

Rapid Energy Modeling (REM)



3D Building Information Modeling Tool Delivered 90% Time and Cost Savings

In a 2013 ESTCP demonstration, REM was used to evaluate energy use in 23 DoD buildings across eight locations, six climate zones and seven building types.

► **WHOLE-BUILDING ENERGY SIMULATION**

Rapid Energy Modeling (REM) takes a whole-building approach to energy assessment. Using information on building operations, geometry, orientation, weather, and materials, it generates 3D Building Information Models (BIM) and simulates energy use patterns.

► **IDENTIFIED ENERGY CONSUMPTION WITH HIGH DEGREE OF ACCURACY**

REM modeling predicted electrical consumption with 82% accuracy, on average, natural gas consumption with 58% accuracy, and combined energy use intensity (EUI) with 78% accuracy. Overall results indicate that REM can yield >90% savings in time and cost compared to traditional ASHRAE Level 2 auditing approaches.

Technologies Tested

Rapid Energy Modeling is a 3-step process: capture, compute, and report

1. CAPTURE EXISTING CONDITIONS

Complete energy survey and incorporate location and satellite data.

2. CREATE 3D MODELS

Create generic shape models while in the field with FormIt, a mobile application that interprets existing building conditions using satellite images.

Use Revit Building Information Modeling software to create building models and integrate energy and carbon analyses.

3. ANALYZE AND COMPARE

Complete whole building analysis with Autodesk Green Building Studio (GBS). Multiple simulations are preprogrammed to explore energy saving alternatives.

Advantages:

- Provides a level of detail not available through benchmarking.
- Costs significantly less costs than on-site energy audits.
- Scalable process that can be taught in less than a day.

Limitations:

- REM does not provide the detail of investment-grade energy audits, nor does it cover some aspects of Level 2 audits.
- Accuracy was lower than primary performance objective of 90%, when compared to historic utility information.

Required Inputs:

- Meter Data.
- Energy Survey.
- Location and satellite data

ABOUT ESTCP

The Environmental Security Technology Certification Program (ESTCP) is the U.S. Department of Defense's environmental technology demonstration and validation program. The program's goal is to identify and assess innovative technologies that address DoD's high-priority environmental requirements efficiently and cost-effectively.



Demonstration Sites: 23 Buildings, 8 Locations

The goal of this demonstration was to evaluate REM workflows and performance by comparing simulated to actual building energy consumption and to investigate the technology's scalability. REM, which uses whole-building energy simulation algorithms driven by the DOE 2.2 64 bit version software engine for energy analysis, was applied to 23 DoD buildings across eight locations, six climate zones and seven building types, including thirteen offices, five barracks, and five special-use buildings (a fire station, a gym, a school, an auto facility, and a cafeteria). The simulated and actual building energy data was analyzed by energy type (electricity and natural gas) and EUI and further segregated by building type. Results show that the model for offices and special-use buildings performed better than models for barracks, where variable occupancy did not match model assumptions.

INSTALLATION'S COSTS*

Existing laptop/desktop computers can be used for REM.

Air Force, Navy and Army Corps of Engineers have existing software licenses for REM.

SOFTWARE

\$4,590 per installation
\$200 per user to install
\$600 per year subscription

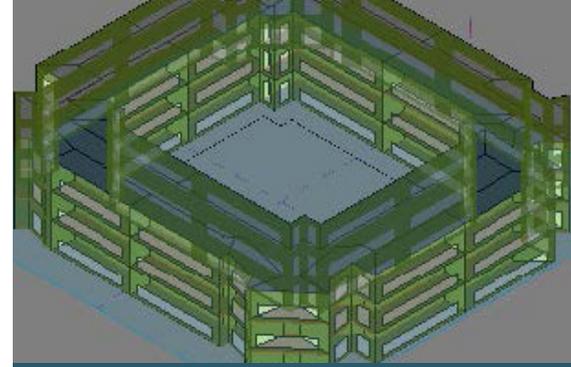
OPERATIONS

\$300 per building
\$500 per user training

*Cost information is for reference only. Individual sites should do due diligence to determine local costs.

ADDITIONAL MILITARY DEPLOYMENTS

A \$1.2 million research contract through the Air Force Research Lab Advanced Power Technology Office (AFRL-APTO) to demonstrate REM at Tinker Air Force Base in Oklahoma City, Oklahoma was awarded in 2016.



Demonstration Results

REM COMPARED TO HISTORIC UTILITY DATA

- 82% average accuracy for electricity. Highest accuracy in office buildings, 86%; lowest in barracks, 73%.
- 58% accuracy for natural gas. DoD office buildings consumed significantly more natural gas and had higher EUI values than predicted by the models and in comparison to similar buildings in the CBECS database.
- 78% accuracy for EUI. Considered a "reasonable" forecast.
- Modeled results for 5 out of 23 buildings were within 20% of metered values.

INSTALLATION & COMMISSIONING

- <1 day to learn REM process.
- 3 hrs/building to create REM models.
- 90% time savings compared to ASHRAE Level 2 audit.

USER SATISFACTION

- Participants indicated a high level of satisfaction with the workflow.

COST-EFFECTIVENESS

- 95% cost savings compared to ASHRAE Level 2 audits. REM audits averaged \$0.005/ft². Detailed energy audits vary from \$0.12 to \$0.50/ft², depending on the size and complexity of the building.

Additional Resources

► EW-2012591 FINAL REPORTS AND TECHNOLOGY TRANSFER TOOLS

<https://serdp-estcp.org/Program-Areas/Energy-and-Water/Energy/Conservation-and-Efficiency/EW-201259>

► TECHNOLOGIES USED AT DEMONSTRATION SITES

3D Modeling Applications: Formit, Revit formit360.autodesk.com/ www.autodesk.com/products/revit-family/overview

Energy Modeling Software: Green Building Studio (GBS) <https://gbs.autodesk.com/GBS/>

NOTE: Before incorporating new technology, refer to Unified Facilities Criteria (UFCs) and other appropriate guidance to ensure compliance with current requirements. <https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc>