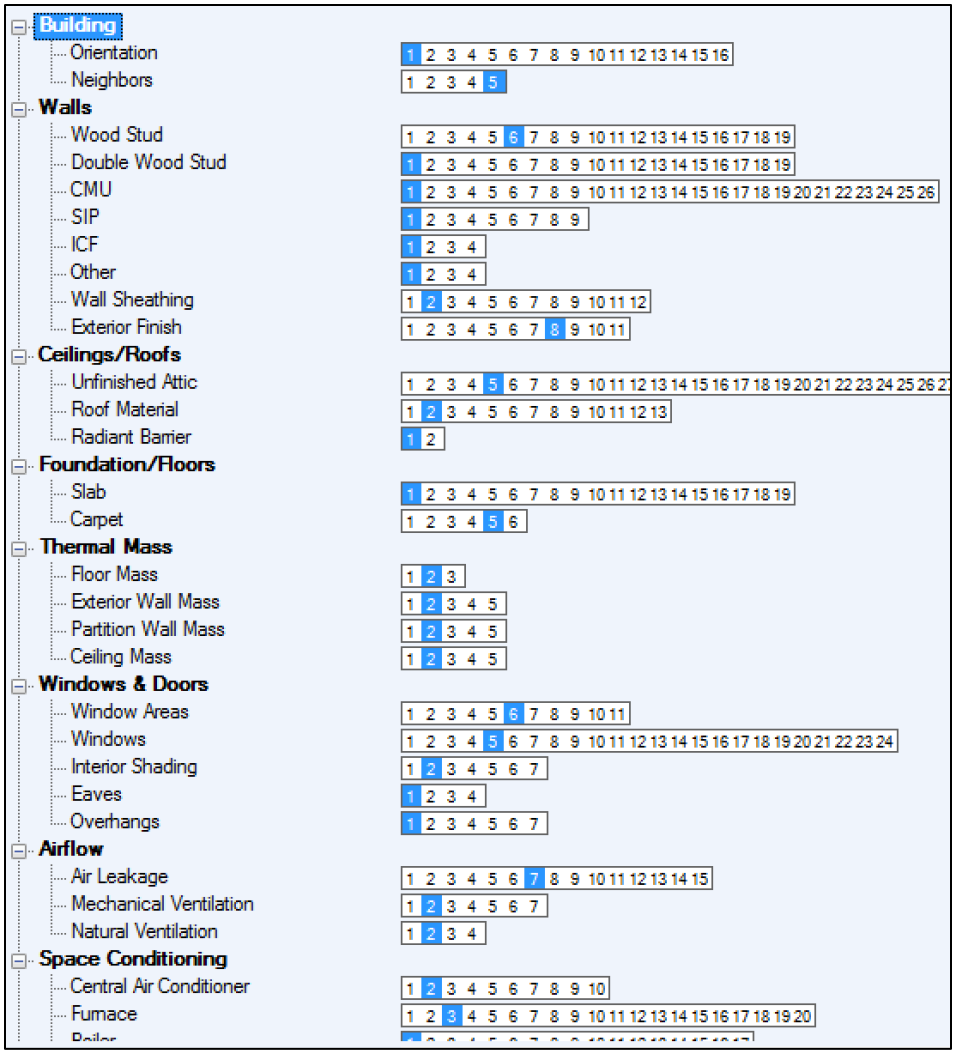
Modeling Enhancements

1. **Model whole-building in single simulation**
   - Expand building description XML format to support multi-family
   - Necessary for central HVAC and DHW systems
   - Necessary for common spaces/corridors

Modeling Enhancements

2. **Most option categories will apply across all units** (or units of interest)

- Same appliances, equipment, setpoints, etc.
- Occupancy/usage can be different based on # bedrooms



Modeling Enhancements

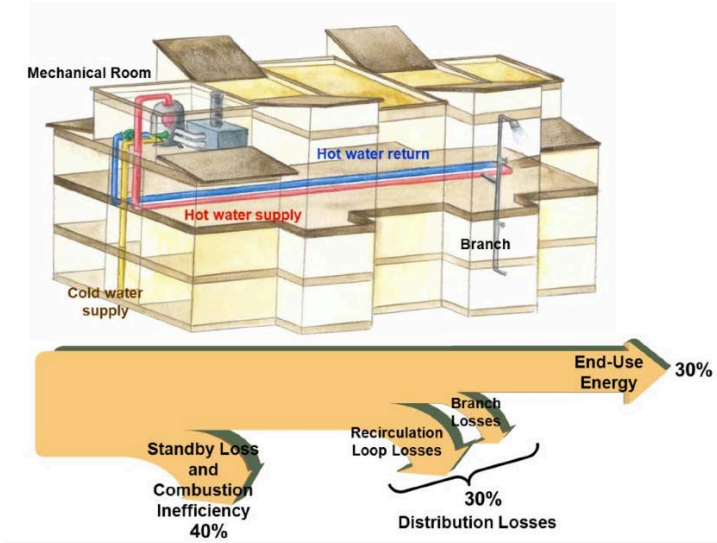
3. New individual HVAC system types – *will be prioritized*

System Type	Level of Effort to Add	Common in California?
Wall furnace, gas (gravity or fan assist)	Low	Yes
Wall furnace, electric (gravity or fan assist)	Low	Yes
PTAC/PTHP	Med.	Yes
Combined hydronic heat (individual DHW)	High	Yes
Combined hydronic heat (central DHW)	High	Yes

Modeling Enhancements

4. Central boilers
   - Hot water
     - Radiators
     - Hydronic air handler
   - Steam (lower priority)
   - Controls (lower priority)
     - OA reset
     - In-unit radiator controls
     - Other boiler controls (ARIES, PARR)
5. Central DHW systems
   - Recirculation systems and controls
   - Combined space/water heating
6. Central ventilation (lower priority)

