House geometries are among the many options users can enter in BEopt. Results shown here are rendered in SketchUp and show neighboring houses for shading analysis.

BEopt has directly impacted thousands of homes participating in the Building America program, ensuring a consistent analysis platform and accurate simulations. Moreover, many BEopt algorithms have been adopted by private-sector HERS software tools that have helped improve the energy efficiency of tens-of-thousands of ENERGY STAR-certified homes.

To achieve Building America’s ambitious energy-efficiency goals, it becomes increasingly important that researchers can identify the most cost-effective, high-performance improvements. BEopt has proven to be an invaluable analysis tool enabling Building America and its research partners to progress to zero net-energy new homes and deep energy retrofits.

There are many energy analysis software tools out there—some do optimization, some do residential analysis, some do retrofit analysis, some come pre-packaged with options and costs, etc. With support from DOE’s Building America program, researchers at the National Renewable Energy Laboratory developed a tool that can do all of these things and more, with a user-friendly interface. BEopt, the “Building Energy Optimization Analysis Method,” can simulate the energy performance of new or existing homes, efficiently analyze and prioritize various combinations of energy-saving measures, and make recommendations for optimal performance.

BEopt provides detailed simulation analysis based on specific house characteristics, such as size, architecture, occupancy, vintage, location, and utility rates. Discrete envelope and equipment options, reflecting realistic construction materials and practices, are evaluated. BEopt can be used to analyze both new construction and existing home retrofits, through evaluation of single building designs, parametric sweeps, and cost-based optimizations.

BEopt uses existing, established simulation engines (currently DOE2.2 or EnergyPlus). Simulation assumptions are based on the Building America House Simulation Protocols. This robust analysis engine is fully linked to another Building America Top Innovation, the National Efficiency Measures Database, to drive the optimization analysis.

The sequential search optimization technique used by BEopt finds minimum-cost building designs at different target energy-savings levels. It identifies multiple near-optimal designs along the path, allowing for equivalent solutions based on builder or contractor preference.

An hourly simulation is often necessary to fully evaluate the time-dependent energy impacts of advanced systems used in Building America houses. Thermal mass, solar heat gain, and wind-induced air infiltration are examples of
time-dependent effects that can be accurately modeled only by using a model that calculates heat transfer and temperature in short time intervals. An hourly simulation program is also necessary to accurately estimate peak energy loads. Because it has been specifically developed and tailored to meet Building America’s needs, BEopt is the hourly simulation tool recommended for systems analysis studies performed under the DOE Building America program. Thus, all research under the Building America program is benchmarked with a consistent tool. In addition, BEopt has developed significant improvements for whole-house simulations that lead to improvement of other software tools, including popular private-sector home energy rating system (HERS) tools.

7. Output Screen (Results Browser)

Once an optimization process has been run, the output screen can be displayed. Figure 9 illustrates a typical example of the output screen. For each case, the BEopt output screen displays the results in three different graphs: the path to zero net energy graph located in the upper left corner of the screen, the end-use graph in the bottom left corner, and the option costs graph on the right side of the screen.

7.1 Ma in Output Screen

The upper left graph in Figure 9 shows optimal and near optimal points along the path to zero net energy. The x-axis displays the percent of energy saved compared to the base case, whereas the y-axis shows annual energy-related costs. Energy savings are calculated relative to a reference: either a user-defined base-case building or a climate-fpecific baseline cost (Christensen et al. 2006)

REFERENCES


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