WAPTAC
WEATHERIZATION ASSISTANCE PROGRAM
TECHNICAL ASSISTANCE CENTER

NEW TOOL FOR THE WEATHERIZATION ASSISTANT SUITE:

Multifamily Tool for Energy Audits (MulTEA)

The U.S. Department of Energy Weatherization Assistance Program has commissioned Oak Ridge National Laboratory (ORNL) and Lawrence Berkeley National Laboratory (LBNL) to develop a new, fully-featured Multifamily Tool for Energy Auditing (MulTEA). The new tool will be a part of the Weatherization Assistant suite of resources used by the Weatherization Assistance Program and beyond.

The MulTEA Weatherization Assistant tool will:

- Provide energy auditors with an improved energy simulation and weatherization measure selection tool for multifamily buildings,
- Expand and enhance the energy auditing capabilities of auditors in multifamily buildings,
- Provide a DOE-sponsored multifamily energy audit instrument to complement the single-family and mobile home energy audits already supported by DOE under the Weatherization Assistance Program.
- Help improve retrofit work quality and provide a foundation for quality assurance,
- Assist training providers in developing better training materials,
- Increase workforce mobility up career ladders and across career lattices, and
- Help to build confidence in energy efficiency improvements among consumers, building owners, and the energy efficiency finance community.

MulTEA Calculation Engine

MulTEA uses a new building energy calculation engine based on the Home Energy Saver Application Programming Interface (HES-API) web service (https://developers.buildingsapi.lbl.gov). The new energy calculation engine will serve the Weatherization Assistant, as well as new multifamily analysis features in HES (http://hes.lbl.gov, http://hespro.lbl.gov) that currently serve non-Weatherization Program markets.

Weatherization Assistant

The Weatherization Assistant is an energy audit software tool developed for the Weatherization Assistance Program that contains the National Energy Audit Tool (NEAT) for site-built single-family houses and the Manufactured Home Energy Audit (MHEA) for mobile homes. In addition, the latest update of the tool, Version 8 provides expanded optional capabilities, including agency-related contact information, client data intake, recording of health and safety issues, recording of diagnostic measurements, work orders, status tracking, simplified cost accounting, inventory control, report generation, site mapping, and digital photo storage. (See http://www.waptac.org/Energy-Audits/Weatherization-Assistant.aspx)

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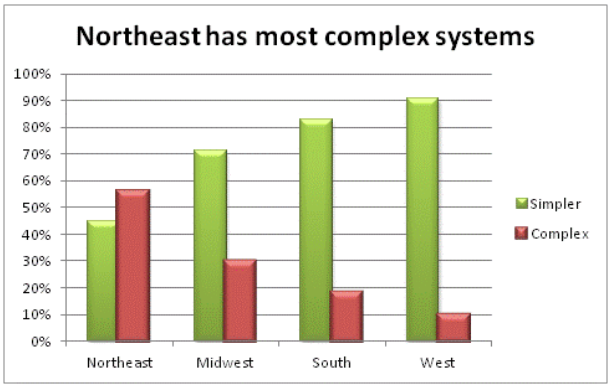
Web Service Deployment

The Weatherization Assistant is currently being moved to a web service software platform. When complete, the new Weatherization Assistant user interface will handle all weatherization audit types, single-family, mobile home and multifamily. MulTEA will be the first tool deployed in the new interface, with Version 1 expected to be ready for production use by October 2012.

Development Strategy

The multifamily energy audit tool is being developed in two versions, in order to expedite earlier availability for users who work on less complex low-rise buildings, and to also allow testing at an earlier date. Version 1 will handle low-rise buildings that have individual unit-level space conditioning systems and both unit-level and central domestic hot water systems. Version 1 is a more basic version of the tool and will not include all of the desired improvements indicated by the needs assessment described in the next section. Version 2 will increase the energy calculation capabilities to include central plant based space conditioning systems, as well as provide as many of the user-desired improvements as possible. Version 1 is expected to be applicable to 73% of 5 units or more multifamily buildings in the United States, as determined by an analysis of the 2005 Residential Energy Consumption Survey (RECS). Regionally, the Northeast has more need for Version 2, due to the higher number of high-rise buildings with highly complex systems; however, there are currently approved tools that can handle that need for the present.



The main energy modeling engine will be DOE-2.1E, based on input from experts and assessment of the best balance between modeling capabilities and usability.

Needs Assessment

Starting with input from national experts, two needs assessment webinars were held in the Fall of 2010 asking if an improved energy audit for multifamily buildings was needed. Multifamily audit tool methods experts and users identified desired improvements for multifamily energy audit tools as follows:

Domestic hot water systems modeling — Extensive input from national experts indicated a need for improved modeling of domestic hot water systems, as existing methods were too limited and less capable than needed.

