

# SEET 2012



Instructor's Guide to:

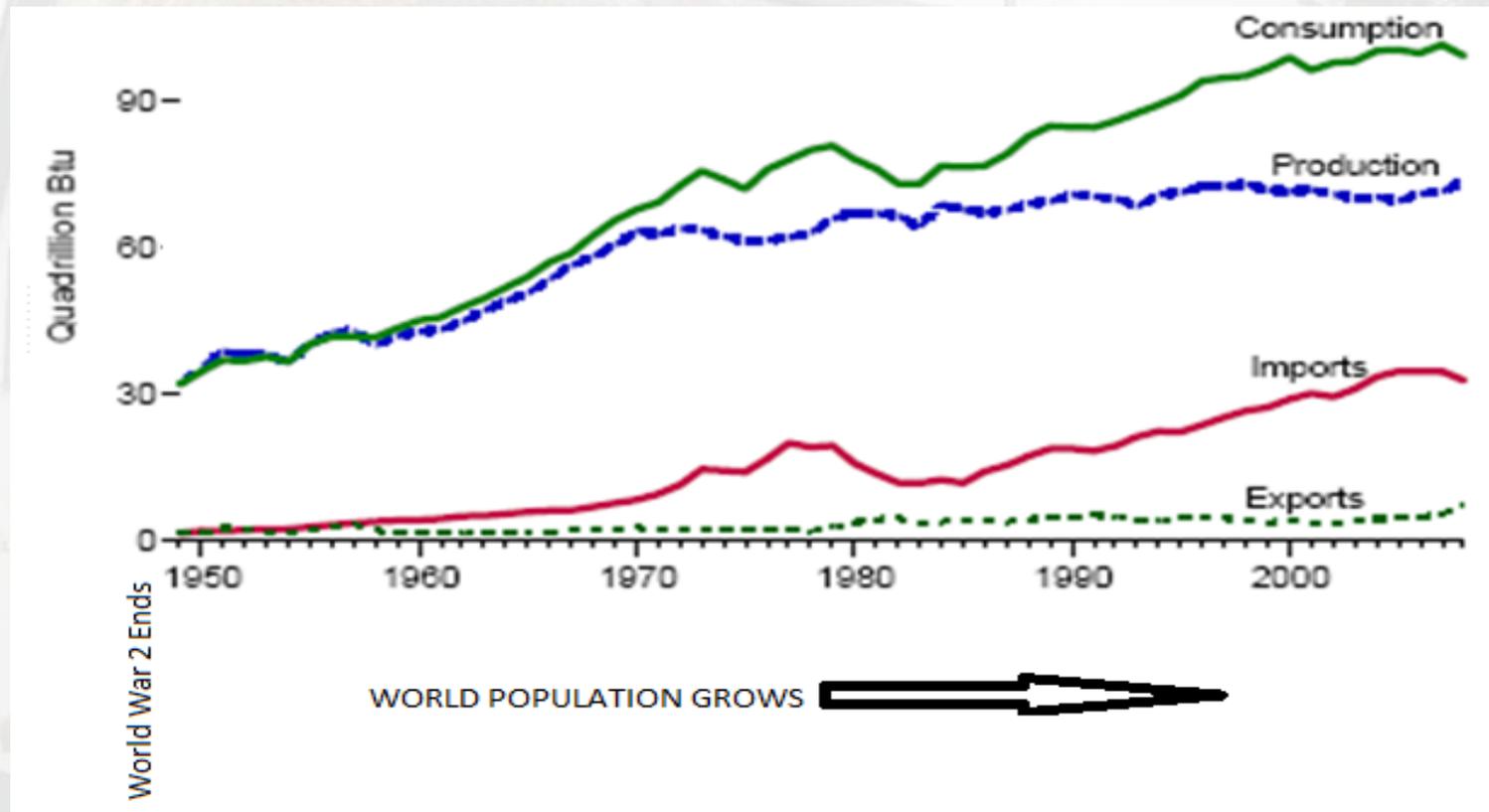
# Residential Energy Audit

- **Bill Beauchamp** –  
Energy Management & Renewable Resources, Delaware Technical Community College
- **Jim Jazdzewski** –  
Electronic Engineering Technology, Gateway Technical College
- **Shahed Mustafa** –  
Mechanical & Manufacturing Technology, Bridgemont Community and Technical College

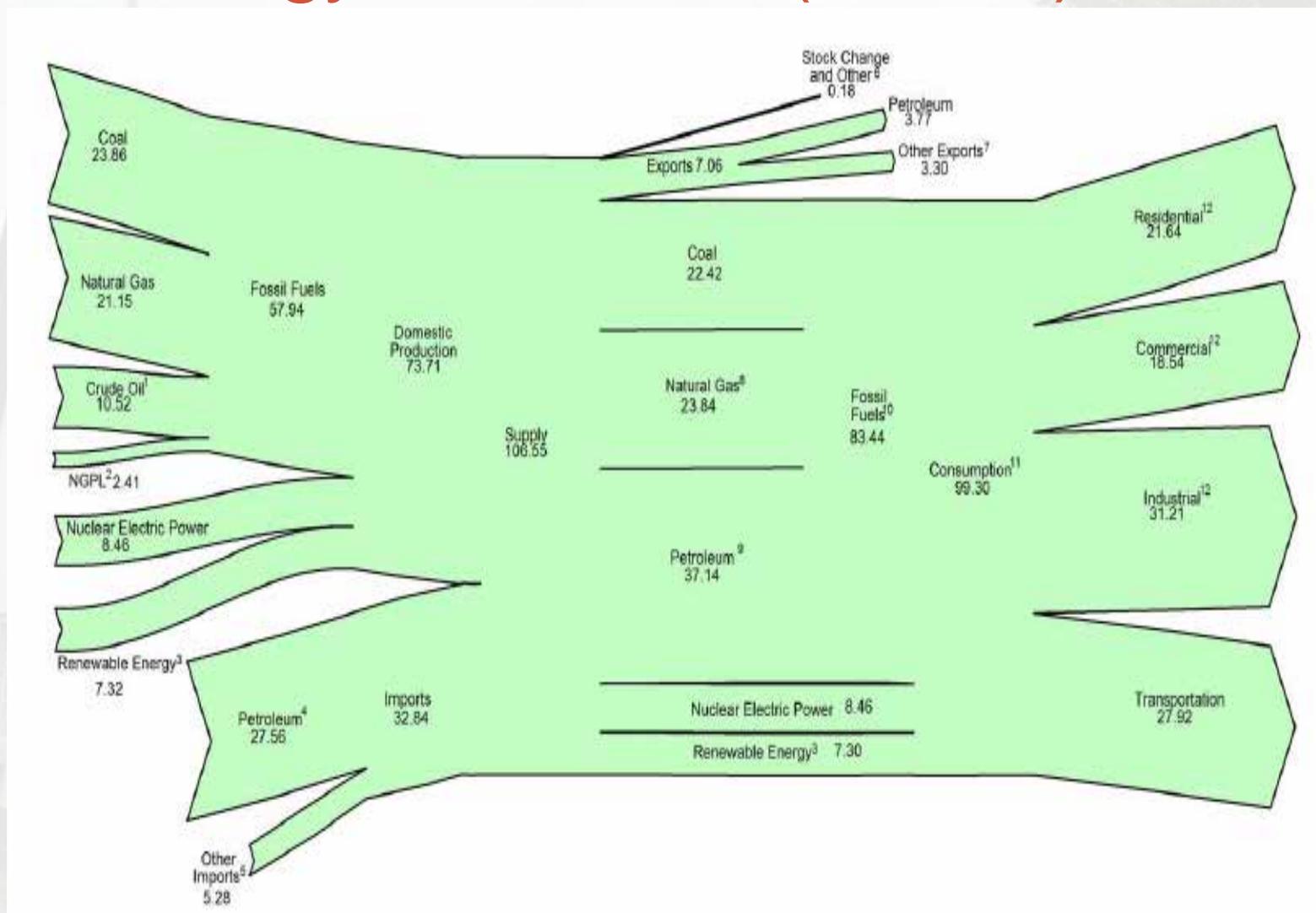
# Lets talk about energy.

- Wood was the world's main fuel from the beginning of mankind's time on earth.
- Coal rapidly replaced wood during the Industrial Revolution.
- At the end of World War II, the world's energy use increased as the population began to soar.

# World Energy Use



# US Energy Flow 2008 (Quads)

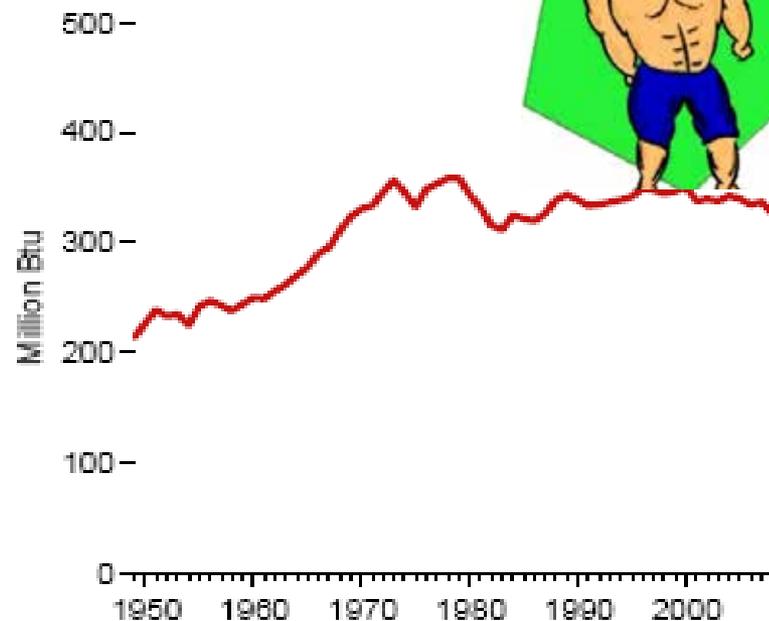


# Overuse of energy has several negative effects.

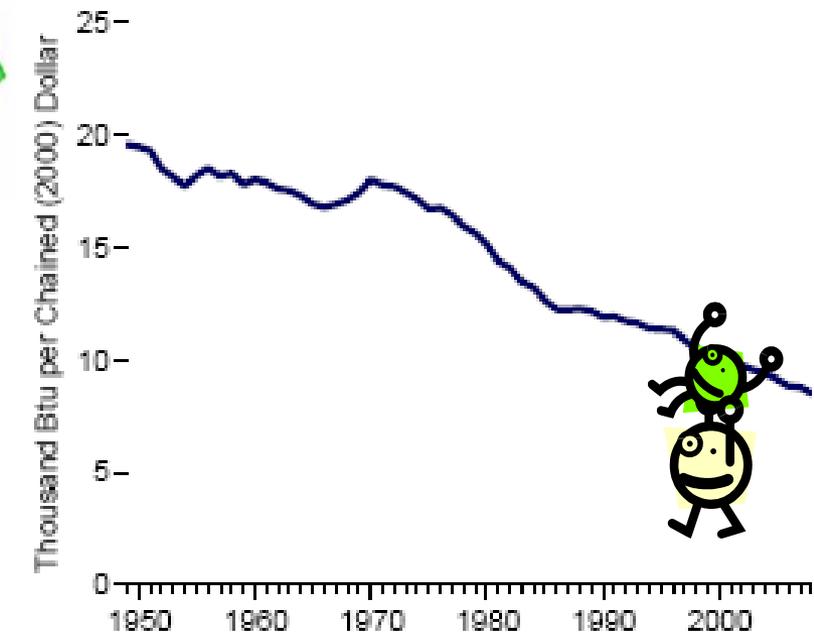
- Costs money
- Threatens the U.S. economy (trade deficit)
- Damages the environment (global warming)
- Threatens national security

# As energy use increases, GDP decreases.

Energy Consumption per Per  
1949-2008



Energy Consumption per Real Dollar<sup>2</sup> of  
Gross Domestic Product, 1949-2008



To maintain our standard of living & stop damage to our environment, we need to use less energy!

When we waste energy...

**A FINITE RESOURCE IS WASTED  
& THE ENVIRONMENT IS  
POLLUTED!**

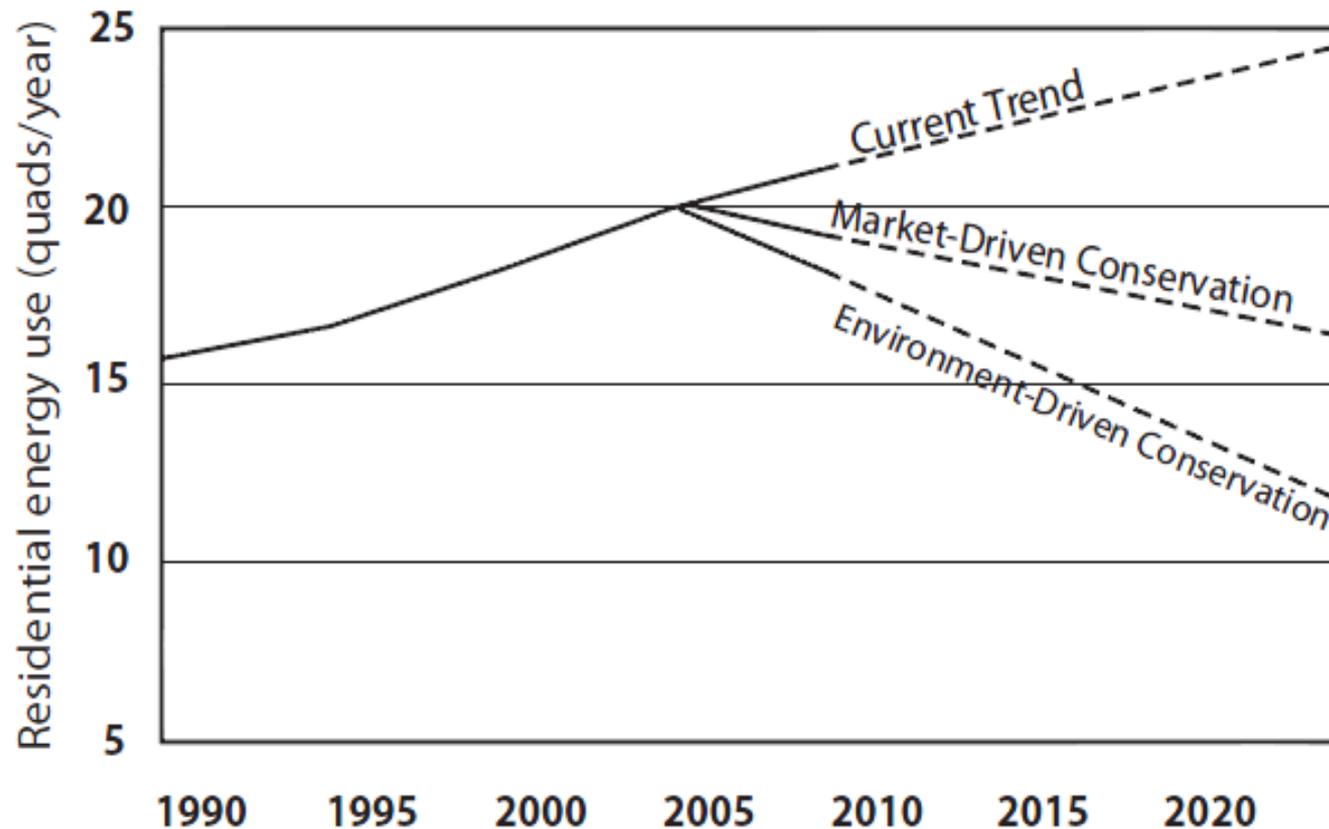
# Energy Conservation

**CHANGING BEHAVIORS  
TO SAVE ENERGY**

Energy Efficiency =

**DOING MORE WORK  
WITH LESS ENERGY.**

## Past, Present, and Future Energy Consumption



From Energy Information Administration, DOE Energy Efficiency and Renewable Energy Division, and American Council for an Energy Efficient Economy

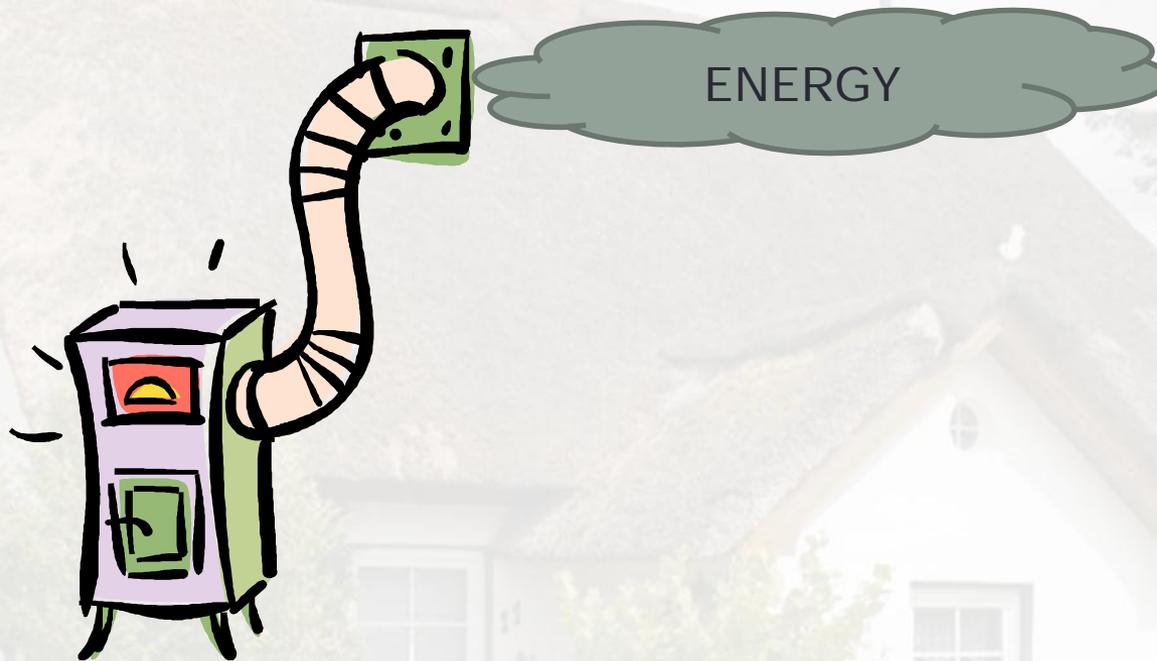
Each citizen helps make the decision about which energy path we will follow in the future. International standards favor returning to 1990 annual energy consumption levels, though environmental-driven conservation efforts could result in even lower energy consumption.

This old house uses too much energy!



Typical U.S. residential buildings use  
**1.5 to 2 times** as much energy as is necessary.

# Residential Energy Waste



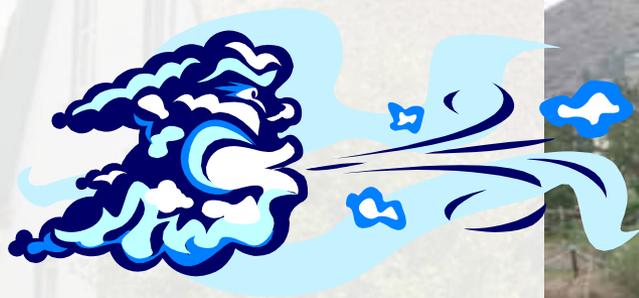
Heating & cooling system inefficiency

# Residential Energy Waste



Building shell heat losses & gains

# Residential Energy Waste



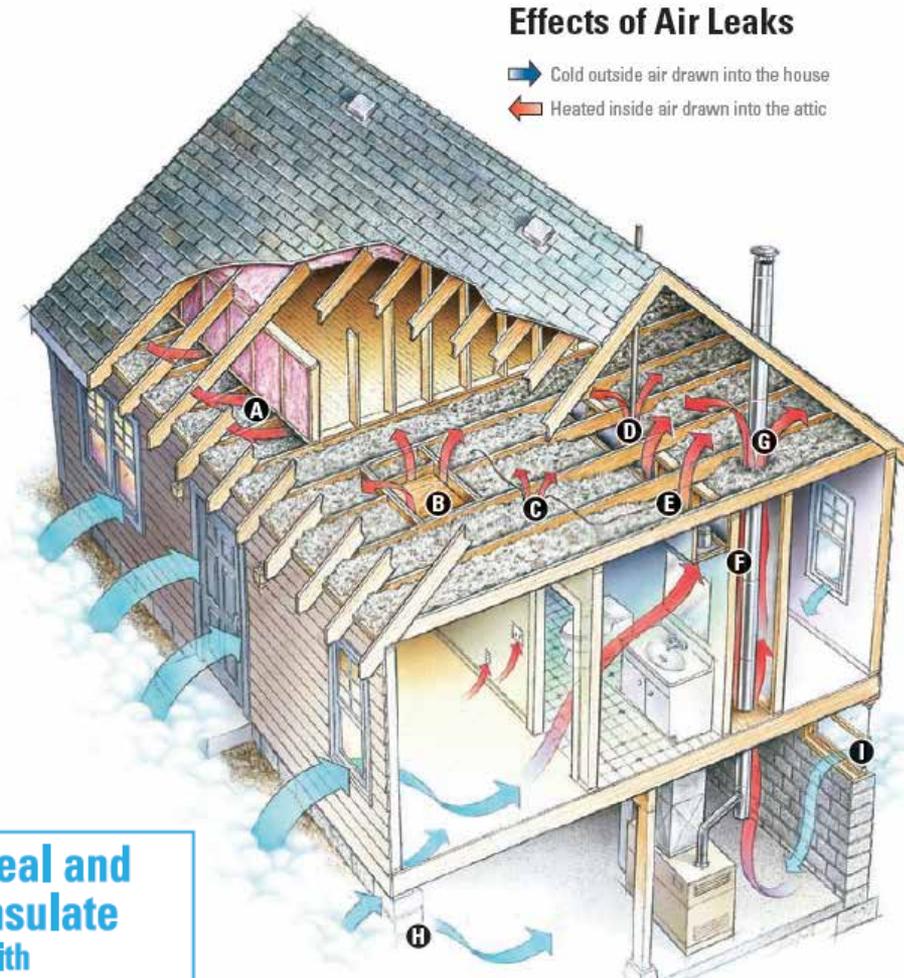
Air leakage

# Common Household Air Leaks

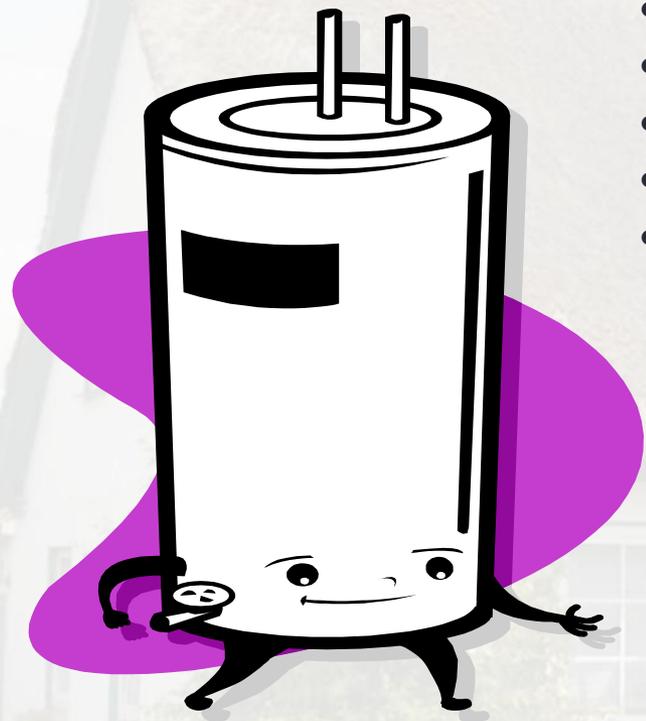
- A** Behind Kneewalls
- B** Attic Hatch
- C** Wiring Holes
- D** Plumbing Vent
- E** Open Soffit (the box that hides recessed lights)
- F** Recessed Light
- G** Furnace Flue or Duct Chaseways (the hollow box or wall feature that hides ducts)
- H** Basement Rim Joists (where the foundation meets the wood framing)
- I** Windows and Doors

## Effects of Air Leaks

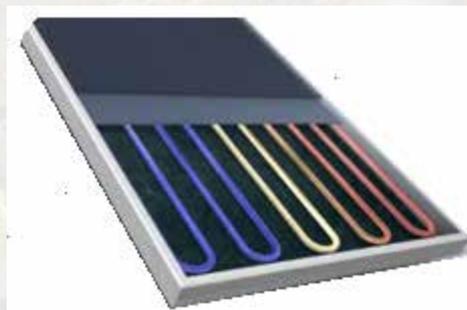
-  Cold outside air drawn into the house
-  Heated inside air drawn into the attic



# Residential Energy Waste

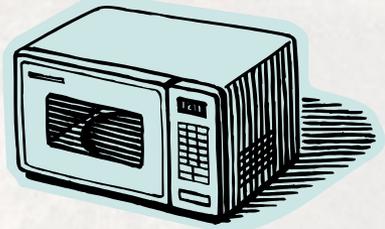


- Lower the temperature set point.
- Use an on-demand HWH.
- Avoid excessive use (low flow devices).
- Use cold water when possible.
- Add insulation.
- Use solar-assisted appliances/equipment.



Water heating inefficiency

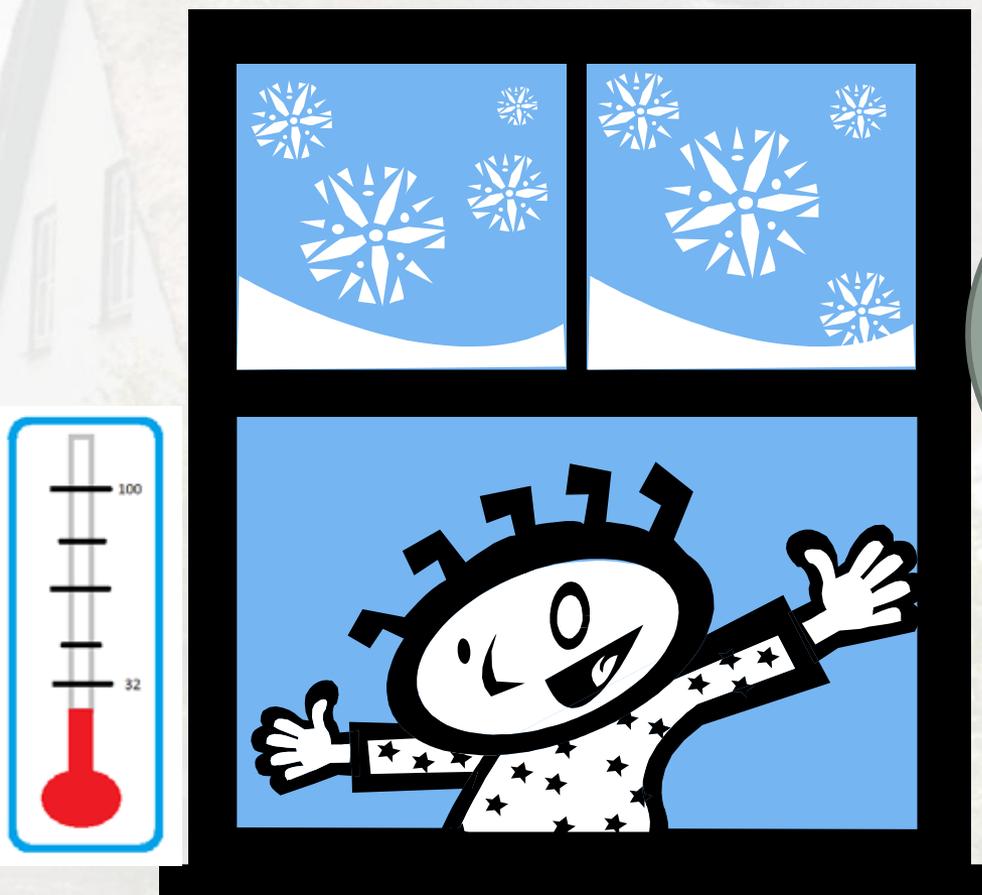
# Residential Energy Waste



- Use Energy Star appliances.
- Use LED/CFL.
- Reduce phantom loads.
- Fix leaky plumbing.
- Use proper equipment.

Appliance inefficiency

# Residential Energy Waster In Action



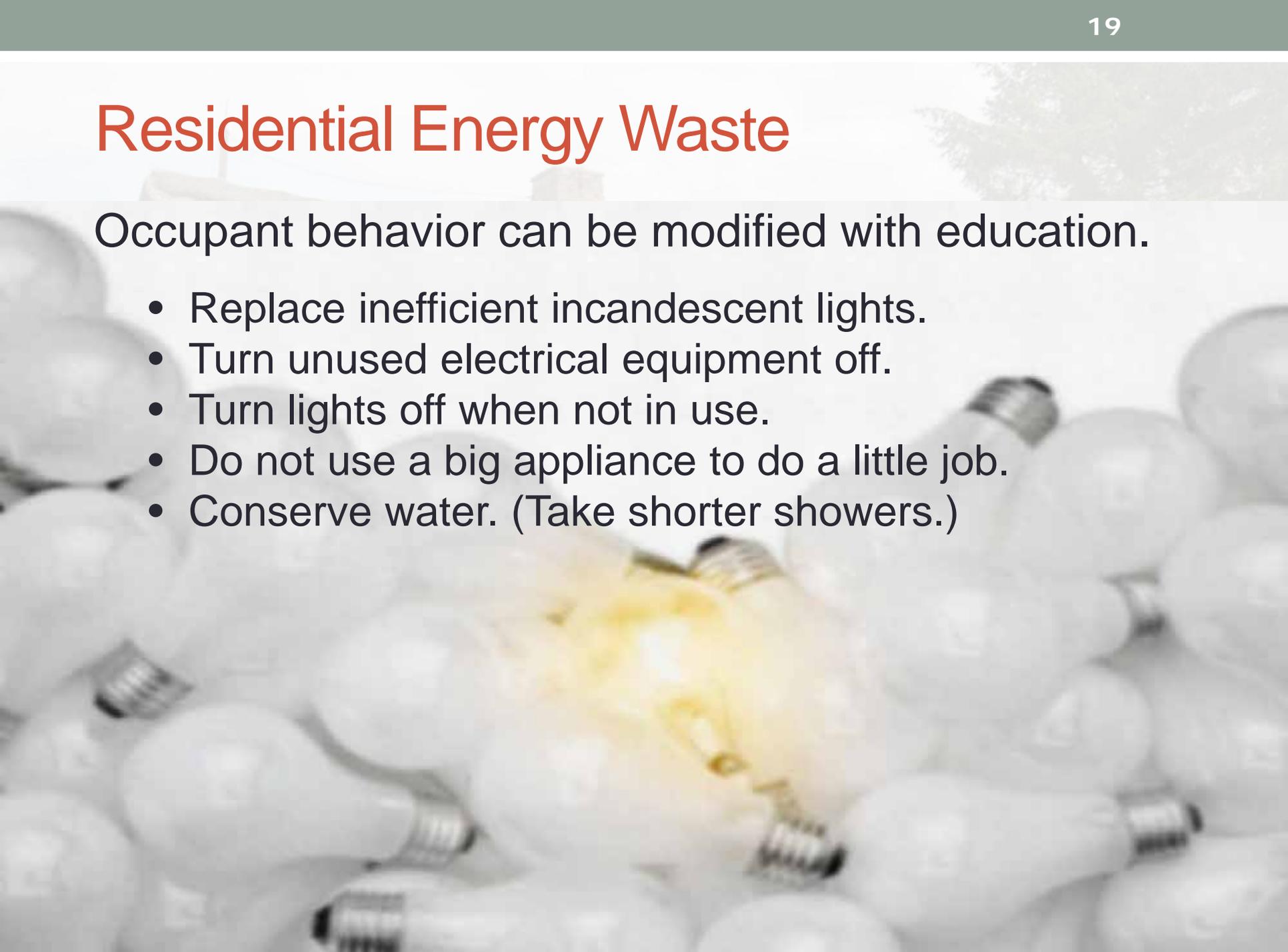
*I need fresh air.*

*I am going to sleep with the window open tonight.*

# Residential Energy Waste

Occupant behavior can be modified with education.

- Replace inefficient incandescent lights.
- Turn unused electrical equipment off.
- Turn lights off when not in use.
- Do not use a big appliance to do a little job.
- Conserve water. (Take shorter showers.)





Now that we understand energy waste a little better, we can talk about an energy audit.

# What are the goals of an energy audit?

- Locate energy-wasting appliances.
- Find sources of poor air quality.
- Locate causes of moisture in a home.
- Assess combustion appliances for proper operation and safety.
- Improve air quality and comfort.
- Recommend energy-saving repairs and upgrades.
- Locate existing or potential health and safety problems.
- Provide a written report with findings, recommendations and financial analysis.

# The Energy Audit Process

- The Interview
- Information collection “The Walk-Around”
  - Safety first
  - HVAC systems
  - Vents
  - Chimneys
  - Windows
  - Doors
  - Insulation
  - Attic
  - Crawl spaces/basements



# The Energy Audit Process

## The Interview

Talk to the client and find out:

- Why they want an audit done
- Utility data
- Any special concerns
- Go over the audit process.
- Make an appointment to discuss results.

**WHO?**

**WHAT?**

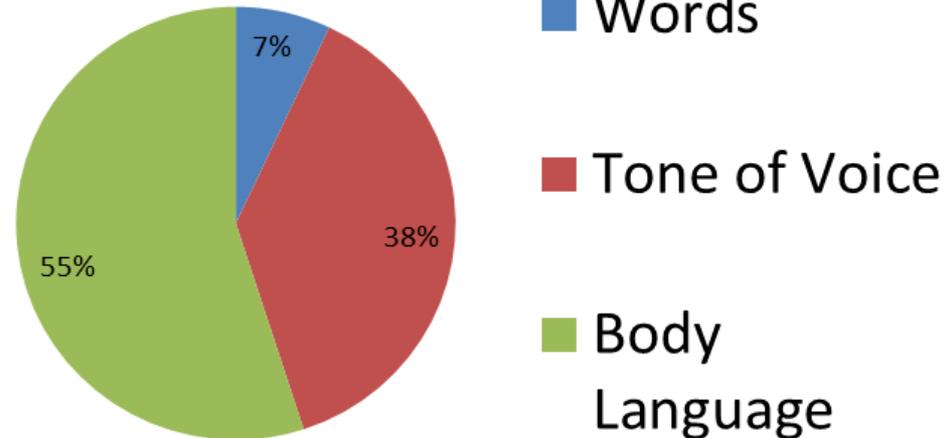
**WHY?**

**HOW?**

# During the Interview

- Respect
- Boundaries
- Understanding
- Professionalism

*Actions speak louder than words.*



# Investigate – “The Walk-Around”

## *Safety First*

**PROTECT YOURSELF AND THE OCCUPANTS OF THE HOME!**

- CO monitor
- Hardhat
- Gloves
- HEPA respirator
- Dust mask
- Protective clothing
- Head light
- Ladder safety

# Investigate – “The Walk-Around”

## HVAC Systems

- Heating system
- Cooling system
- Duct systems
- Indoor air quality
- Water heating system

# Investigate – “The Walk Around”

## Heating System Efficiencies

Identify all system's check for combustion safety and record:

- Combustion safety
- Efficiency
- Characteristics of operation
- Age
- Quality
- Problems
- Recommend set-points



# Investigate – “The Walk Around”

## Cooling System

- Air conditioners use about 5% of all the electricity produced in the United States. This results in 100 million tons of carbon pollution each year.
- Switching to high-efficiency air conditioners could reduce this energy use and associated pollution by 20%–50%.

# Investigate – “The Walk Around”

## *Cooling System*

Identify all systems and record the following for each:

- Efficiency
  - EER (output/input)
  - SEER (Seasonal Energy Efficiency Ratio)
- Characteristics of operation
- Age
- Quality
- Problems



# Investigate – “The Walk Around”

## Indoor Air Quality

Most of us spend much of our time indoors. The air that we breathe in our homes, in schools and in offices can put us at risk for health problems. Some examples of pollutants are chemicals, gases and living organisms like mold and pests.

# Investigate – “The Walk Around”

## *Indoor Air Quality*

Identify all pollutant sources and record:

- Combustion
- Building materials and furnishings
- Asbestos-containing materials
- Wet or damp areas
- Radon, pesticides and outdoor air pollution
- Household cleaning and maintenance products
- Humidification devices
- Building deterioration

# Investigate – “The Walk Around”

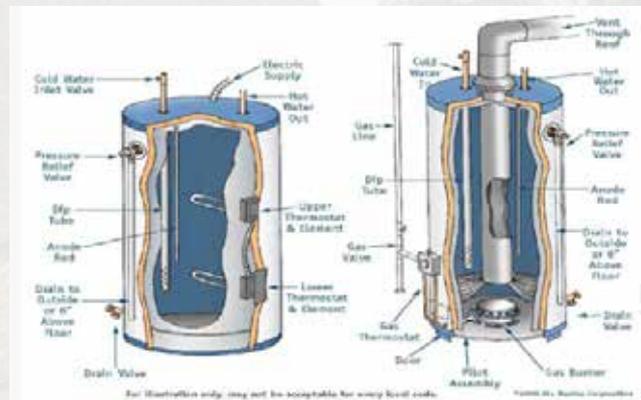
## Water Heating Systems

Residents use 64 gallons of hot water a day.

**BEST**  
Almost  
No  
Energy  
Cost



**POOR**  
Electric  
90%



**POOR**  
Gas  
59%

**GOOD**  
96%  
Condensing  
Gas



**POOR**  
59%

# Investigate – “The Walk Around”

## Water Heating Systems

Identify all systems, then check for combustion safety issues and record:

- Combustion safety
- Efficiency
- Characteristics of operation
- Age
- Quality
- Leaks
- Problems

# The Blower Door Test

- Blower door test creates a pressure difference between the home's interior and exterior.
- This pressure difference allows an auditor to easily find air leakage problems in a home.
- Another benefit is that air changes in a home can be calculated to insure proper ventilation.
- The blower door also aids in duct leakage testing, also known as duct blasting.



# Duct Blasting and Inspection

- Duct blasting is pressurizing a duct to locate air leakage.
- This is an important test because leaky, non-insulated ducts are one of the biggest energy wasters found in a home.
- Ducts move pressurized air through a home.
- It is estimated that 20% to 60% of the energy used in a heating/cooling system is lost thru duct leaks.

# Reports

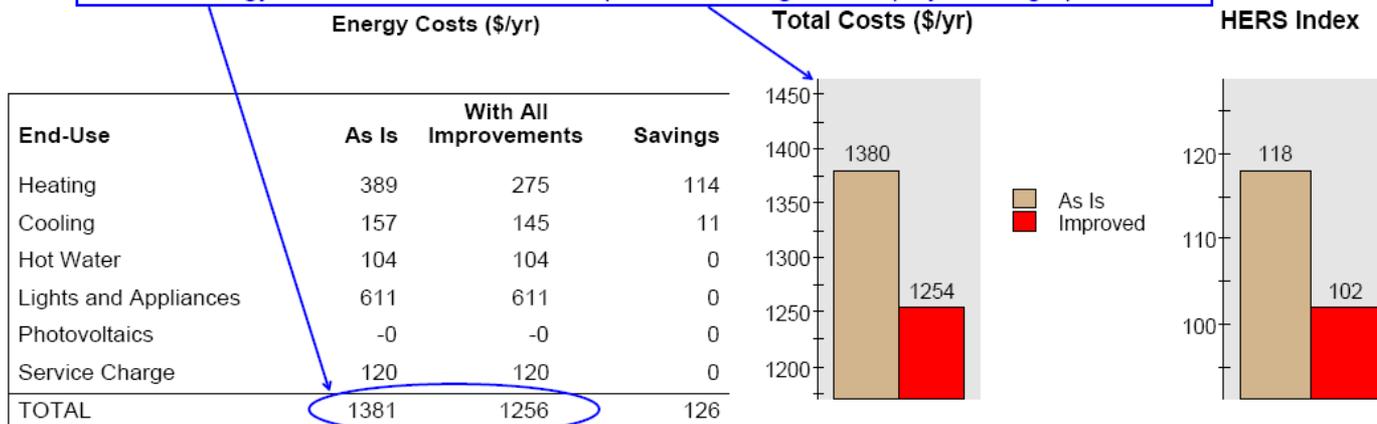
**No building audit is complete without a report!!!**

## Reports should contain:

- All safety issues and concerns found
- Building issues (e.g., leaky windows and doors, decay, damage, drainage issues)
- Pictures, pictures, pictures.....
- Identification of energy-related issues and recommendations
- Cost analyses of energy use and possible improvements (presented in a clear, detailed and understandable format)

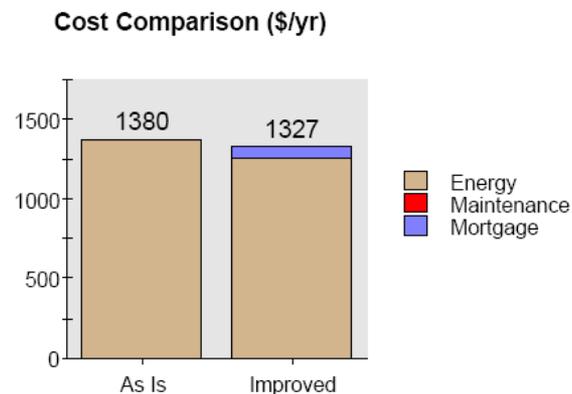
# Financial Analysis Report

The total energy costs for the "As Is" and "Improved" buildings are displayed in a graphic format.



REM also includes economic detail to assist lenders and appraisers in their decision-making process.

Information For Lenders and Appraisers	
Installed Cost of Improvements (\$)	1051
Cost Weighted Life of Measure (Years)	30
Mortgage Term (Years)	20
Discount/Mortgage Rate (%)	3.400
Present Value Factor	18.6
Expected Annual Energy Savings (\$)	126
Expected Annual Maintenance Costs (\$)	0
Expected Annual Savings (\$)	126
Increased Annual Mortgage Costs (\$)	73
Present Value of Savings (\$)	2340
Expected Annual Cash Flow (\$)	52



# Recommended Improvement Analysis Report

## IMPROVEMENT ANALYSIS REPORT

example.blg

Page 2

### Recommended Improvements

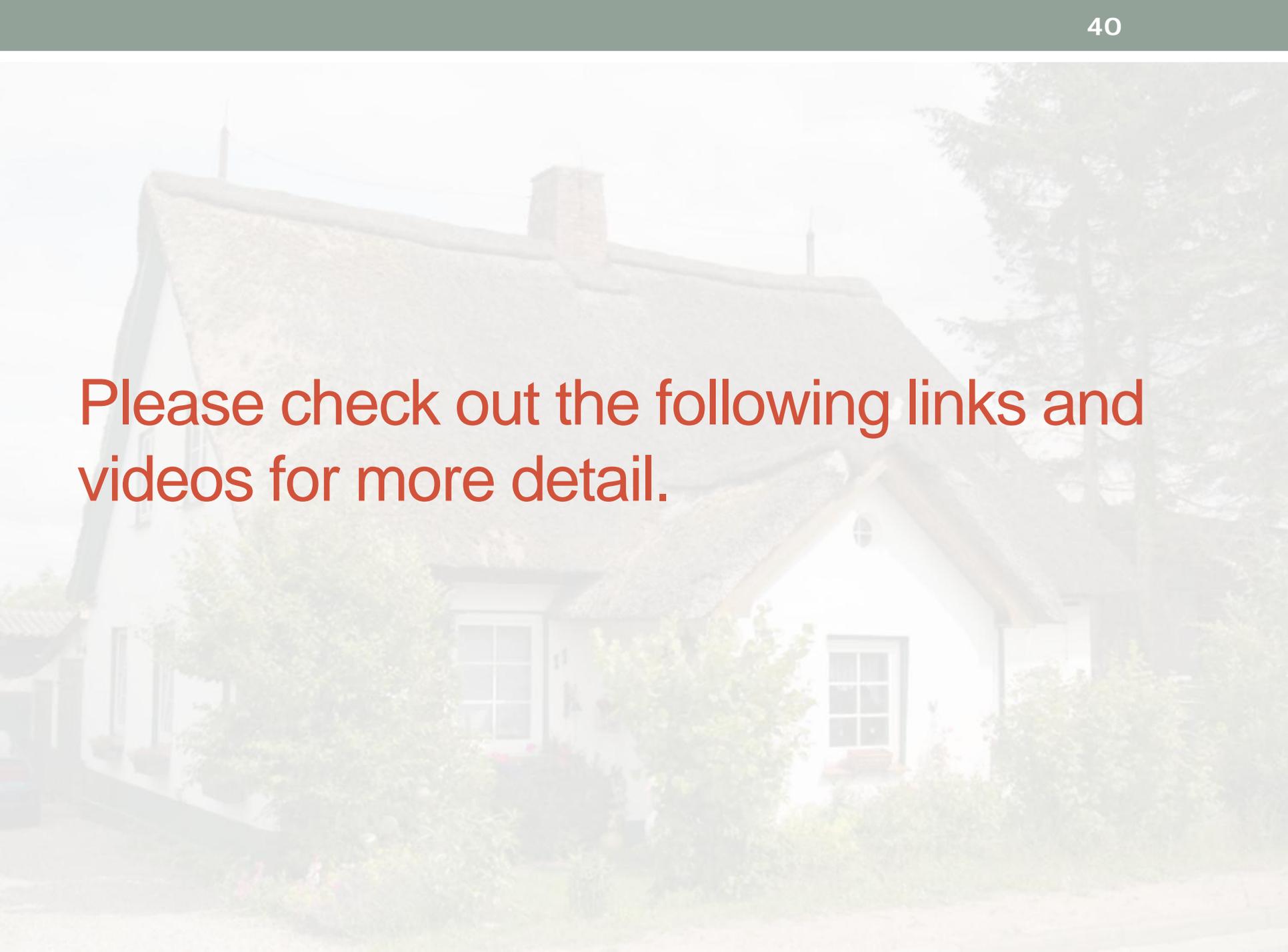
Results for weatherization measures.

