

Max Balter and Nolan Julseth-White

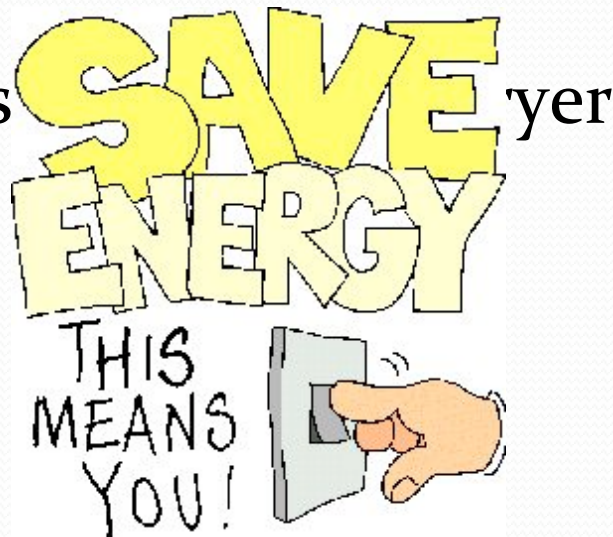
Chapter 7: Energy Conservation



"Tonight, an in-depth look at what each of us can do to help conserve electricity."

How Can U Conserve Energy?

- Lower thermostat setting, resulting in cooler home
- Choosing to walk or ride a bike rather than driving
- Hanging laundry ins
- What else?



peda.gov.in/eng/images/conserve%20energy.jpg

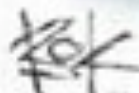


Federal Energy Policy

- The federal Energy Policy Act of 1992
 - Energy Star
- Updated Energy Policy Act of 2003
- Even more updated Energy Policy Act of 2005
 - *Intends to reduce the national energy consumption*
 - *Various tax credits*

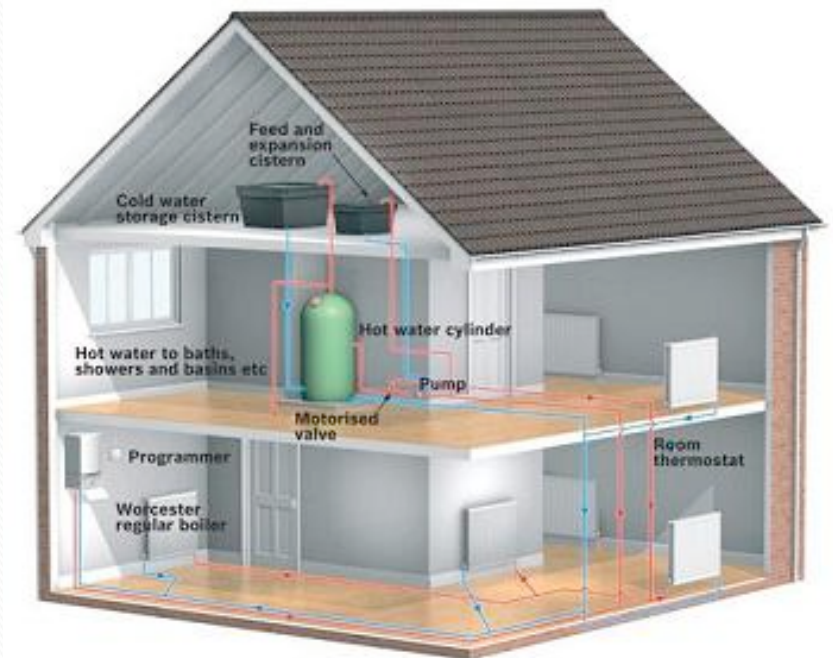
WHY DON'T THE
GREENHOUSE GASES
ESCAPE THROUGH
THE HOLE IN THE
OZONE LAYER?



 RAY BLISTER.COM
AARON KEARON JOURNAL

Space Heating

- Largest amount of household energy use in US is for space heating
- Natural gas is the main source of this energy
- Idea of perfect insulation
 - No need for energy source to keep house at constant temperature



www.hsg.ie/iopenz4/images/content_images/cent

Thermal Insulation

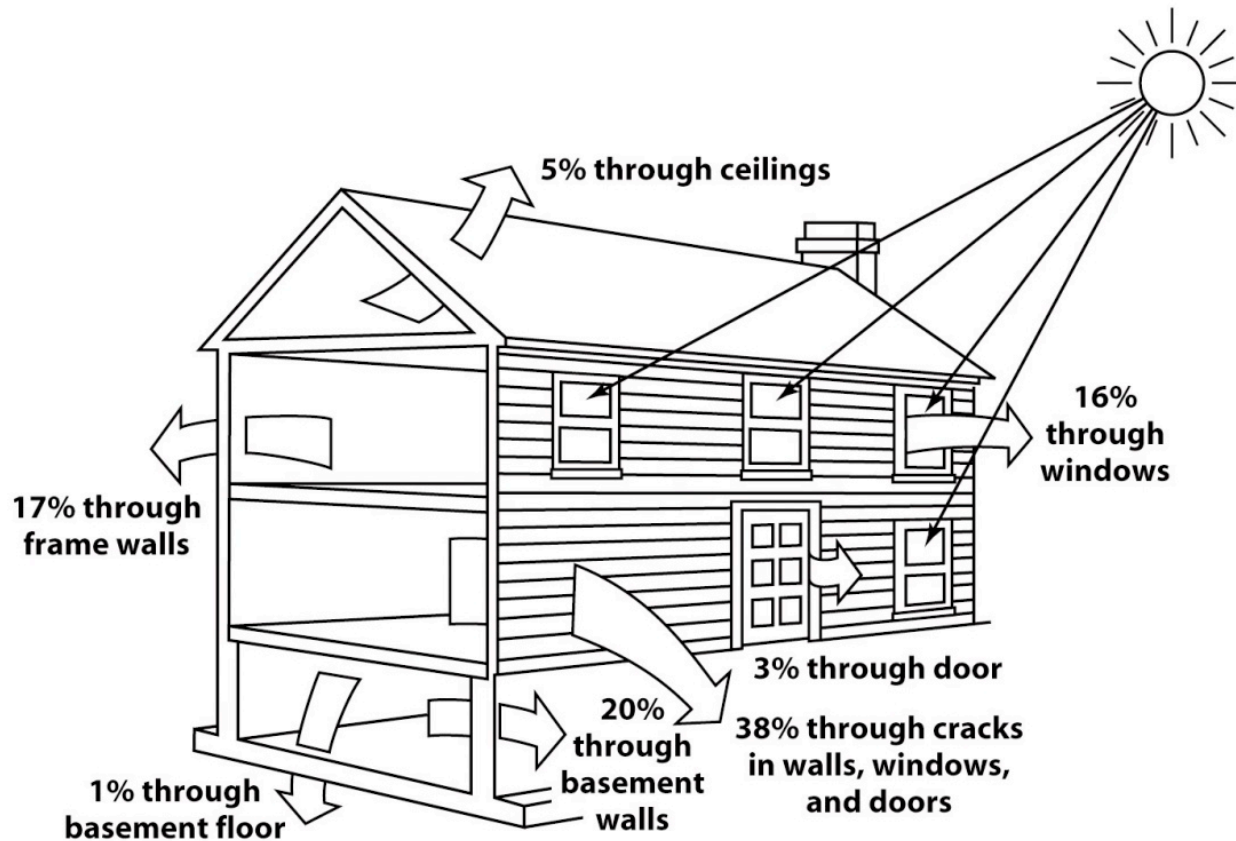


Figure 7-1 Energy and the Environment 2e
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Thermal Insulation Explained

- $Q/t = kA(T_i - T_o) / l$
 - k is the thermal conductivity of the wall material
 - A is the area of the wall surface
 - l is the thickness of the wall
 - $(T_i - T_o)$ is the temperature difference between the inside and outside

Thermal Insulation Continued...

- Degree days as a measure of the severity of the winter
 - Given by the average temperature difference between inside and outside with the inside temperature taken to be a constant 65°F
 - For heating season the total number of degree days is the sum of all the individual degree days



www.kasilofseafoods.com/.../images/flats.jpg

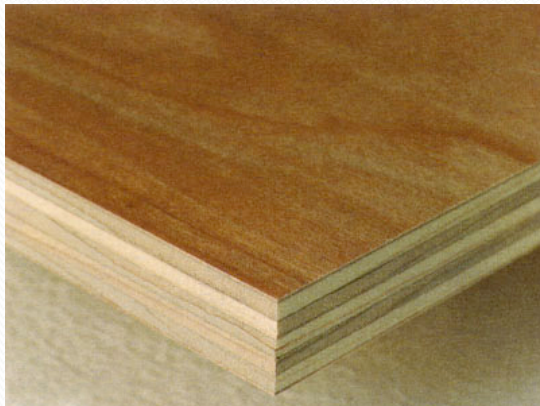
VS.



www.miamism.com/.../featured/miami-shores.jpg

Material Thermal Conductivity

- Thermal conductivity (k) is a property of a material disregarding its dimensions
- R value: $R = l / k$ (includes wall thickness and material)
 - l is the thickness of the slab
 - k is the material's thermal conductivity
 - Labeled on insulation and other building materials



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VS.

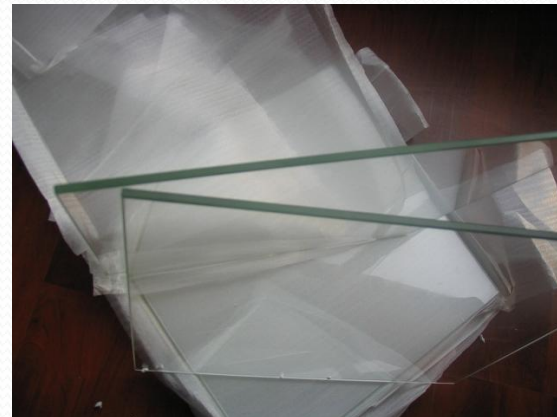


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Thermal Insulation Equations

- For any surface built up of a layered series of material the total R-value is given by the sum of the individual R-values ($R_T = R_1 + R_2 + R_3 + \dots$)
- Conductive heat loss: $Q = A / R_T (\Delta T)(t)$ [Btu]
 - Where A is the area of the surface
 - ΔT is the temperature difference
 - T is the time in hours
- $Q = 24 A / R_T * (\text{degree days})$ [Btu]
- Example 7.2 in textbook



Air Infiltration

- Infiltration of outside air is sufficient to account for a complete change of air in a house about once per hour
 - This can account for 1/3 of the total heat loss
 - This leakage can be reduced!
 - Caulking and weather stripping
 - Closure of fire place openings and chimneys
 - Others?
 - Possible complications with excessive sealing
 - Radon
 - Carbon monoxide gas
 - Others?

Air to Air Heat Exchanger

- Relieves problem of unhealthful indoor concentrations of gases
- Air flows driven by electric fan
- Heat energy and moisture are interchanged through paper, thus conserving energy
- Humidity transfer involving water evaporated in humidifier

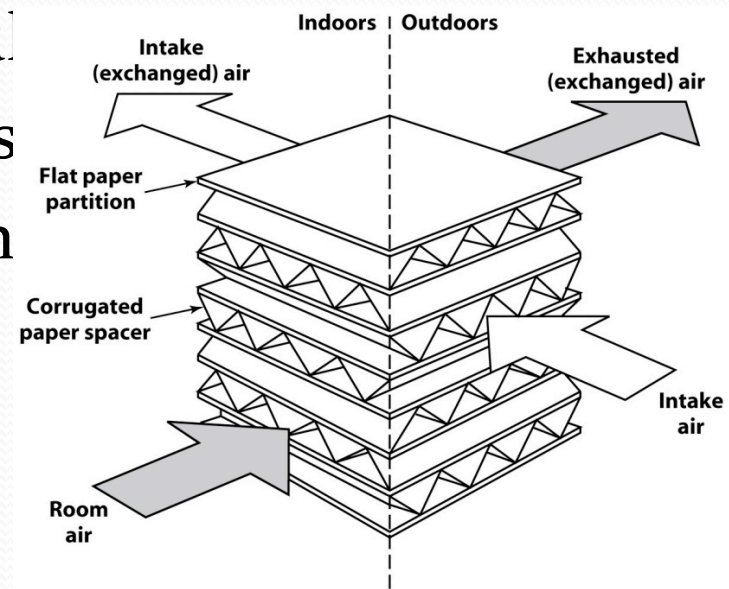


Figure 7-2 Energy and the Environment 2e
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Furnaces

- Furnaces burn natural gas or fuel to keep living spaces comfortable
 - Only around 60 – 90 % efficient
 - Lots of wasted energy
 - Alternatives to furnaces?
 - Electrically powered heat pumps
 - Electric resistance heating
 - Nearly 100% efficient
 - High cost of operation

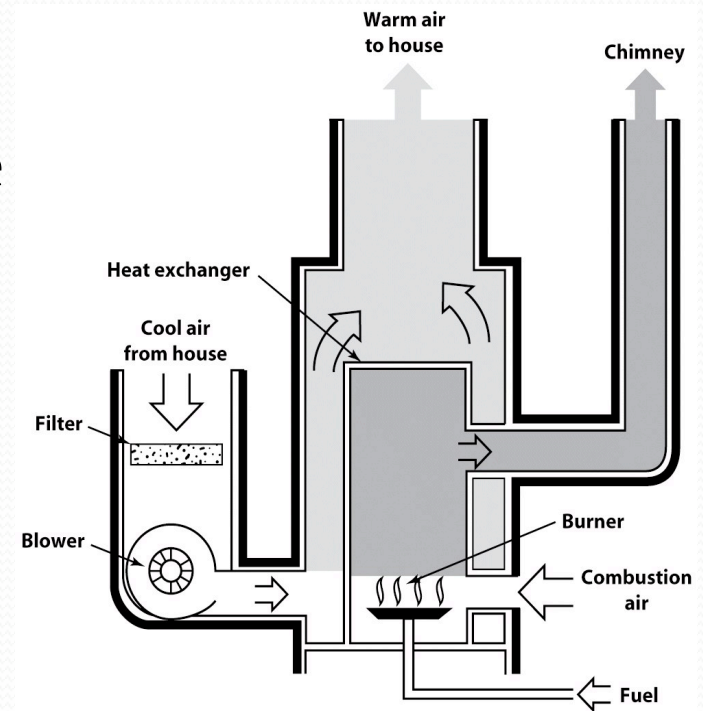


Figure 7-3 Energy and the Environment 2e
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Furnaces Continued...

- New furnaces incorporate recovery of heat energy resulting in much greater efficiencies
- Annual Fuel Utilization Efficiency (AFUE)
 - At least 78% efficient
- Other ways to increase furnace efficiency
 - Insulate ducts and water pipes
 - Others?



Stoves and Fireplaces

- Use of wood burning stoves and fireplaces is not an energy conservation measure (efficiency = 40 – 65%)
- Open fireplaces actually have negative efficiency as they remove more heat from a home than they provide

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“Warming may be GLOBAL to you, but it’s FREEZING over here!”

Other Sources of Heat Energy

- Energy Audit as a process of adding up all the space heating energy losses for a year and then trying to balance those losses against all known sources of heat energy
 - Examples of heat sources
 - Electric appliances
 - Lighting
 - Solar
 - Others?



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Standards for Home Heating

- How many Btu should be needed to heat a house?