Multiple heating systems — Existing DOE-approved multifamily audit tools require that a building be modeled as having one heating system, and the building may need to be analyzed as one major heating zone. Practitioners must now devise methods of "tricking" the energy calculation tools into providing a correct "one-system" answer, when multiple heating system types would allow better and easier energy modeling. This is an example of applying expert-knowledge "rules" to producing results in cases where systems effects are too complicated to be simulated correctly using standard abilities of the audit tool. Some simple rules are incorporated in Version 1 of the tool to simplify required user input, but most rules-based measure capabilities will be developed in Version 2.

Ventilation (natural and mechanical) and associated measures — There was concern about how to handle ventilation system measures and treating issues of adequate or over-ventilation with existing tools. Ventilation systems can have complex interactions with heating and cooling, and capabilities for handling these systems are planned for Version 2 of the tool.

Distribution system (pipes, ducts, tank losses) — Methods of modeling distribution systems and components are limited in most energy simulation tools, and specialized methods are often needed to correctly capture the energy impacts of system components and the potential savings for proposed improvements. Improved methods of handling distribution systems were considered important, and development of distribution system capabilities is planned for Version 2.

Impact of sensor location and controls — Many controls measures cannot be modeled directly with typical energy calculations found in energy audit tools or energy simulation programs. Improper control sensor location is one example of an area where substantial energy savings may be possible through

correction. This measure is an example of expert-knowledge rules-based savings calculation methods. Rules-based savings are typically derived from verified field results of achieved measure savings, where the "rules" for achieved savings are applied separately from standard simulation calculations, such as for this measure, where systems effects are too complicated to simulate.

System degradation and tune-up/maintenance type measures — Another example of an area where rules-based estimates of savings are important is degradation of energy system performance with increasing age. Similarly, if system tune-up or maintenance-type measures are appropriate, rules-based estimates of savings are usually needed.

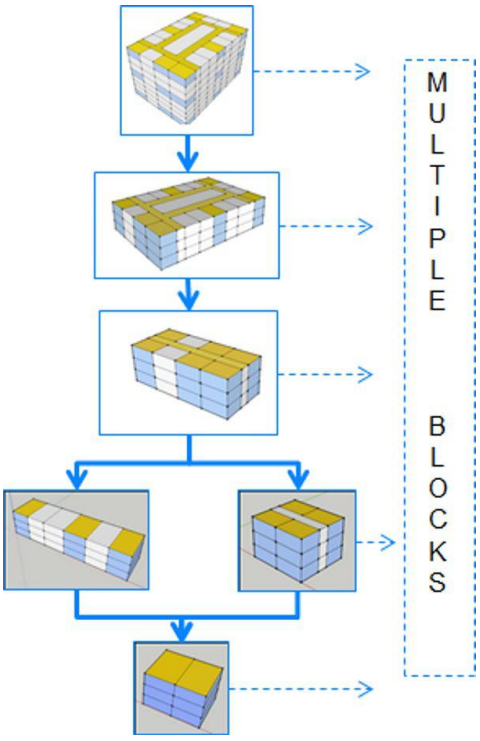
Water mains temperature effect on DHW energy use — Because domestic hot water energy use is influenced by incoming water mains temperatures, especially when surface water is the source, methods of handling water source temperature were considered important. It was concluded that existing tools do not handle this adequately.

Comparable system efficiency input — The tool should make heating and cooling equipment efficiencies readily apparent, in order that the user can make sure the correct (comparable) efficiencies are being used in any savings calculations.

Utility bill Analysis — For utility bill analysis, disaggregation of end-use energy was identified as an important need. Having access to reasonably recent weather data, especially outdoor temperature data, is valuable for supporting ease of data analysis in these areas. Extensive work is also in progress by public goods energy efficiency researchers to make real-time historical weather data available at the moment of building simulation, which will greatly simplify bill calibration efforts.

MulTEA Methodologies

National input from experts indicated increased zoning capabilities were needed to handle multiple types of space uses and multiple heating or cooling systems. The new multifamily energy calculation engine will build up the needed complexity from the current HES building simulation engine that addresses single-family houses using DOE-2.1E, along with specialized models for infiltration, domestic hot water and appliances. Expert stakeholder input from across the country corroborated DOE-2.1E as an appropriate simulation engine for the space conditioning systems.