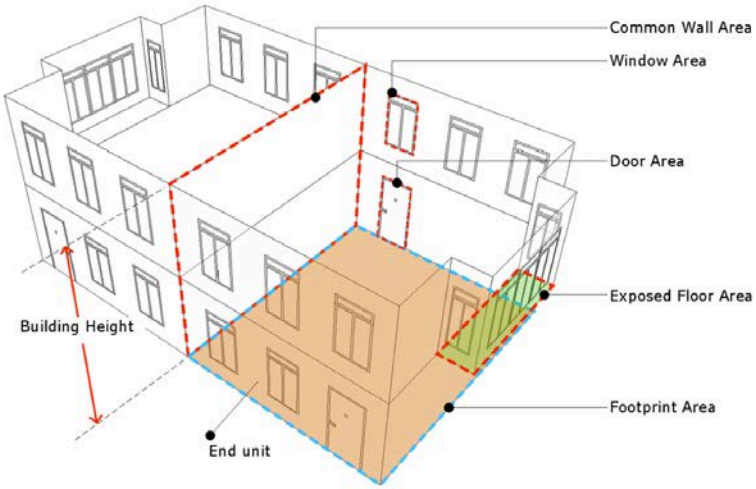
Source: PARR Building America Team



Source: Davis Energy Group

Modeling Enhancements

7. Infiltration
   - Single, average input value for all units
   - Use CARB/SWA empirical equation for predicting *guarded* blower door results from *solo* blower door test value (Faakye et al. 2013).
   - Possibly scale average based on individual unit characteristics
   - Use ASHRAE Method (Walker and Wilson 1998)
   - Account for wind pressures and height of unit, but not whole-building stack effect (Gowri et al. 2009)



Source: CARB Building America Team

Modeling Enhancements

8. New Doors categories
   - Door area options
   - Door material/insulation options

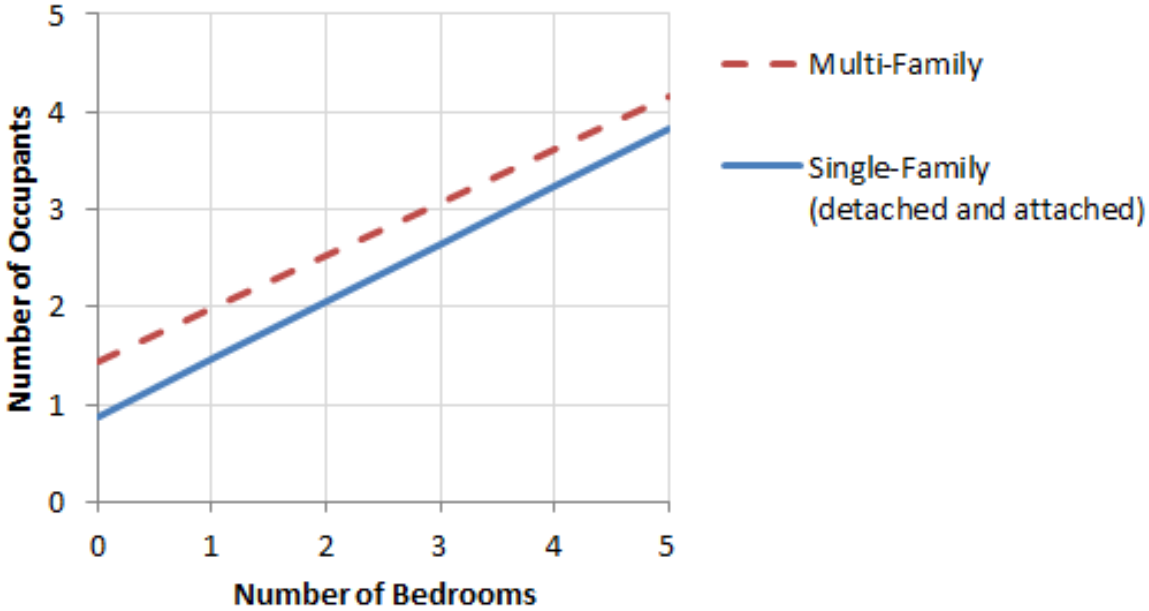
Output Enhancements

1. Optimization of whole-building or unit(s) of interest
2. Disaggregate energy use for individual dwelling units (lower priority)
   - Apportioning central heating and DHW energy to individual units?

Changes to Building America Benchmark

(as defined in the Building America House Simulation Protocols)

1. Remove room-by-room lighting method requirement
2. Window Area (based on CARB research)
3. Multi-Family specific loads and schedules (as available)
   - # occupants per bedroom (from BA HSP)



Changes to Building America Benchmark

In general, have equations that provide a **smooth transition** from single-family detached to multi-family and work across the range of multi-family buildings.

Submit questions and comments:

Dial *1

1. What features are necessary to model most multi-family buildings?
2. What is the frequency of partitions in attics and crawlspaces?
3. Are there other HVAC system types common in multi-family buildings?

Send additional comments to: **eric.wilson@nrel.gov**

References

Faakye, O., Arena, L., & Griffiths, D. (2013). Predicting Envelope Leakage in Attached Dwellings. Building America Report.

Gowri, K., Winiarski, D., & Jarnagin, R. (2009). *Infiltration Modeling Guidelines for Commercial Building Energy Analysis*. PNNL Report.

Walker, I. S., & Wilson, D. J. (1998). Field validation of algebraic equations for stack and wind driven air infiltration calculations. *International Journal of Heating, Ventilation, Air Conditioning, and Refrigerating Research*, *4*(2), 119–140.