Energy Exchange℠

Better Buildings® SUMMIT

**AUGUST 21-23, 2018** • CLEVELAND, OHIO

# Get Sorted:

## Efficiency in Distribution and Logistics

Energy Exchange | Better Buildings SUMMIT

# Speakers

**Bert Hill**

*Manager, Health Safety & Environment*

*Volvo Group N.A.*

**Sachin Nimbalkar, PhD**

*Group Leader - Energy Efficiency Research & Analysis*

*Energy & Transportation Science Division*

*Oak Ridge National Laboratory*

# Bert Hill, Volvo Group

U.S. DEPARTMENT OF ENERGY

VOLVO

VOLVO GROUP

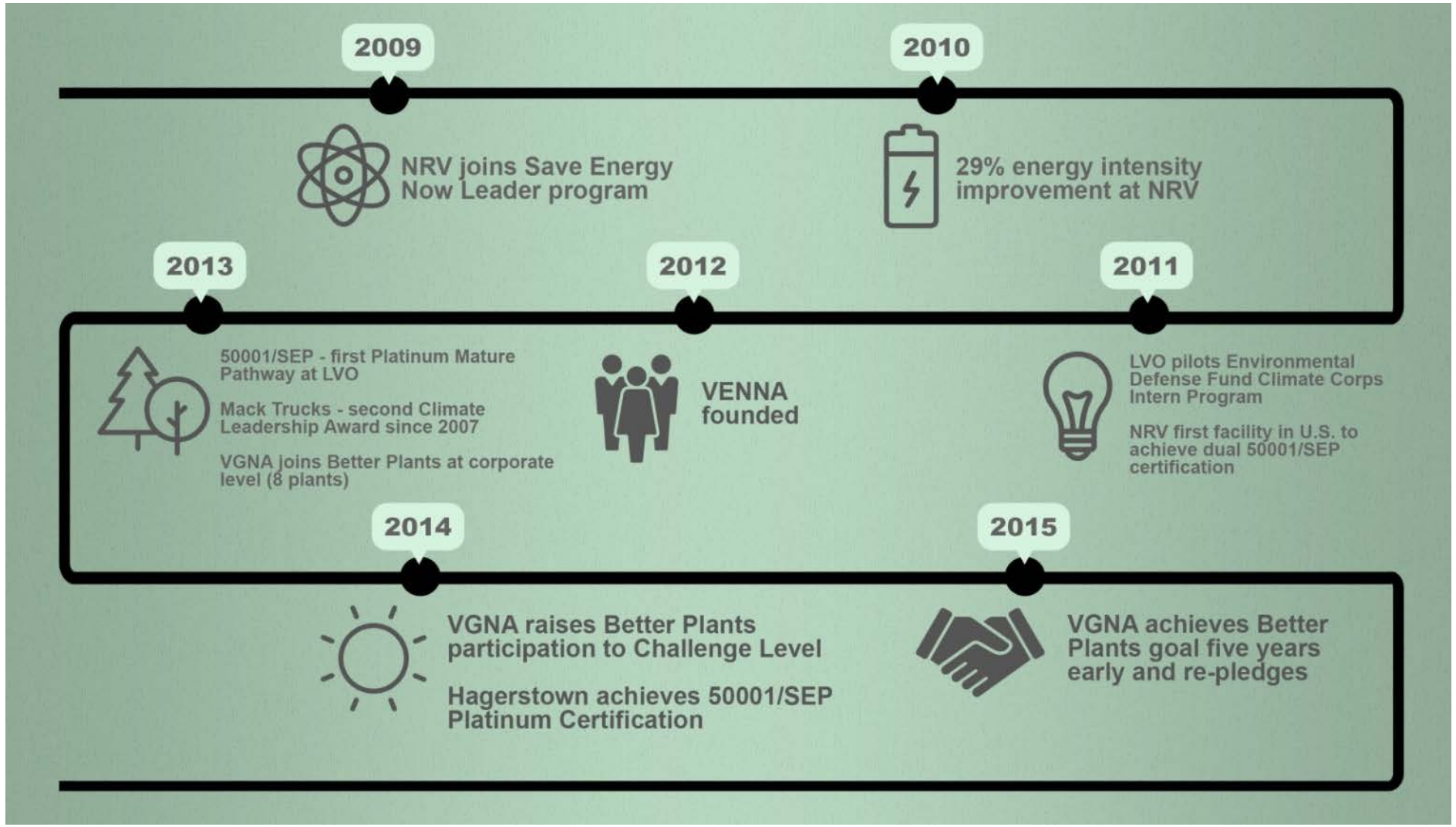
# On the Hunt for Energy Savings

**Bert Hill**

**2018 Better Buildings Summit**

**Cleveland, OH**

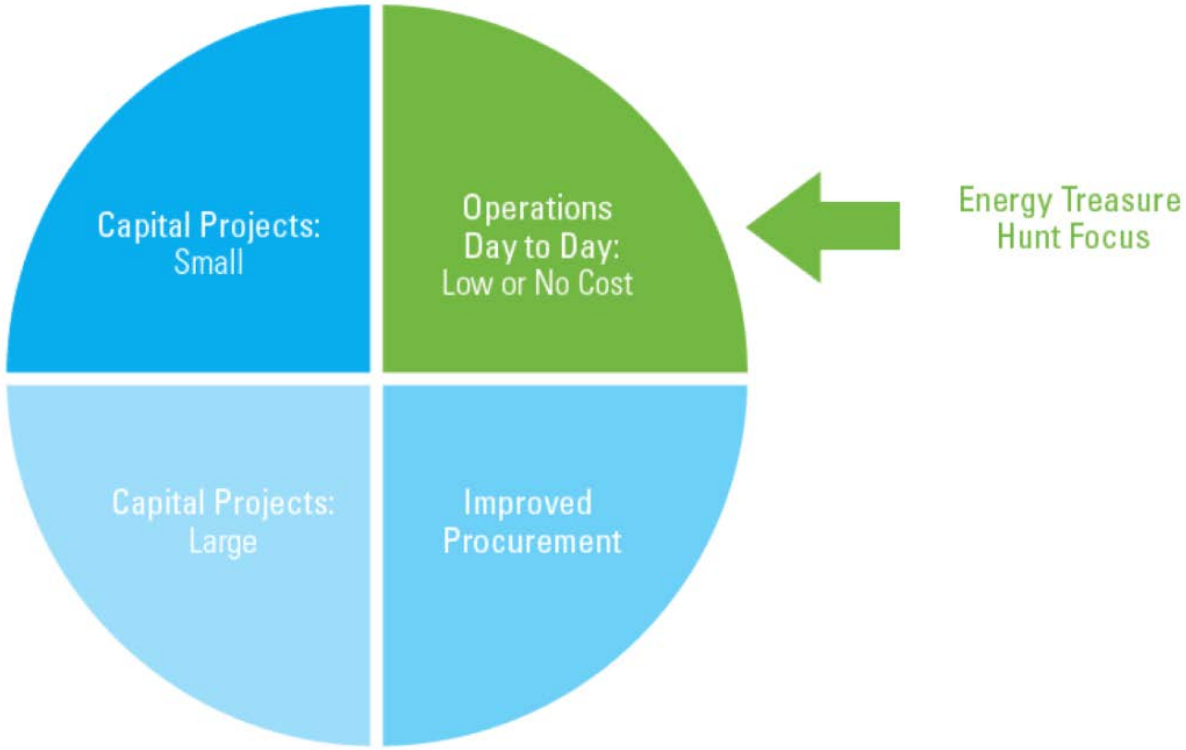
# Volvo Group North America Energy Milestones



# Volvo Group North America Energy Program Focus

Source: Aly Shawky, Director Energy Management, Entegreat

# Energy Treasure Hunts




- Focus on operational and behavioral opportunities
  - Turning off equipment when not in use
  - Changing set points
  - Automating shutdowns
  - Reducing load on the equipment
- Begin during idle/partially idle time periods to identify waste



Source: DOE

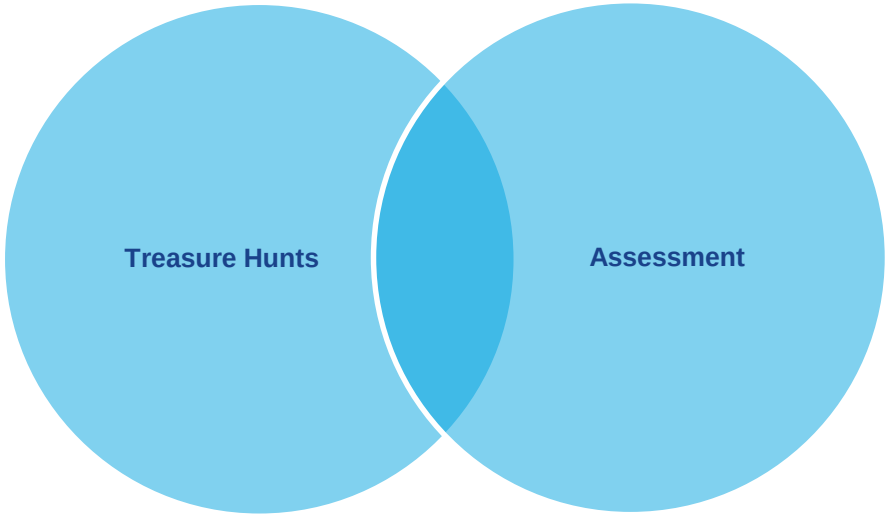
# Energy Treasure Hunts vs. Energy Assessment

## Treasure Hunt

- Continuous process (repeat annually, quarterly . . . )
- Internal resources
- Focus on operational opportunities

## Assessment

- Standalone event
- External resources
- Focus on system performance and technology



Source: DOE

# Advantages of a Treasure Hunt

- A Treasure Hunt Exchange encompasses both training and a "hunt"
    - Does not require sophisticated technical analysis
    - Calculations are (relatively) simple
    - Can be applied by employees of varying disciplines
    - Train selected participants to facilitate future treasure hunts

- A three day activity – at completion, the facility has sufficient information to execute identified opportunities and an employee who can facilitate future treasure hunts within the organization

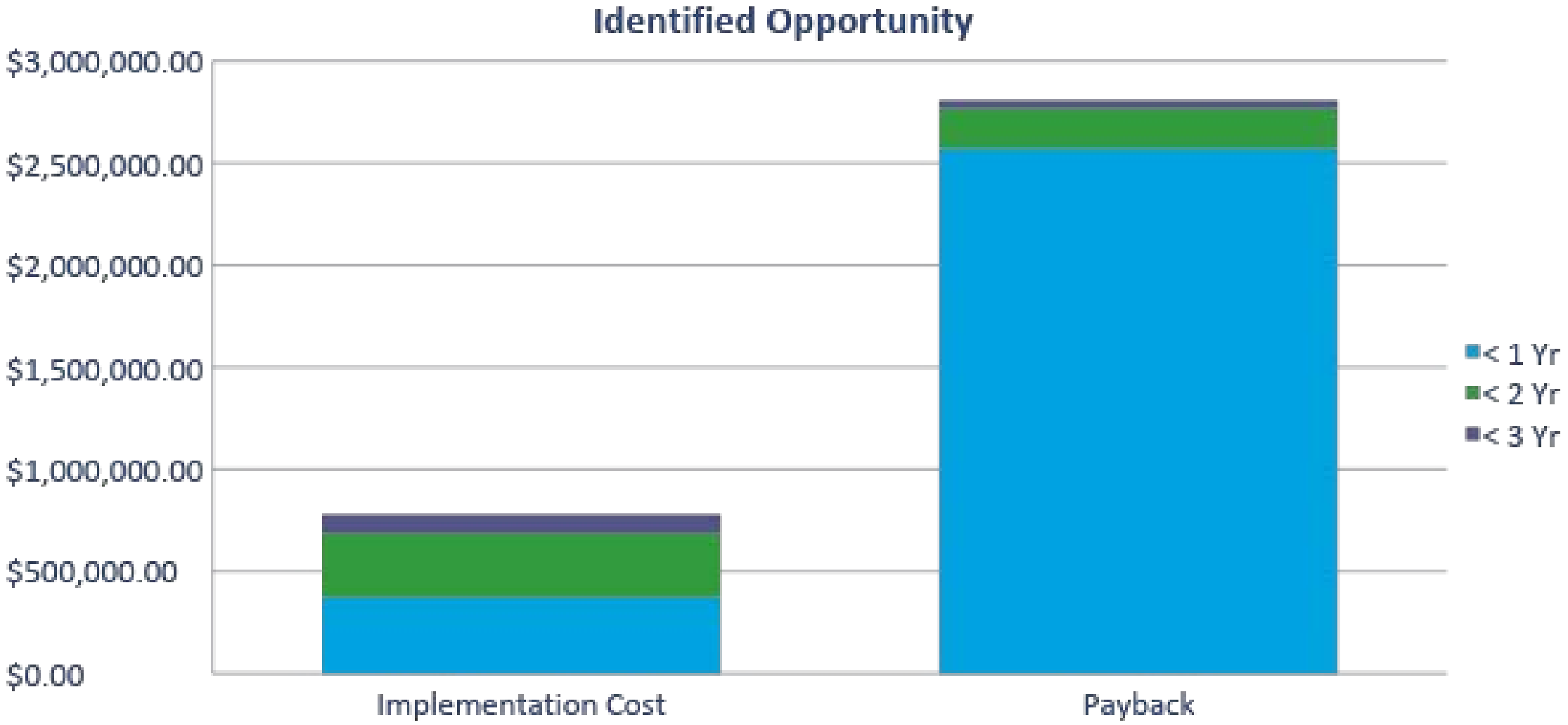
- Opportunities/ideas are solicited from many disciplines and can be replicated across similar processes and businesses



Source: DOE

- The Treasure Hunt process can be replicated and repeated

# 90% of opportunities identified have < 1 year paybacks






Source: DOE

# Typical lighting opportunities

- Turn off excess lighting where possible. During a treasure hunt, experiment by turning off lights and then measuring the available lumens.
- At infrequently occupied areas, implement shut down procedures or install occupancy sensors.
- Identify unnecessary lighting.  Robots do not need light to work.
- Retrofit lighting with more efficient technology.
- LED can save more on maintenance than energy in some applications.