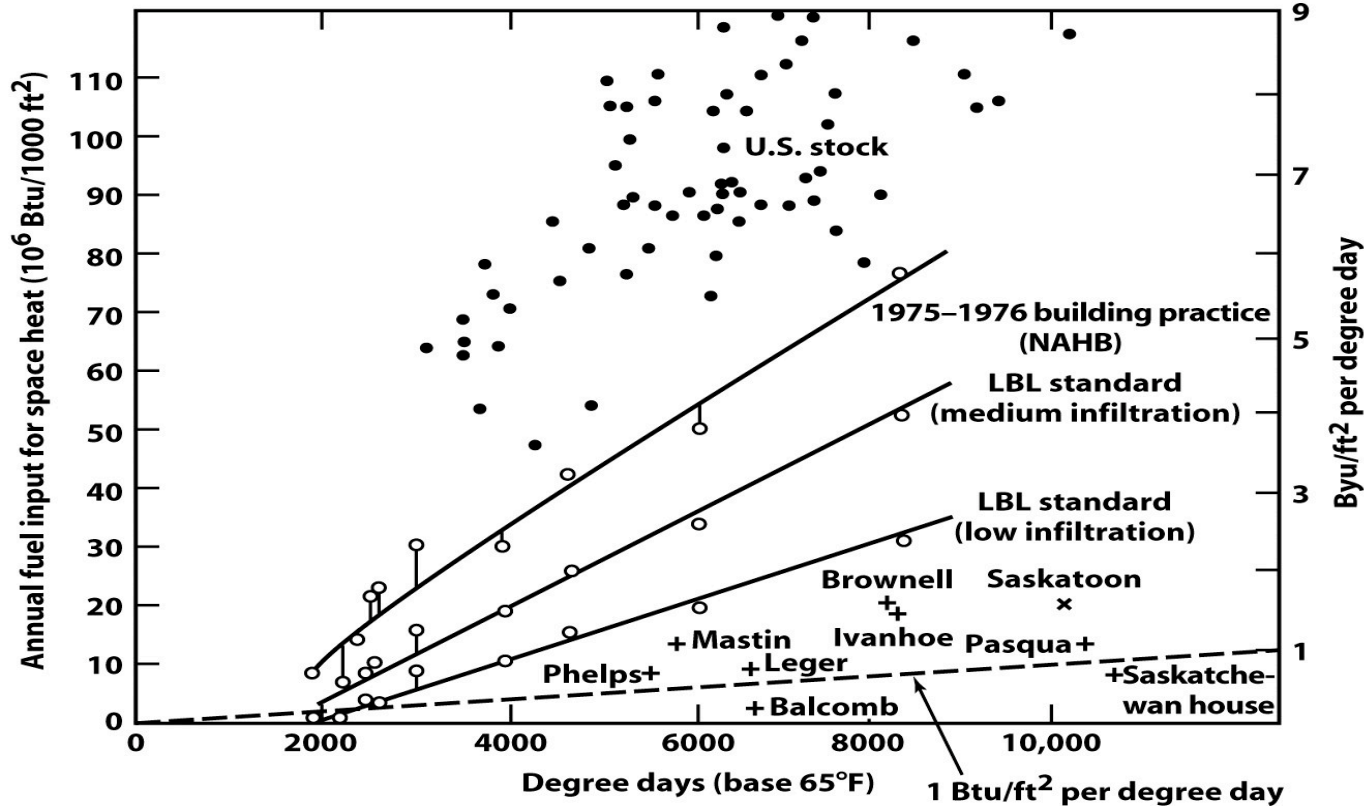


Figure 7-5 Energy and the Environment 2e
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Water Heaters

- Water Heaters use 10-20% of the energy consumed in a typical American home
 - Energy conservation ideas
 - Lower heater's thermostat to 120° F
 - Add insulation to tank and pipes
 - Install flow-restricting shower heads and faucets
 - Application of electronic igniters instead of pilot light
 - Installation of flue damper

Appliances

- Main consumers of electric energy: refrigerators, clothes dryers, and air conditioners
 - In 1972 it took 1700 kWh/yr = \$130 annually
 - Today energy usage is 500kWh/yr= \$40 annually
- Clothes dryers consume 15% of the electric energy
 - Gas-fired dryers cost less to operate but consume about the same
 - Obviously the most efficient way is to hang your clothes outside

Based on standard U.S. Government tests

ENERGYGUIDE

Refrigerator-Freezer
With Automatic Defrost
With Side-Mounted Freezer
With Through-The-Door Ice Service

LG
Model LRSC26930SW
Capacity: 25.5 Cubic Feet

**Compare the Energy Use of this Refrigerator
with Others Before You Buy.**

**This Model Uses
626kWh/year**



ENERGY STAR
A symbol of
energy efficiency

Energy use (kWh/year) range of all similar models

**Uses Least
Energy
618**

**Uses Most
Energy
727**

kWh/year (kilowatt-hours per year) is a measure of energy (electricity) use. Your utility company uses it to compute your bill. Only models with 25.5 to 26.4 cubic feet and the above features are used in this scale.

**Refrigerators using more energy cost more to operate.
This model's estimated yearly operating cost is:**

\$52

Based on a 2001 U.S. Government national average cost of 8.29¢ per kWh for electricity. Your actual operating cost will vary depending on your local utility rates and your use of the product.

Important: Removal of this label before consumer purchase is a violation of Federal law (42 U.S.C. 6302).

3850JZ1114B

Appliances Continued...

- About 76% of the U.S. households have air conditioners
- A sixth of the nations electricity consumption goes to air conditioning, residential and commercial
 - Central AC's are rated by their seasonal energy efficient ratio (SEER)
 - National standard requires a minimum SEER of 13



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Appliances Continued...

- A typical home uses about 50 watts of electric power continuously even when the power is off on all other household items: TVs', computers, DVDs, etc.
- This is called electricity “leakage”
 - Estimates that such leaks in the United States total around 3 billion dollars per year
 - Equivalent to all the annual electricity generated by four large power plants



Lighting

- 20-25% of the electric energy in the U.S. goes towards lighting
 - School classrooms have light levels around 60 lumens(lm) per sq ft
 - Office buildings range from 80-100 lm/sq ft
 - Most buildings have master light switches that turn on whole floors, leading to huge waste when custodians are cleaning on room at a time during the night

COUNTERTHINK

INTRODUCING THE AMAZING LIGHT BULB!
INVENTED IN THE 19TH CENTURY! AND STILL THE SAME TODAY!