Component	Life	Cost	Yr Savings	SIR	PV	SP	Index
<b>1. AG Wall 1: From SI</b>	30	41	11	4.8	155	3.89	117
Existing: R-11							
Proposed: R-15							
Measure: Increase by R-4							
<b>2. Window 3:</b>	30	180	35	3.6	475	5.12	113
Existing: Double - Wood							
Proposed: Dbl/LoE/Arg - Vinyl							
Measure: Upgrade to Dbl/LoE Vinyl							
<b>3. Infiltration:</b>	30	320	46	2.7	545	6.89	106
Existing: 0.5-0.7/0.5-0.7 ACHnat							
Proposed: 0.4/0.4 As Specified							
Measure: Achieve 0.4ACH							
<b>4. Ceiling 1: Attic</b>	30	150	13	1.6	87	11.79	104
Existing: R-30 Blown, Attic							
Proposed: R-50 Blown, Attic							
Measure: Increase by R-20							
<b>5. Window 1:</b>	30	180	13	1.3	62	13.84	103
Existing: Double - Wood							
Proposed: Dbl/LoE/Arg - Vinyl							
Measure: Upgrade to Dbl/LoE Vinyl							
<b>6. Window 2:</b>	30	180	8	0.8	-35	23.11	102
Existing: Double - Wood							
Proposed: Dbl/LoE/Arg - Vinyl							
Measure: Upgrade to Dbl/LoE Vinyl							

# The Home Energy Audit Process

- <http://www.bing.com/videos/search?q=what+are+the+goals+of+an+energy+audit%3f&view=detail&mid=1415564A86E6D9AD79701415564A86E6D9AD7970&first=0>





Please check out the following links and videos for more detail.

# RESOURCE /LINKS



<http://ateec.org/energy>



<http://www.bpi.org/>



<http://www.resnet.us/>



[http://ornl.gov/sci/roofs+walls/insulation/ins\\_01.html](http://ornl.gov/sci/roofs+walls/insulation/ins_01.html)



[http://www.energystar.gov/?c=higher\\_ed.bus\\_highereducation](http://www.energystar.gov/?c=higher_ed.bus_highereducation)



# BLOWER DOOR TESTING IN HOMES

(HOW TO SET UP A BLOWER DOOR THE EASY WAY.)

<http://www.youtube.com/watch?v=IHjl2Tfl5Xg>

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# Blower Door Basics: Part 1 – Prep & Setup

<http://www.youtube.com/watch?v=aaw9zpGTaw4&feature=related>

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# Blower Door Basics: Part II - The Test Process

<http://www.youtube.com/watch?v=cVNEVSeEvFE&feature=relmfu>

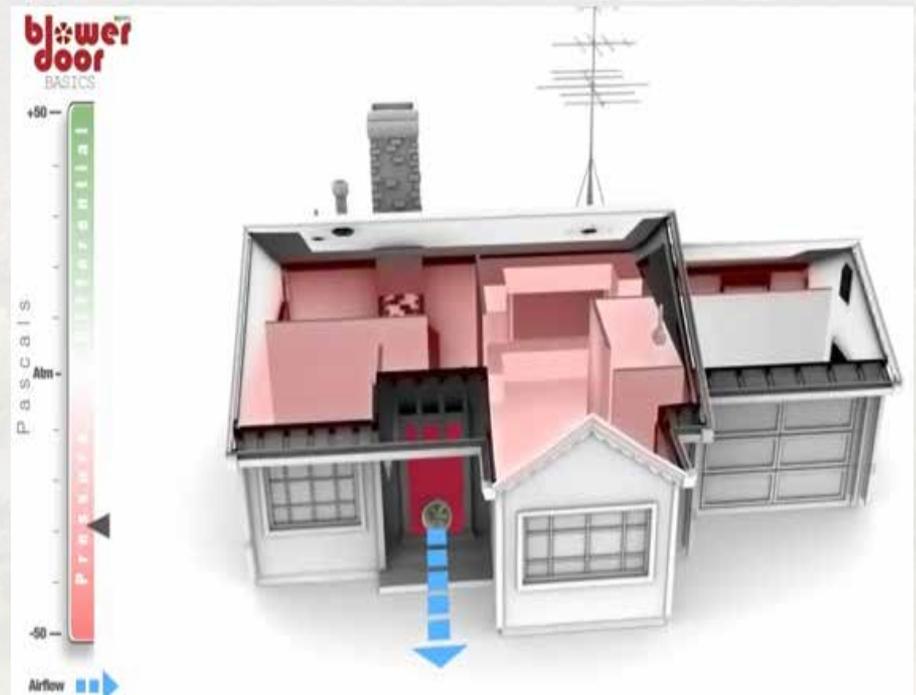
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# Blower Door Basics: Part III - The Breakdown

[http://www.youtube.com/watch?v=8\\_6c6xj1doA&feature=relmfu](http://www.youtube.com/watch?v=8_6c6xj1doA&feature=relmfu)





# Worst Case CAZ Depressurization

Building Performance Workshop Review

<http://www.youtube.com/watch?v=C2ILNnckKyM&feature=fvwrel>

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# Professional Home Energy Audit

<http://www.youtube.com/watch?v=zeNi3bU8OqY&feature=related>

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**Steve Easley**  
**Energy Expert**

## HERS Duct Testing

<http://www.youtube.com/watch?v=W4BbxVzpaKU&feature=related>

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## Home Energy Audit

<http://www.youtube.com/watch?v=6QQRy0I-Ez4&feature=related>

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Energy Webinar Series, please  
contact Melonee at ATEEC  
**[mdocherty@eicc.edu](mailto:mdocherty@eicc.edu)**

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