Middle School Energy Curriculum

"Biggest Energy Loser"

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Project Overview

With the cost of energy increasing, it is important that new methods of energy are being used by consumers. There are many ways to save energy in homes and buildings. Students will be introduced to several areas of energy efficient building technologies such as energy efficient lighting, renewable and nonrenewable energy, and energy conservation. There will be 3 sessions to present new information and apply the information presented. Session 1 will introduce energy and describe the different types. Session 2 will present methods on how to manipulate buildings for energy efficiency. Session 3 will include the student presentations of the final project-The Biggest Energy Loser Challenge. The overall objective is create an excitement in students about energy usage and ultimately develop energy conscious students who consider how their energy usage is impacting various areas of their daily lives.

Middle School Energy Curriculum Timeline

Deliverable	Due Date
Updated slides with cultural information	Friday, September 30, 2011
Identify Japanese school and Review Curriculum	Saturday, October 01, 2011
Website Development	Monday, October 10, 2011
Curriculum Reviewed and approved by ALL Schools	Wednesday, November 16, 2011
First two sessions Recorded and loaded to website	Monday, November 28, 2011
Pictures of Houses due to SU (post in dropbox folder for your class)	1/30/2012- 02/06/2012
Session 1 (post comments to edmoto.com)	February 13,2012
Session 2 (post comments to edmoto.com)	Monday, February 20, 2012
Houses are sent to teachers for Projects (posted to dropbox Folder for your class)	February 22,2012 - February 27, 2012
Biggest Energy Loser Challenge Project (post to dropbox Folder for your class)	After Session 2 is completed; Teachers and students have a 2 weeks to complete and post comments/responses on edmoto.com, February 27-March 12, 2012
Judging of Biggest Energy Loser Challenge Projects	Will begin 1 day after after students have completed projects; Judging will occur for 2 days
Winners from Each Class Announced	Live, March 29 2pm HST/7pm CDT/8pm EDT March 30 9am JST
Review of Winners by students, discussion on website	Students will discuss via forum on day of announcement
Evaluation of Course by Students and Teachers	Immediately after course is completed, link for evaluation will be sent via email and posted to dropbox (due by April 3, 2012)
Plus/Delta Meeting after review of Evaluation	Wednesday, April 04, 2012

Teacher Planning Guide

1. We are asking that students in each class be divided into energy saver teams for the duration of the course. Students should get into teams at least one week before the session starts because there are preparation homework assignments that are required for the activity to work best. Students should be encouraged about competition and even create a name for their team. The teams will only compete with other teams in their class not across classes.

2. Pre-Session Activities
    a. Each team should select a team member's house to take pictures of to submit as their model home. We are suggesting that students select a single-family home as compared to a multi-family building (i.e. apartment/high-rise building) because a single family home is easier for students to manipulate for the final challenge. If none of students live in a single family home, ask them to submit pictures of a typical single family home in their area.
        i. Take pictures of all four sides of house (including all windows and as much of the roof as possible.)
        ii. Here are some questions students should consider while taking pictures:
            1. Do you live in a single family home or multi-family building?
            2. How many rooms are there?
            3. How many windows?
            4. What color is the outer surface of your residence?
        iii. Students need to also list the following information:
            1. How many rooms?
            2. How many windows?
        iv. We are recommending that pictures be submitted at least a week before session. Directions will be provided as to where to send or upload.

    b. The students will be using Google Sketch up for the final activity. There are several tutorial videos on the web for students to review before and during the sessions. We suggest the two below:
        i. http://sketchup.google.com/
        ii. http://www.youtube.com/watch?v=26OtjJP-PXk

3. Assignments
    a. There will be activities after each session. We suggest that you determine what fits best for your students and how you will allow them to work on the team challenge projects.

    b. After session 1
        i. Home Energy Audit
            1. Worksheet for students to calculate energy cost at their home.