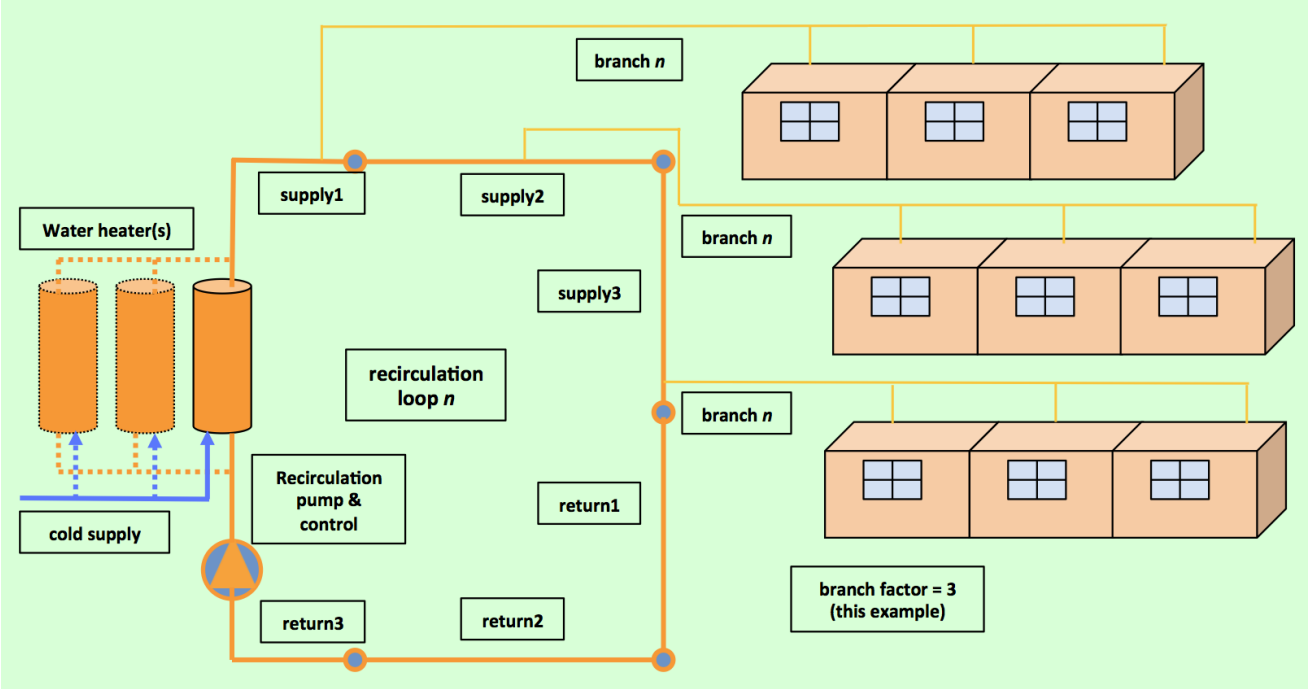
In multifamily buildings, multiple thermal zone models are the optimal method to analyze the multiple heat transfer paths and energy interactions the conditioned space experiences with adjacent atypical conditioned zones, unconditioned zones and the outdoors. This is a significant departure from the currently used modeling methods in the NEAT, MHEA and HES tools. Therefore an extensive analysis of typical geometric configurations was conducted, producing a generalized thermal zoning strategy for the model.

Multifamily building typologies vary widely and cannot be simulated with one static model. For example, the following building types all require different zone configurations: compact, box-shape buildings with double loaded corridors and protected entrances in cold climates; apartments with a breezeway or open verandah in warm climates; and garden style apartments

similar to single-family units. To address the building configuration diversity, a dynamic macro structure has been developed within the DOE2.1E model providing an automatic ability to activate/deactivate zones, floors, or surfaces depending on key user inputs on the number of units, number of floors, space types, etc.

Another major innovation planned for version 2 of MulTEA is that the building can be run using hourly historical weather data that prevailed during the billing period. This new innovation in building simulation accesses newly available near real-time weather data and assembles a custom hourly DOE2 weather file.. With this new weather data source, traditional "weather-normalization" (e.g. by degree-days) of utility bills to model results (traditionally calculated with long-term weather average data) is not necessary. Since this capability will be implemented in the HES-API, other API users will have this feature as well.

Domestic hot water systems in the new multifamily audit tool are handled by a new model capable of calculating the energy loads of individual dwelling-unit water heating systems as well as centralized systems with recirculation loops. The first version of the new hot water model will be available in the Version 1 tool, since simpler low-rise buildings often have complex centralized domestic hot water systems.



User Testing

User testing of the Version 1 Weatherization Assistant Multifamily Tool for Energy Audits will commence in June 2012.