Source: DOE

# Typical HVAC opportunities

## Cooling Towers

- Match tower capacity with process requirements – less active cooling may be needed during night, colder seasons, and non production
- Check for throttled pumps /opportunities for VFD

## HVAC / Makeup Air / Comfort Cooling

- Use programmable thermostats to optimize cooling schedule, particularly in non 24/7 areas such as offices, warehouses, partial production areas
- Challenge temperature set points



Source: DOE

# Heat Loss – example 1

| | |
|---|---|
| **Saving Opportunity:** | **$3,975** |
| **Implementation cost:** | **$1,500** |
| **Payback:** | **4 months** |

# Heat Loss – example 2

Currently there are areas where outside air is being let in due to the facility negative pressure. We propose to seal these leaks with dock seals and insulation.

178 $ft^2$ of air gaps to environment

- Overhead door gaps
- Man door gaps
- Wall openings

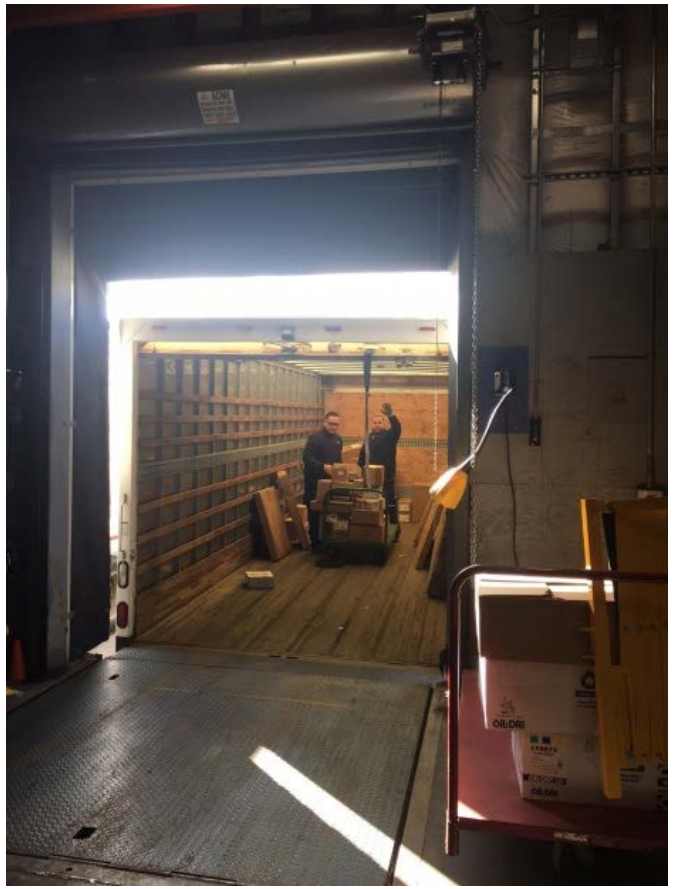
32ft/min flow average

50ft/min flow on windy day

Savings: $5,043.68 /Year

Implementation: $10,000

Payback Period: 1.98 yrs.



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# Thank You!

Sachin Nimbalkar, Oak Ridge National Laboratory

U.S. DEPARTMENT OF ENERGY

# Web-Based Energy Savings Calculator for Building Envelope Air Tightness

**Andre Desjarlais**
**Som Shrestha**
**Diana Hun**
**Sachin Nimbalkar**
Oak Ridge National Laboratory

**T20-S8a – Get Sorted: Efficiency in Distribution and Logistics**

Better Buildings Summit 2018
August 23, 2018 – 2:00 to 3:30 pm
Cleveland, OH

# Outline

- Why do we care about air leakage?
- Web-based tool to estimate energy savings associated with air tightness
- Some examples


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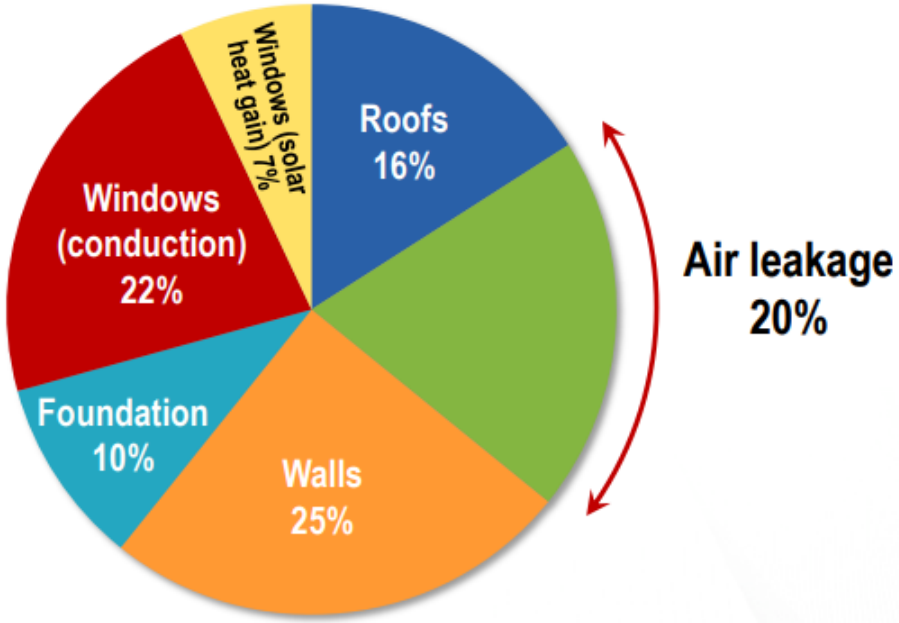
# Buildings Use a Lot of Energy

40% of all energy and 75% of all electricity used in the US

Source: U.S. Department of Energy

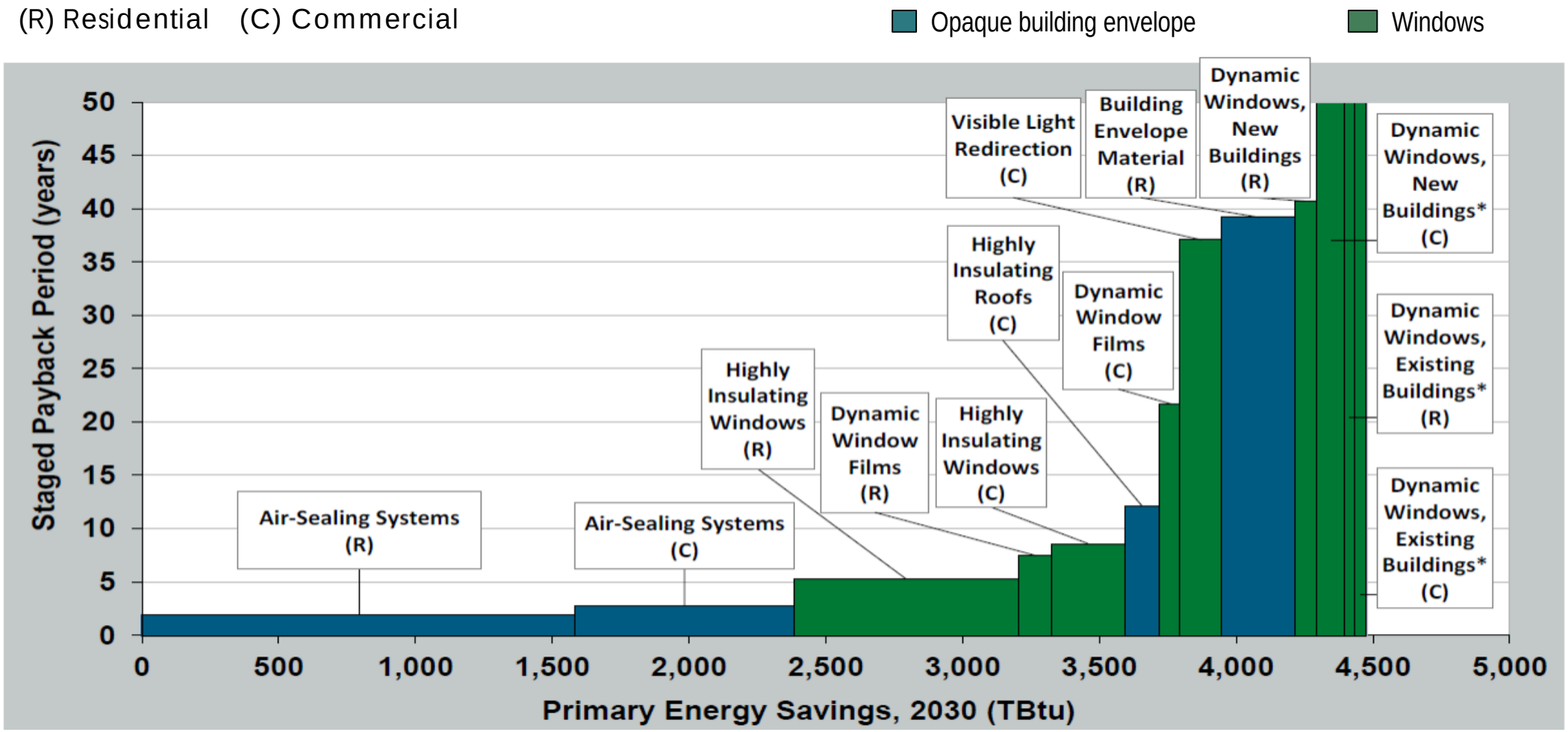
# Windows and Building Envelope R&D ET Roadmap




Source: Research and Development Roadmap: Windows and Building Envelope

Air leakage (infiltration and exfiltration) is responsible for ~6% of total energy used by commercial buildings in the US and it represents ~20% of total energy losses.

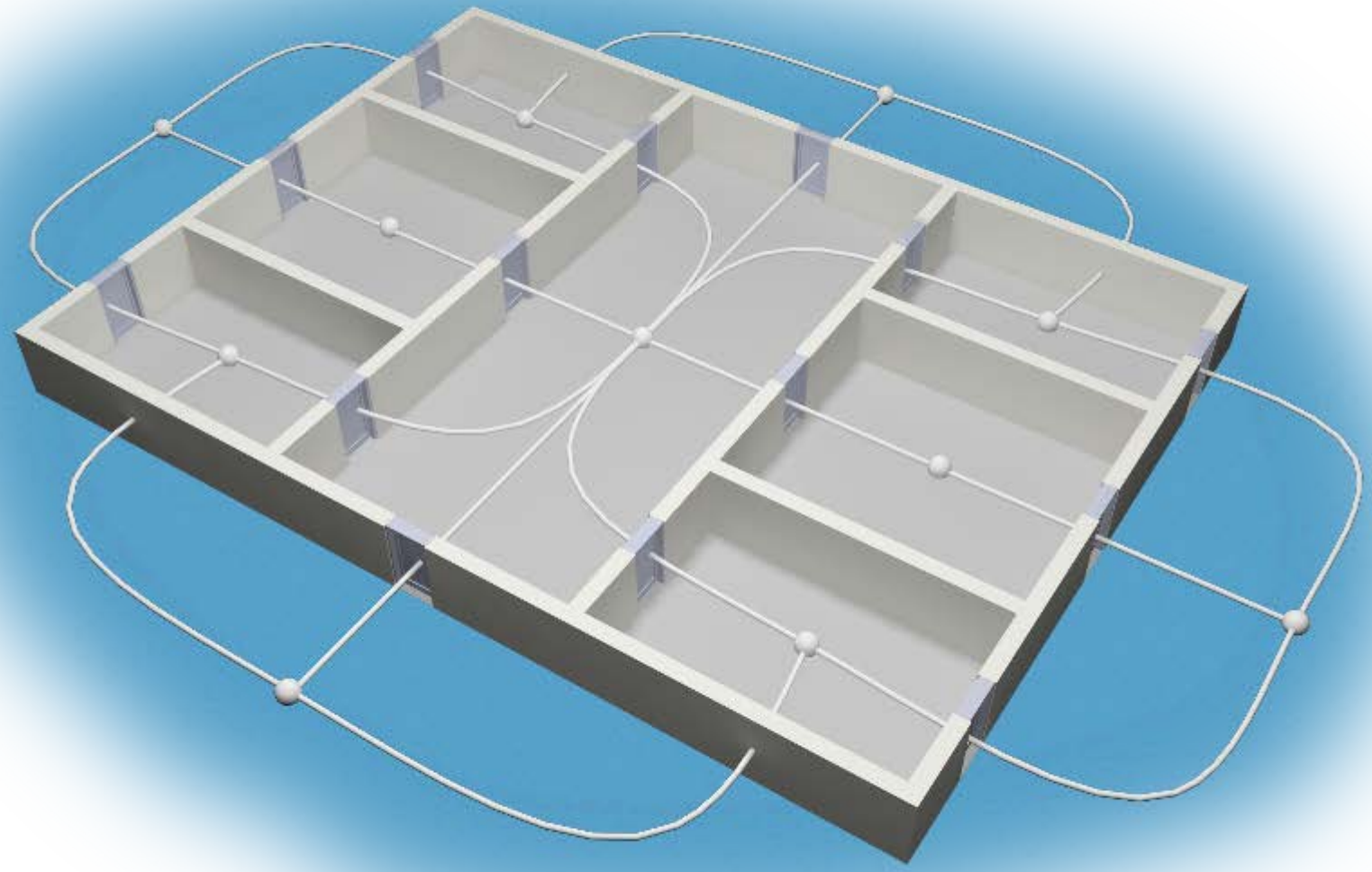
# Windows and Building Envelope R&D ET Roadmap