2. Suggestion to use it as a team activity to prepare them for final challenge of reducing energy cost. They can ask the student who lives in the home questions to calculate total cost.
3. Students will be asked at the end of this activity sheet how they can save money. This will allow them to start thinking about the final challenge where they will redesign their model home to reduce energy cost.
4. Included in Activities Section.

ii. Website scavenger hunt
    1. www.eia.gov/kids
    2. US Department of Energy website with basic information about Energy.
    3. Activity Sheet asks students to go through the website and fill-in the blanks and will serve as a reinforcement of concepts presented in session.

iii. REVIEW!!!! There is a practice house for students to explore Google Sketch up.. There are several tutorial videos on the web for students to review before and during the sessions. We suggest the two below:
    1. http://sketchup.google.com/
    2. http://www.youtube.com/watch?v=26OtjJP-PXk

c. After Session 2 - Biggest Energy Loser Challenge
    i. REVIEW!!!! The students will be using Google Sketch up for the final activity. There are several tutorial videos on the web for students to review before and during the sessions. We suggest the two below:
        1. http://sketchup.google.com/
        2. http://www.youtube.com/watch?v=26OtjJP-PXk
    ii. Teams will work together to redesign their model home to have greatest percentage of energy reduction. Students should be encouraged to manipulate their home to be the most energy efficient and be able to tell others how they can replicate the process.
    iii. Students will be allowed to change or manipulate:
        1. Orientation of building-North South East West
        2. Number of trees (and/or shading device) around house
        3. What color is the surface of the building?
        4. What type of heating and cooling system?
        5. What type of Lighting?
        6. How many windows and where they should be placed?
    iv. Students should be asked to make notes during the project about the following
        1. How easy would this be to do at your home?
        2. What is the first thing you can do to reduce cost at your house?
        3. If you live in a multi-family unit, how do you think you can apply some of energy saving methods?
    v. Biggest Energy Loser Challenge rubric, checklist and evaluation are included in the Appendix.

Curriculum Alignment

School District	Grade Level	Content Area	Details
Hawaii Content and Performance Standards (HCPS) III Benchmarks	7th Grade	Science	Scientific Inquiry 7.1.1, 7.1.2
			Scientific Knowledge 7.1.3
			Science Technology and Society
		Math	Data collection and Representation 7.11.1
			Predictions and Inferences 7.13.1
			Probability 7.14.1
Louisiana Grade Level Expectations	6th	Science	Transformation of Energy 24,25, 39
			Science and Environment 42,43,46
	6^{th}, 7^{th} and 8^{th} Grade	Science	Science as Inquiry: The Abilities Necessary to do Scientific Inquiry 1-4, 8,9,11,12,15,17,19,22
			Science as Inquiry: Understanding Scientific Inquiry 27,29,33,34,37-40
	6^{th} Grade	Math	Number and Number Relations 9, 10
	7^{th} Grade		Number and Number Relations 3,5,7,8,9

Assignment Details

Details of Photo Assignment:

Each team should select a team member's house to take pictures of to submit as their model home. We are suggesting that students select a single-family home as compared to a multi-family building (i.e. apartment/high-rise building) because a single family home is easier for students to manipulate for the final challenge. If none of students live in a single family home, ask them to submit pictures of a typical single family home in their area.

When taking pictures, students should capture the following views:

1. Photo one: Take picture of the front of the house; picture should include front door, windows, landscaping, roof (if possible)
2. Photo two: Take picture of right side of the house; picture should include any windows, landscaping, roof (if possible), outdoor cooling/heating units
3. Photo three: Take picture of left side of the house; picture should include any windows, landscaping, roof (if possible), outdoor cooling/heating units
4. Photo four: Take picture of rear of the house; picture should include any windows, landscaping, roof (if possible), outdoor cooling/heating units, patio/deck

If the home is a multi-level (has basement or upstairs), students may have to take multiple pictures to include all details; there is no limit to number of pictures. Students are asked to use the information above as a guide. Please keep in mind, the goal is to re-create the house by only using the pictures.

Purpose of Edmoto.com:

The Edmoto.com site was established to allow students and teachers to communicate during the duration of the course. The use of a site like edmoto.com allows cross culture communication and will allow student to learn more about the other students whom are enrolled in the same course. Students should post their thoughts about the sessions, homework assignments, and final challenge project. Please ask the permission of the parents for this activity, if you do not get a favorable response from parents we can eliminate this activity. Parents can also sign up and chat with students and teachers.

Websites	When should it be used?	Who Should use?	
		Teachers	Students
Dropbox	1-Before session: To retrieve sessions, teacher planning guide 2- During Session: To upload pictures from students	✓	
Google Sketch-Up	1-Before Session: Introduce students to program 2-During Session: Practice House 3- Biggest Energy Loser Challenge	✓	✓
You Tube Video http://www.youtube.com/watch?v=26OtjJP-PXk	1-Before Session: Introduce students to Google Sketch-up program 2-During Session: Practice House (Use as a guide if there are any questions) 3- Biggest Energy Loser Challenge (Use as a guide if there are any questions)	✓	✓
US Department of Energy www.eia.gov/kids	2-After Session 1: Website Scavenger Hunt; students are to use handout provided to answer questions.	✓	✓
Edmoto.com	Throughout the entire session as a discussion board to allow students to communicate to discuss the sessions, activities, pictures, Biggest Energy Loser Challenge (and parents can use as well)	✓	✓

Middle School Energy Curriculum: Biggest Energy Loser Challenge

Southern University and A&M College, Baton Rouge

September 2011

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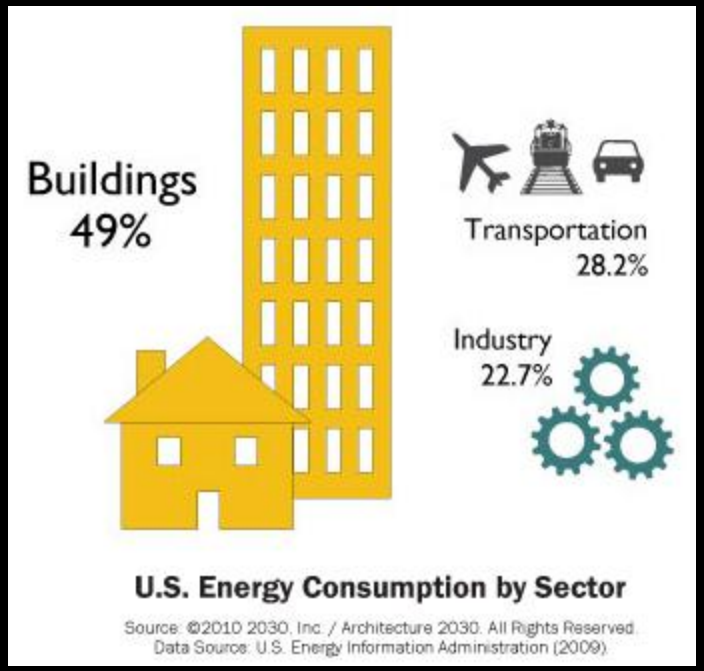
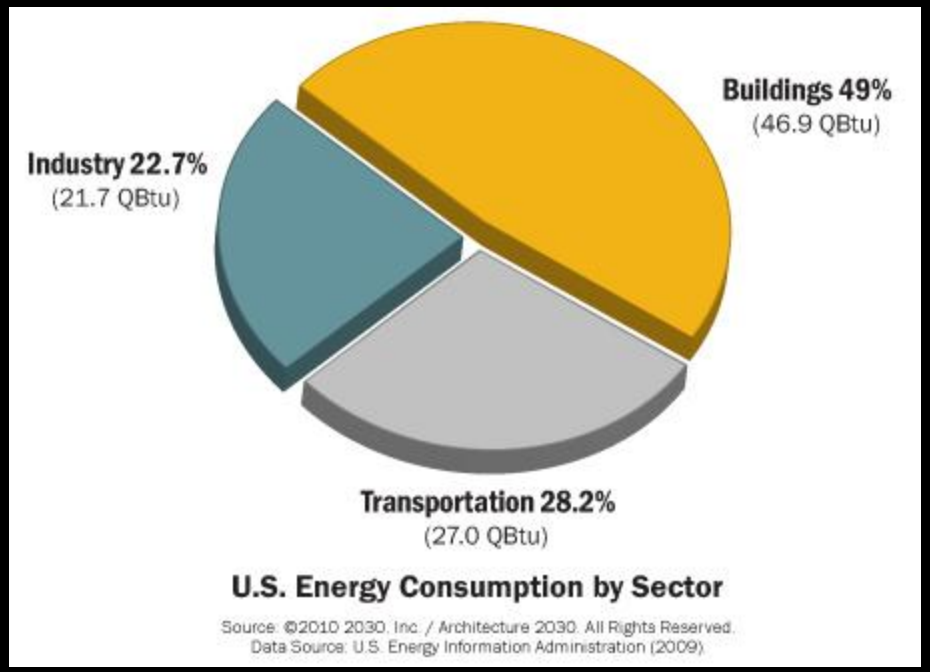
- **Objectives of Session 1**

1. Compare the different types of energy.
2. Describe the types of renewable energy.
3. Describe the types of nonrenewable energy.
4. Describe the types of energy used in buildings.

- **Introduction to Energy**

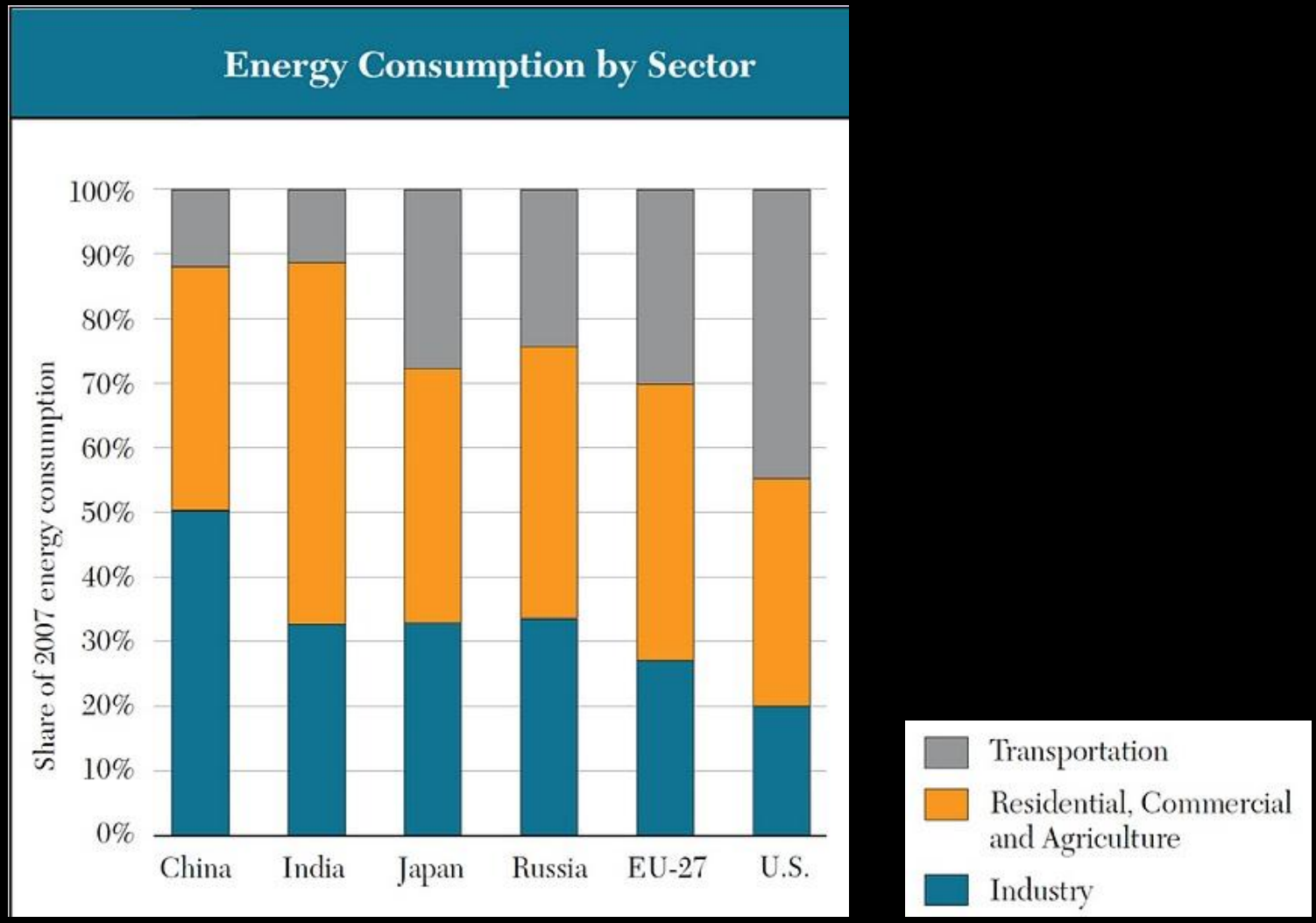




- **U.S. Energy Consumption by Sector**

images from Architecture 2030