GENERATES EXTREME HEAT
THAT MUST BE COMPENSATED
AT GREAT EXPENSE.

PRODUCES ENORMOUS
CO₂ EMISSIONS FROM
COAL-FIRED POWER PLANTS.

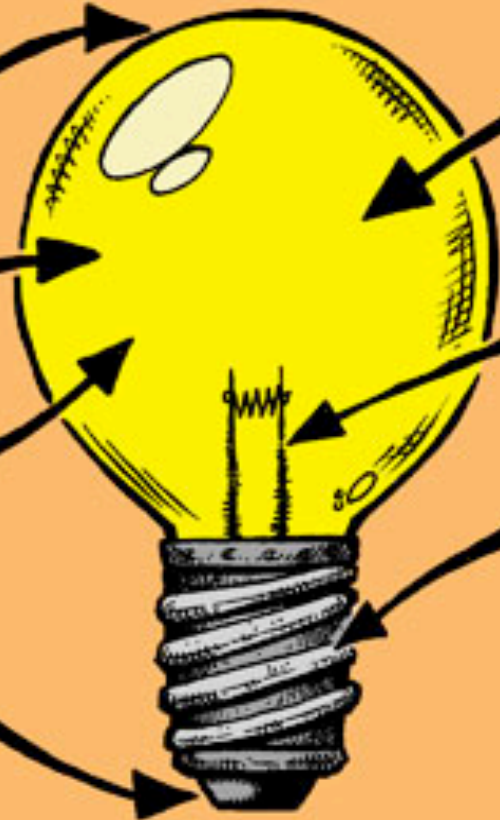
GLASS GLOBE BREAKS
INTO TINY, RAZOR-SHARP
SLIVERS.

BURNS OUT EVERY
1,000 HOURS.

CREATES MILLIONS OF
TONS OF LANDFILL
EACH YEAR.

WASTES 95% OF THE
ELECTRICITY IT CONSUMES.

POSES AN ELECTRICAL
FIRE HAZARD IN
HOME WIRING.



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WWW.NEWSTARGET.COM

CONCEPT- MIKE ADAMS

ART- DAN BERGER

THERE IS A BETTER TECHNOLOGY: WWW.ECOLEDS.COM

Lighting Continued...

- Fluorescent lamps last about 10,000 hours
 - About ten times that of a conventional incandescent light bulb
- Tungsten-halogen lamps are 10-50% more efficient than an ordinary incandescent lamp
 - Excellent color quality, compact, dimming capabilities
 - Substantially more expensive
- Light-emitting diode (LED) → inexpensive, durable, and have good brightness



"Think of all the money we are going to save on our utility bills!"



Light Conservation

- Individual switches rather than having many lights controlled by one switch
- University classrooms and large retail buildings have the capability on sunny days to use the daylight through windows and skylight
- Excessive energy used by lighting indoors on sunny days increases the load on air conditioners because of the extra heat given off by the lights