# Web-Based Energy Savings Calculator for Building Envelope Air Tightness

# Air Leakage Calculation is Not a Trivial Task

**CONTAM – Multizone Software**



# Energy and Cost Savings Depend on …

- Air leakage rates
- Weather
- Building type
- HVAC efficiency
- Energy and demand price

# Challenges

- Air leakage rates depend on multiple variables
  - Envelope airtightness
  - HVAC system operation
  - Occupancy
  - Weather
  - Stack effect
- Typical assumptions
  - Constant leakage rate
  - Leakage rates from simplified algorithms

} **Under- or over-estimated energy use**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# Overview

- An easy-to-use online tool using the simulation results of the best-in-class building energy simulation tool EnergyPlus and the whole building airflow simulation tool CONTAM.
- Online calculator estimates the potential energy and cost savings + reduction in moisture transfer from improvements in airtightness.
- Further increase market penetration of air barriers.

# Calculations Flow

## Pre-Run Simulations of DOE Commercial Prototype Buildings

Max HVAC/ventilation airflow rates

Hourly infiltration rates

### EnergyPlus
- Envelope airtightness
- Building details
- Weather

### CONTAM
- Envelope airtightness
- Building details
- Weather
- HVAC/ventilation airflow rates

### EnergyPlus
- Building Details
- Weather
- Hourly infiltration rates from CONTAM

### Pre-Run Results
Air leakage rate and energy use as a function of envelope airtightness

## User Specified
- City
- Building type
- Footprint area
- Before / after retrofit airtightness
- Energy rates

**Potential Energy and Cost Savings + Reduction in Moisture Transfer**


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# Easy to Find

infiltration calculator

All | Images | Videos | News | Shopping | More | Settings | Tools

About 361,000 results (0.44 seconds)

LW2: Infiltration Calculator : Xcom - Reddit
https://www.reddit.com/r/Xcom/comments/5p53mm/lw2_infiltration_calculator/
Jan 20, 2017 - 14 posts - 12 authors
based of LW2: **Infiltration Calculator** created by Xwynss I've extended it a little. Choose Expected Infiltration Level and finally you will known final number of enemies on chosen mission. Most of values are easy moddable. Pls Give me your Feedback if you find some errors. Thx and enjoy. VBN XCOM2 ...

| | | |
|---|---|---|
| [LW2] I've improved my **infiltration calculator**, and ... | 11 posts | Mar 9, 2017 |
| [LW2] I made a better **Infiltration Calculator**. Check it ... | 10 posts | Feb 20, 2017 |
| Tired of guessing, I made myself an **Infiltration** ... | 2 posts | Feb 4, 2017 |
| [LW2][mod-request] Integration of xwynns' **infiltration** ... | 2 posts | Jan 26, 2017 |

More results from www.reddit.com

Infiltration calculator by karafso - Pavonis Interactive Forums
pavonisinteractive.com › ... › Long War 2 › Long War 201
Forum rules. Players can post in Long War 201 threads but not start new ones. 1 post • Page 1 of 1. deaconivory: Long War 2 Crew: Posts: 167: Joined: Tue Dec 29, 2015 1:12 am. **Infiltration calculator** by karafso. Postby deaconivory » Mon Feb 20, 2017 7:41 pm. https://docs.google.com/spreadsheets/d/ ... edit#gid=0 ...

Infiltration - calculator - fxSolver
https://www.fxsolver.com/browse/formulas/Infiltration
If the precipitation rate exceeds the infiltration rate, runoff will usually occur unless there is some physical barrier. It is related to the saturated hydraulic conductivity of the near-surface soil. The rate of infiltration can be measured using an infiltrometer. **Infiltration calculation** methods Infiltration is a component of the general ...

Phillip Cheng, MD MS - Hepatic Fat MRI Calculator - hsc.usc.edu
www-hsc.usc.edu/~phillimc/calc/hepatic_fat_mri.html
**Calculator** for determining degree of hepatic steatosis on MRI opposed phase imaging.

[XLS] Infiltration Calculation Spreadsheet - wsdot
www.wsdot.wa.gov/publications/fulltext/Hydraulics/.../InfiltrationCalc.Spreadsheet.xls
2, **Infiltration** Ponds. 3, Length of Pond Bottom (ft), 150, Width of Pond Bottom (ft), 10. 4, Area of Bottom of Pond (acres), 0.03. 5, Pond Side Slopes (3:1 typical), 4. 6. 7. 8, Depth of Pond, Dpond, Depth to Water Table, Dwt, Hydraulic Conductivity, Kequiv, Area of Pond Bottom, Apond, Hydraulic Gradient, i, CFsize, **Infiltration** ...

infiltration
https://airleakage-calc.ornl.gov/
Web-Based Energy Savings **Calculator** for Building Envelope Air Tightness. If you want to sign in, you can try the default account: - User (login="user" and password="user"). © 2017 Oak Ridge National Laboratory. Managed by UT-Battelle for the US Department of Energy. Security & Privacy Notice. To report issues with the ...

air leakage calculator

All | Shopping | News | Images | Videos | More | Settings | Tools

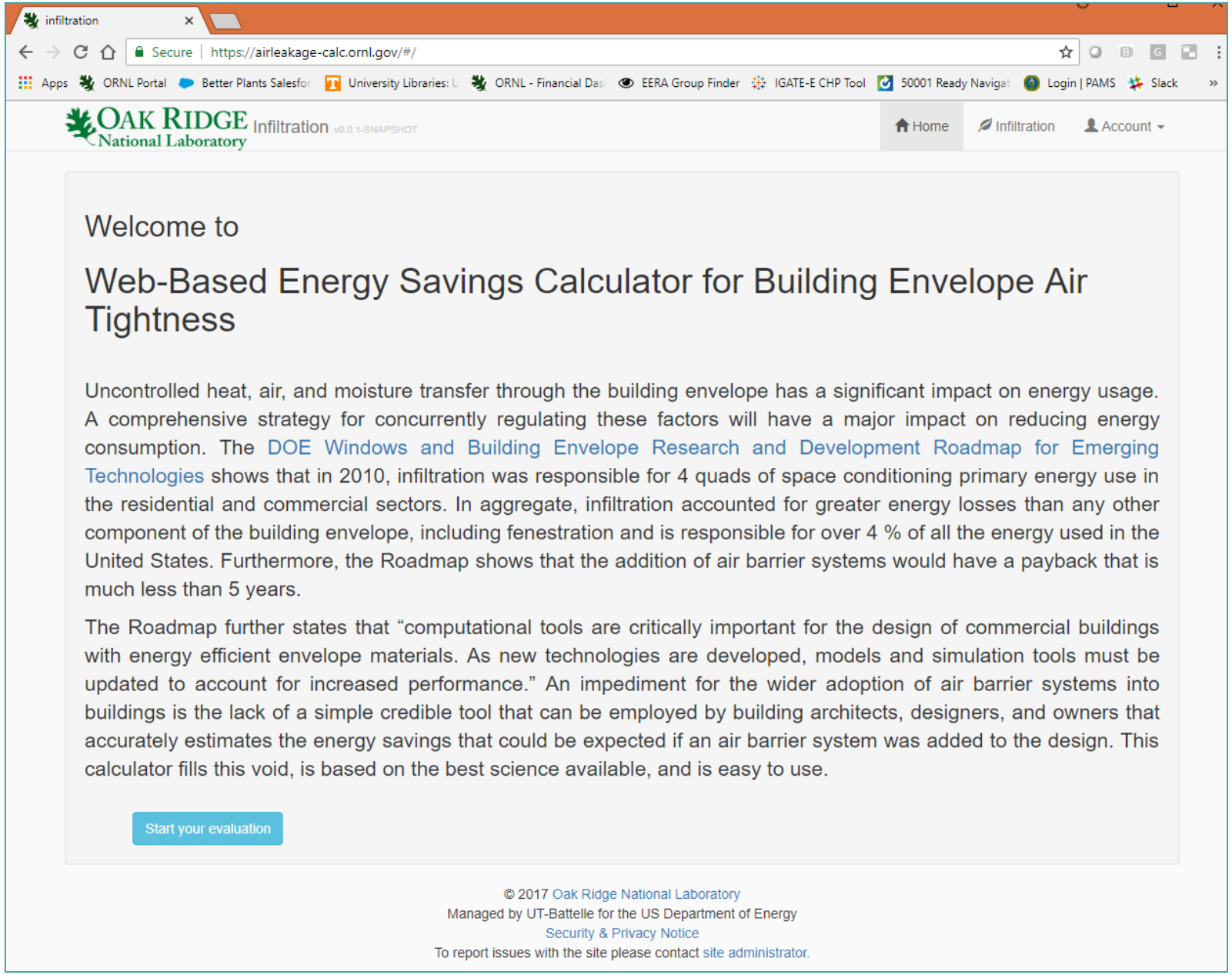
About 645,000 results (0.47 seconds)

Air Leakage Calculator - Lubs Technologies
www.lubstech.com/airleakcalculator
(Time on Load [min] x 100) / (Time On Load [min] + Time Off Load [min]). **Air Leakage** rate, 46, [cfm], = (% **Air Leaks** [%]) x (Rated Free Air Delivery [cfm]). Approximate Energy Wasted, 32,308, [kWh/y], = (**Air Leakage** Rate [cfm]) x 700 [kWh/(cfm)]. Average Electricity Price, $0.140, [$/kWh], Insert from Energy Bills Analysis Tool.

[XLS] Air Leakage Calculator (xls) - ThermWise
www.thermwise.com/home/AirLeakSaveCalculator_v2.xls
Jun 1, 2012 - 2, Questar ThermWise Whole House **Air Leakage Calculator**, No, 1.0, OR - Bend. 3, Home Identifier: 4, Purpose: The tool calculates ACH50 from blower door values and provides estimated energy savings for air sealing measure. Instructions: A. Enter data into the white boxes in the "Inputs" section of the ...

Calculators & Tools - Oak Ridge National Laboratory
https://web.ornl.gov/sci/buildings/tools/
The air tight savings **calculator** helps homeowners and builders **calculator** energy lost when **air leaks** through a building's envelope. Roof Savings **Calculator**. The Roof Savings **Calculator** was developed as an industry-consensus roof savings **calculator** for commercial and residential buildings using whole-building energy ...

