# Calculating Envelope Energy Loss

# Weatherization Energy Auditor Single Family

Learning Objectives

By attending this session, participants will be able to:

* Define basic energy movement.
* State procedures for calculating hourly and annual energy loss.
* Explain the principle of diminishing returns.

Key Terminology

Air changes per hour (ACH)

British thermal unit (BTU)

Building envelope

Conduction

Convection

Cubic feet per hour (CFH)

Exfiltration

Guarded hot box testing

Heating degree days (HDD)

Infiltration

Internal gain

Intrusion

R-value

Radiation

Savings-to-investment ratio (SIR)

U-factor (also U-value)

Wind-washing

Supplemental Materials

Handouts & Resources

Calculating Envelope Energy Loss Worksheet.

Efficient Windows Collaborative Website: <www.efficientwindows.org>.

Heat Loss Calculation Worksheet.

Klems, Joseph H. “Measured Winter Performance of Storm Windows.” *Paper LBNL-51453*. Lawrence Berkeley National Laboratory, 23 August 2002. <www.escholarship.org>.

ORNL Building Envelopes Program Website: <www.ornl.gov>.

Units of Energy handout.

Online Platform Lessons

Use these online interactive training modules as prerequisites before students attend the course or as in-class computer lab sessions. Users must first create an account at [www.nterlearning.org](http://www.nterlearning.org) to access.

c- 5.1 Understanding Effective R-Value  
<https://www.nterlearning.org/web/guest/course-details?cid=247>

Relevant Standard Work Specifications

5.3001.1 – Forced Air, Design, Load Calculation, and Equipment Selection.

5.3011 – Hydronic Heating, Design.

Classroom Props & Activities

* Calculators
* Paper and pencils

**R-Value Comparison:** Visit the ORNL Building Envelopes Program “Simple Wall R-Value Calculator” Website. Take suggestions from students to create various wall assemblies and compare R-values. Click on the name of the details, i.e., “Wall/Partition Wall,” to reveal a drawing of the particular construction detail. Have students suggest assemblies with the highest and lowest possible R-values given the available materials. Are they correct?

**Calculations**: Distribute calculators, paper, and pencils and have students calculate heat loss and savings for various scenarios. Use the example included in the presentation, the included worksheet, and hypothetical locally relevant situations.

Class Overview

* Begin by introducing key terminology and make sure students are familiar with the units and terms used in calculations, i.e., British thermal unit, heating degree day, etc.
* Use the presentation to introduce the concepts of surface losses and air-transported losses as they relate to the energy efficiency of a house. Relate the concepts to the typical weatherization measures of air sealing and insulating. Explain that calculations are theoretical, and that wind-washing and intrusion can drastically lower the effective R-value of building assemblies.
* Present the heat loss calculation formulas to students. Use the “Examples” slides to walk through various calculations, giving students time to complete calculations on their own before clicking ahead to reveal the solutions.
* Based on the calculations, discuss the cost-effectiveness of air sealing versus insulation in the sample cases, and introduce the principle of diminishing returns.
* Give students the Calculating Envelope Energy Loss Worksheet to complete at the end of class or as homework to ensure they have understood the concepts.