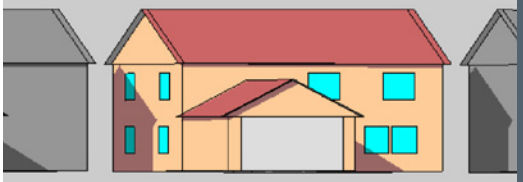


BUILDING AMERICA TOP INNOVATIONS HALL OF FAME PROFILE

INNOVATIONS CATEGORY:

3. Effective Guidance and Tools Solutions
3.3 Research Tools

Building Energy Optimization Analysis Method (BEopt)

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.

BUILDING AMERICA TOP INNOVATIONS

Recognizing Top Innovations in Building Science – The U.S. Department of Energy's Building America program was started in 1995 to provide research and development to the residential new construction and remodeling industry. As a national center for world-class research, Building America funds integrated research in market-ready technology solutions through collaborative partnerships between building and remodeling industry leaders, nationally recognized building scientists, and the national laboratories. Building America Top Innovation Awards recognize those projects that have had a profound or transforming impact on the new and retrofit housing industries on the road to high-performance 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.

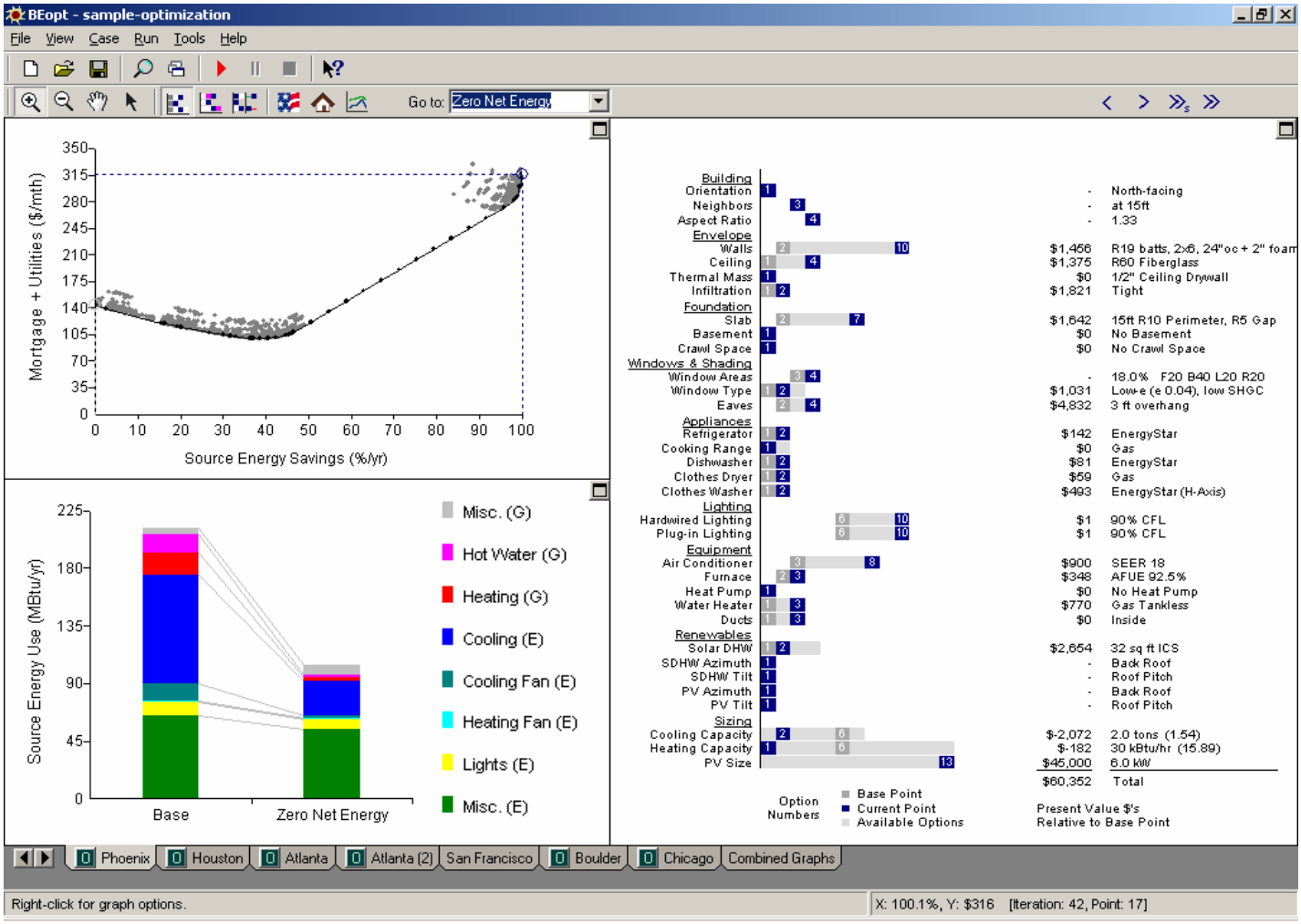
BEopt provides detailed simulation analysis based on specific house characteristics, such as size, architecture, occupancy, vintage, location, and utility rates. Discrete envelope and equipment options, reflecting realistic construction materials and practices, are evaluated. BEopt can be used to analyze 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.



Output screen for single optimization case – Phoenix (Christensen et al. 2006)

REFERENCES

Christensen, C. R. Anderson, S. Horowitz, A. Courtney, and J. Spencer. 2006. *BEopt™ Software for Building Energy Optimization: Features and Capabilities*, NREL/TP-550-39929, prepared by the National Renewable Energy Laboratory for the U.S. Department of Energy Building America, www.nrel.gov/buildings/pdfs/39929.pdf

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DOE Building Technologies Program
www.buildings.gov

Building America Solutions Center
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