The Energy-Conserving House

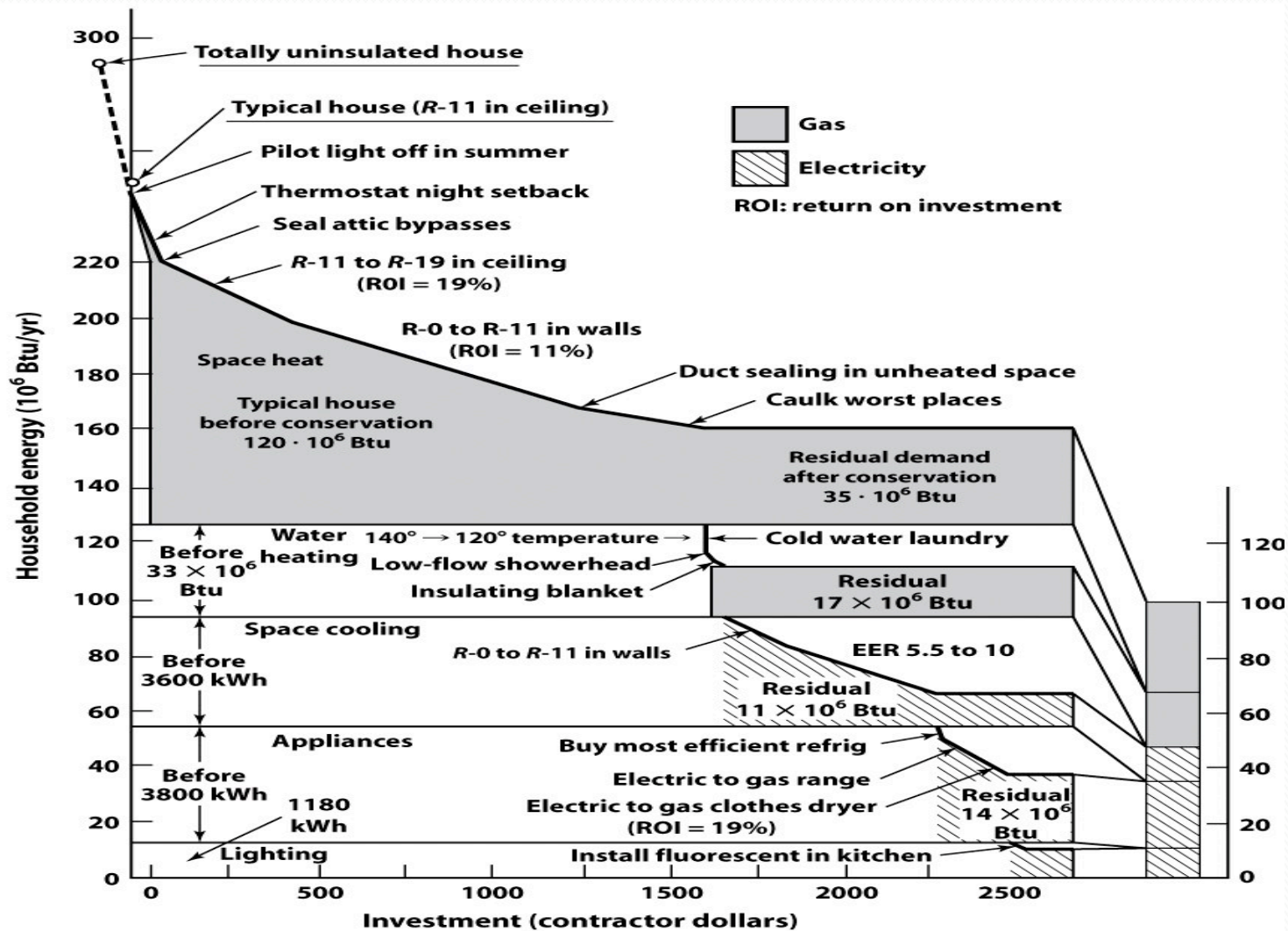


Figure 7-8 Energy and the Environment 2e
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Energy Conservation

- Waste Heat Recovery and Cogeneration
 - It is possible to recover some of the heat rejected to the environment
 - Recovered heat energy is at low temperature but is still suitable for space heating, water heating, greenhouses, water preheating and other various uses
 - Industries, Universities and large institutions are trying to generate more interest in this trend



Recycling

- It takes three times as much energy(Btu) to form a new beverage can from new aluminum stock than from a recycled can
 - More than 50% of aluminum in new cans is recycled
 - More than 35% of glass in new bottles is recycled
 - These figures along with other recyclable objects figures are constantly increasing

MCHUMOR.com by T. McCracken



"Not bad. They gave us \$10.00
a pound for the Tin Man."

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New Developments

- The development of the transistor and microprocessor have become some of the most fundamental changes in energy conservation
 - By replacing “vacuum tubes ”(used in objects like radios, TVs, and computers) energy conservation has improved dramatically over the past 50 years
 - Optic fibers have now replaced copper cables
 - Provide faster data transmission, less interference, and much lower cost



Help from Public Utilities

- Rather than trying to sell energy by kW/hr to increase revenues, utility companies have now catered to many industries that have increased efficiency in their products.
 - Niagara Mohawk Power Corporation in New York had a program which save each household \$278 over an eight year span
 - Whether by giving fluorescent bulbs, low-flow shower heads or insulation to their customers, utility companies are leading the way in household energy savings

COUNTERTHINK

NEW!
ECO-FRIENDLY
TABLEWARE!
100% RECYCLABLE
100% BIODEGRADABLE
MADE FROM PLANTS!

WE USED TO
JUST CALL THEM
PAPER PLATES.



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