# The Tool


infiltration
Secure | https://airleakage-calc.ornl.gov/#/
Apps ORNL Portal Better Plants Salesfor University Libraries: U ORNL - Financial Das EERA Group Finder IGATE-E CHP Tool 50001 Ready Navigat Login | PAMS Slack
OAK RIDGE National Laboratory Infiltration v0.0.1-SNAPSHOT
Home Infiltration Account
Welcome to
Web-Based Energy Savings Calculator for Building Envelope Air Tightness
Uncontrolled heat, air, and moisture transfer through the building envelope has a significant impact on energy usage. A comprehensive strategy for concurrently regulating these factors will have a major impact on reducing energy consumption. The DOE Windows and Building Envelope Research and Development Roadmap for Emerging Technologies shows that in 2010, infiltration was responsible for 4 quads of space conditioning primary energy use in the residential and commercial sectors. In aggregate, infiltration accounted for greater energy losses than any other component of the building envelope, including fenestration and is responsible for over 4 % of all the energy used in the United States. Furthermore, the Roadmap shows that the addition of air barrier systems would have a payback that is much less than 5 years.
The Roadmap further states that "computational tools are critically important for the design of commercial buildings with energy efficient envelope materials. As new technologies are developed, models and simulation tools must be updated to account for increased performance." An impediment for the wider adoption of air barrier systems into buildings is the lack of a simple credible tool that can be employed by building architects, designers, and owners that accurately estimates the energy savings that could be expected if an air barrier system was added to the design. This calculator fills this void, is based on the best science available, and is easy to use.
Start your evaluation
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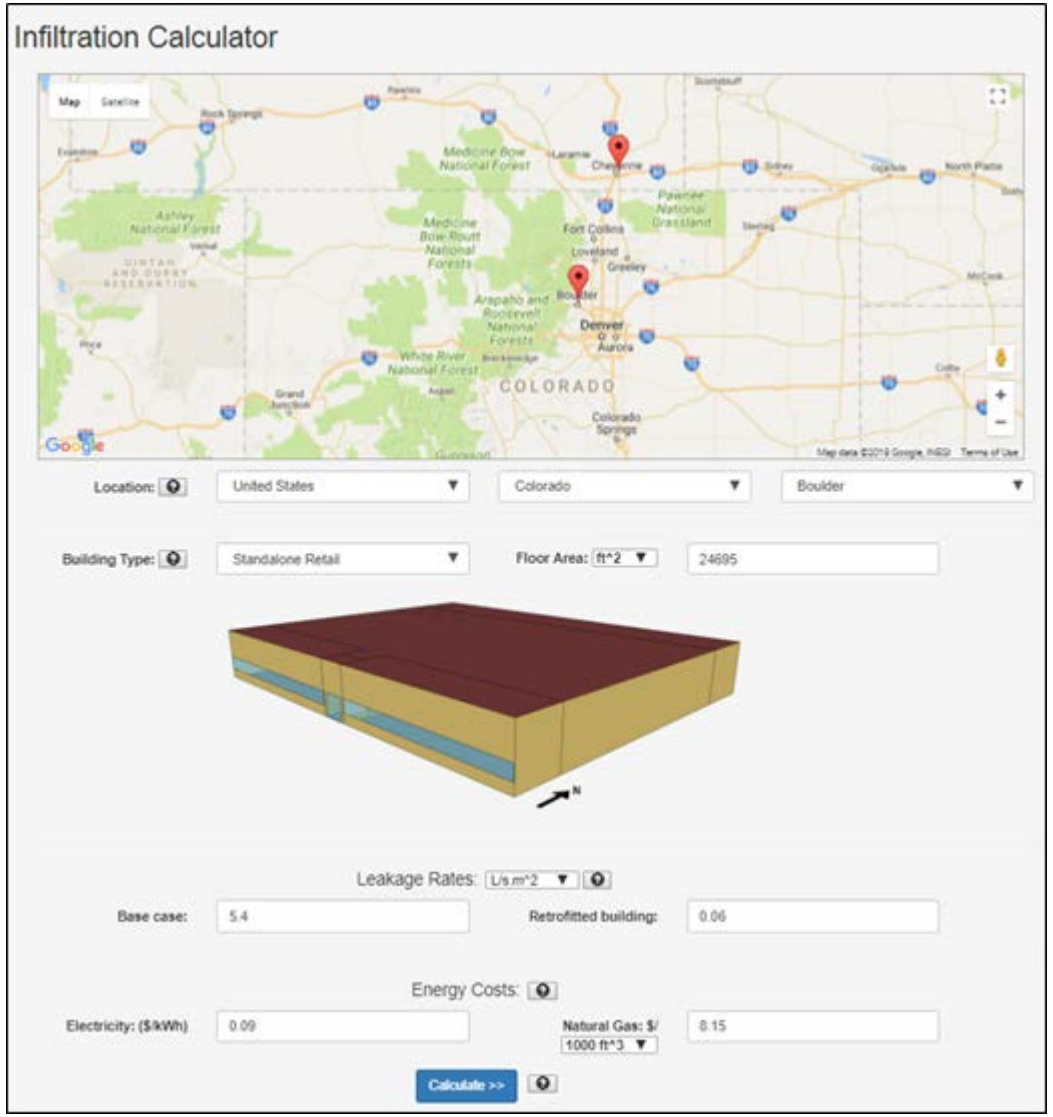
# Easy to Use




## User Inputs

- Location
- Building type
- Floor area
- Envelope airtightness
- Energy rate
- Can switch between IP and SI units
- Descriptions of the input parameters are available

# Locations

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# Building Types

- DOE commercial prototype building models
- ASHRAE 90.1-2013 compliant
- 16 building types
- 3 building types (standalone retail, medium office, and mid-rise apartment) in the first-phase (28.6% of commercial building footprint)
- 4 building types (High-Rise Apartment, Hospital, Large Hotel, and Secondary School) in the second-phase (27.8% of commercial building footprint)


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# DOE Commercial Prototype Building Models (ASHRAE 90.1-2013) Used

| Building | Total Floor Area, $ft^2$ | Number of Floors | Construction Volume Weights |
|---|---|---|---|
| Standalone Retail | 24,695 | 1 | 15.3% |
| Mid-Rise Apartment | 33,700 | 4 | 7.3% |
| Medium Office | 53,600 | 3 | 6.0% |
| High-Rise Apartment | 84,360 | 10 | 9.0% |
| Hospital | 241,410 | 5 | 3.4% |
| Large Hotel | 122,132 | 7 (including basement) | 5.0% |
| Small Hotel | 43,200 | 4 | 1.7% |
| Large Office | 498,600 | 13 (including basement) | 3.3% |
| Small Office | 5,500 | 1 | 5.6% |
| Outpatient Healthcare | 40,950 | 3 | 4.4% |
| Restaurant Fast Food | 2,500 | 1 | 0.6% |
| Restaurant Sit Down | 5,502 | 1 | 0.7% |
| Stripmall | 22,500 | 1 | 5.7% |
| Primary School | 73,960 | 1 | 5.7% |
| Secondary School | 210,900 | 2 | 10.4% |
| Warehouse | 49,495 | 1 | 16.7% |


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# Energy Costs

- Select the default values
  - Electricity and natural gas for US cities: U.S. EIA
  - Energy prices for Canada: rates used to develop the National Energy Code of Canada for Buildings 2011(NECB 2011)
- User-defined electricity and natural gas prices


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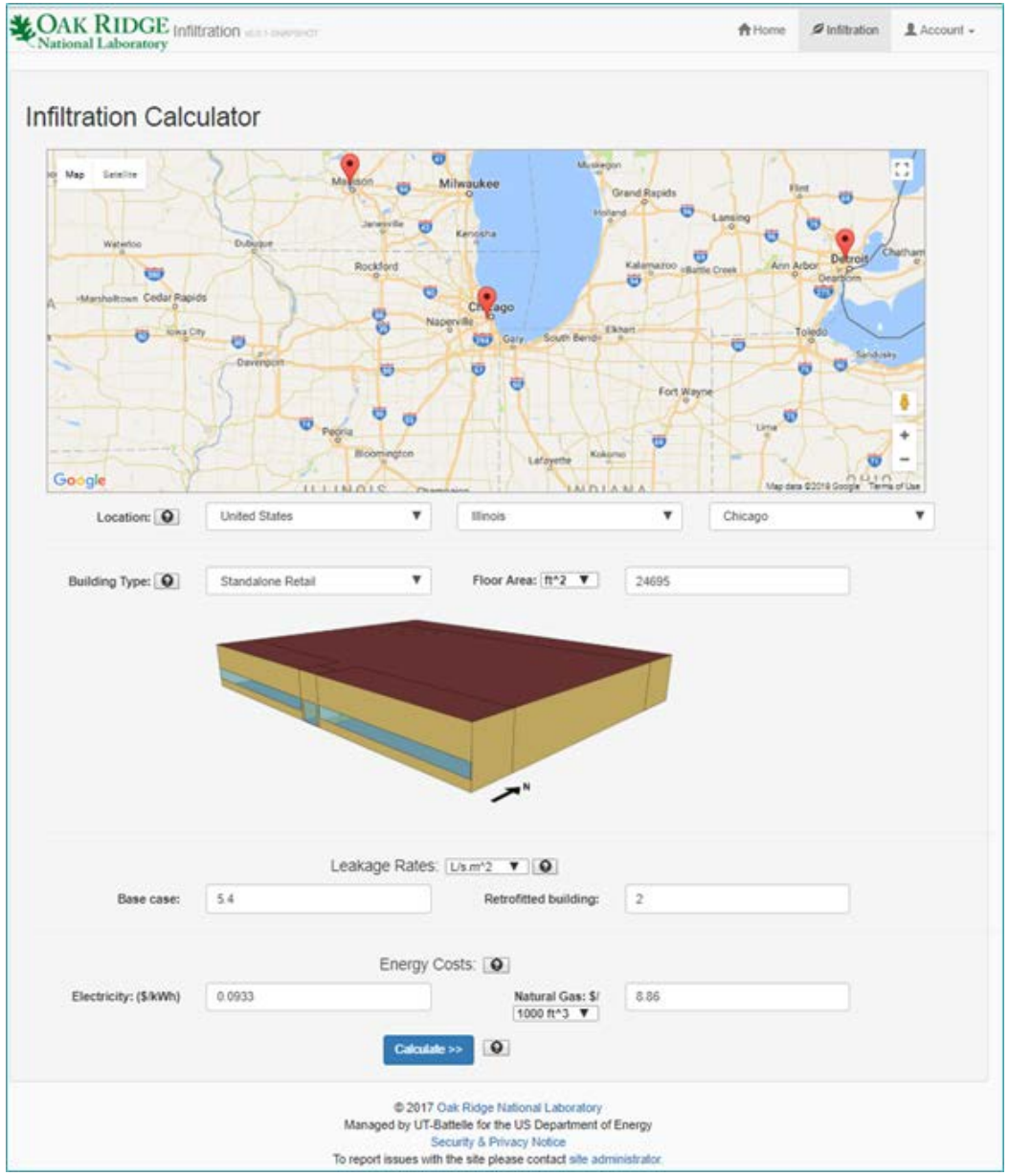
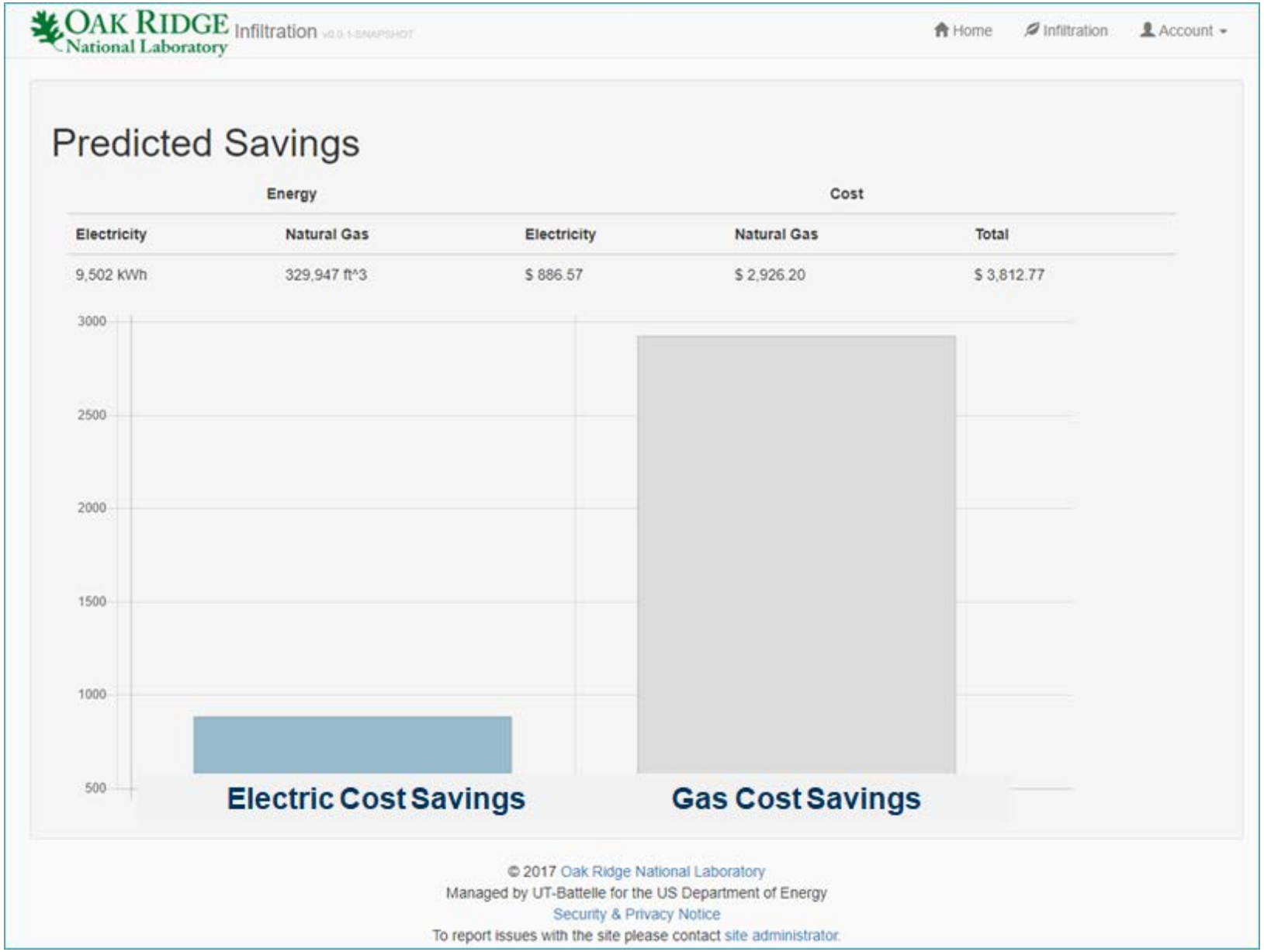
# Example

# Calculator Input



# Calculator Output



# Acknowledgments


- Laverne Dalgleish, ABAA
- Steven Emmerich, NIST
- Lisa Ng, PhD, NIST
- Gina Accawi, ORNL

# Questions

**Sachin Nimbalkar, PhD**
Group Leader
Energy Efficiency Research & Analysis Group
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# References


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# Discussion

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# Thank You!

- Speakers
  - Bert Hill, *Volvo Group*
    bert.hill@volvo.com
  - Sachin Nimbalkar, *Oak Ridge National Lab* nimbalkarsu@ornl.gov

- Moderator
  - Cindy Zhu, *DOE*
    cindy.zhu@ee.doe.gov