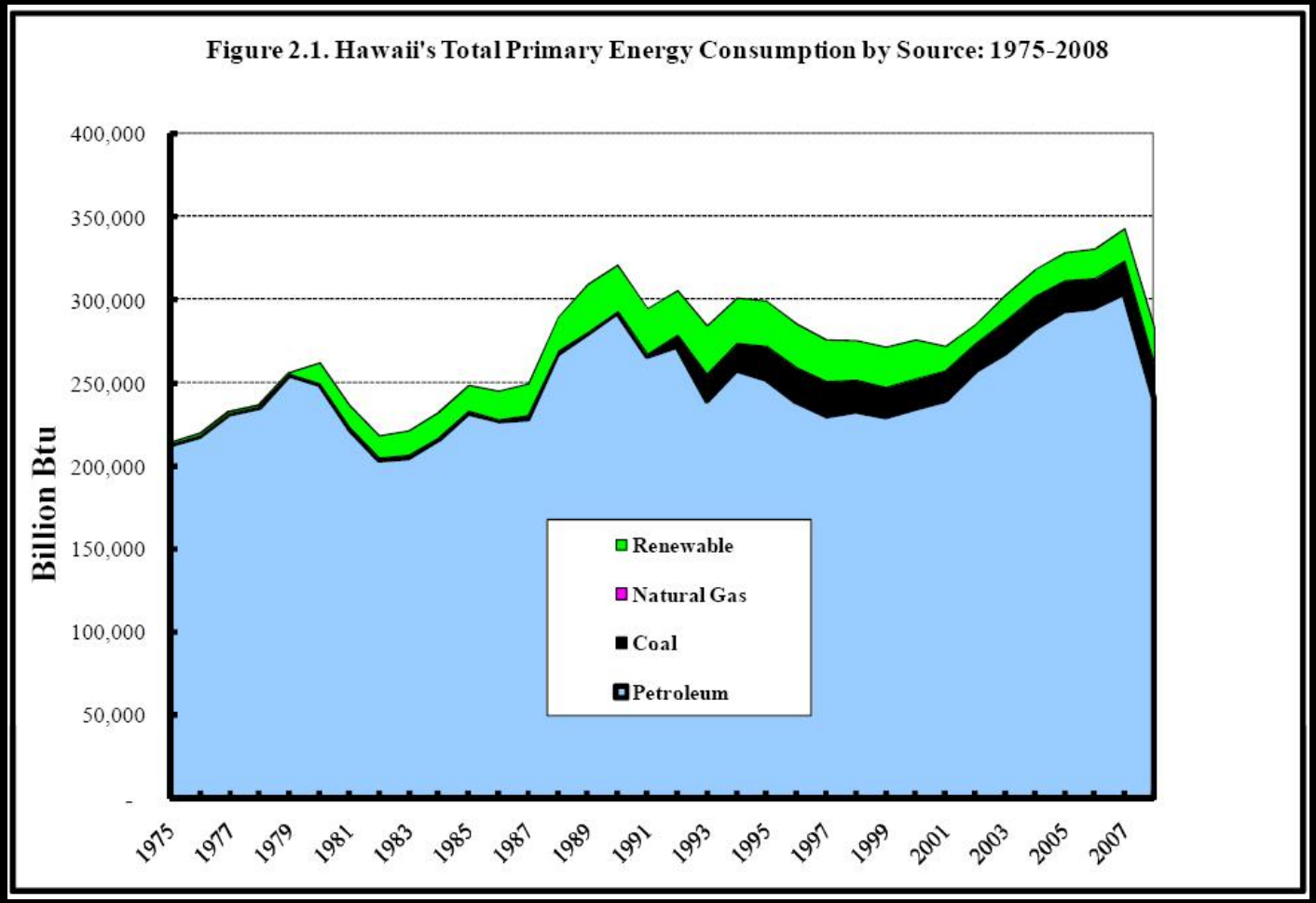
- **Introduction to Energy**



- **Japan and World Energy Consumption by Sector in 2007**

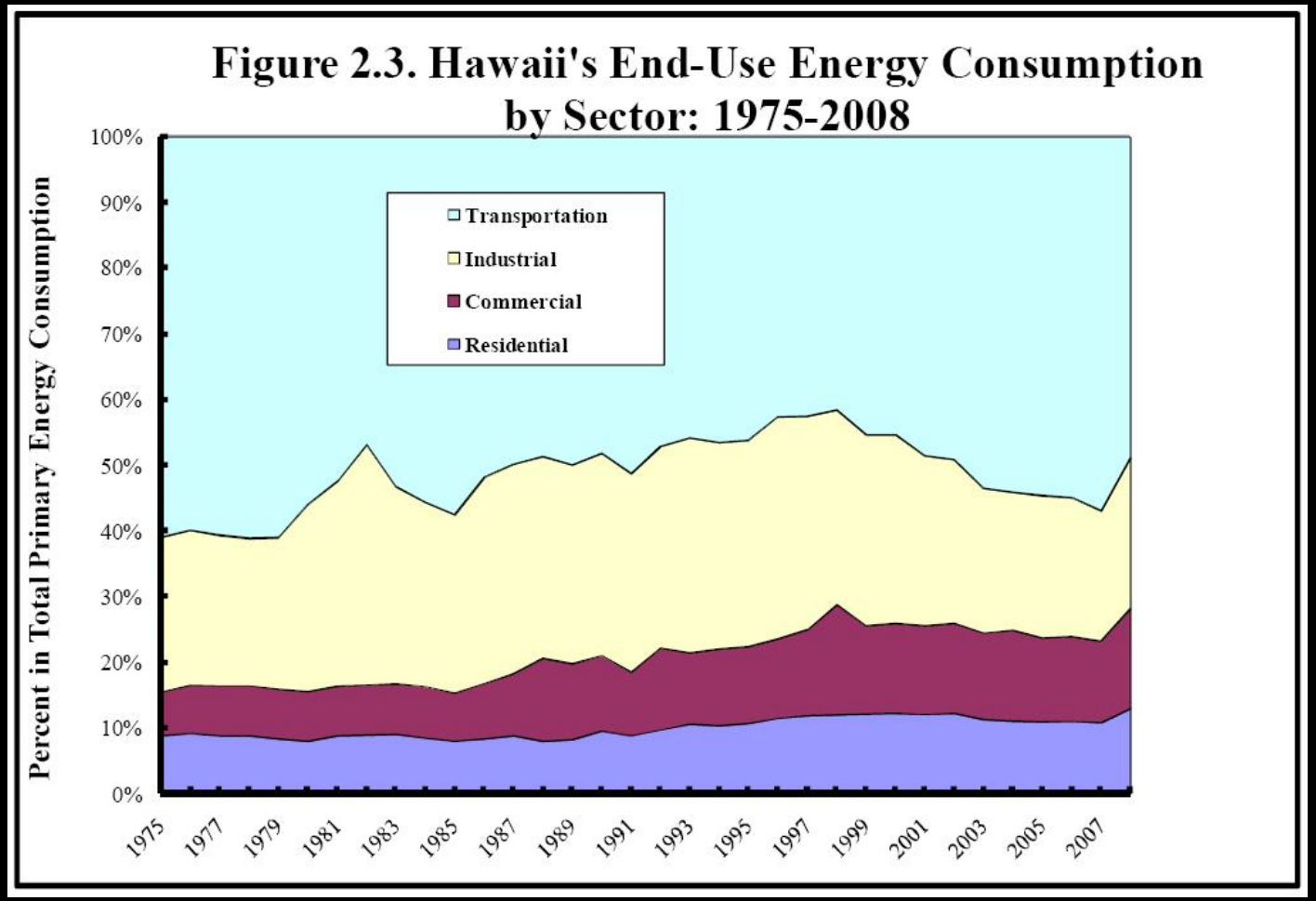
Statistics from IEA World Energy Balance 2009

- **Share of Total Primary Energy Consumption by source in Hawaii**



Source: State of Hawaii

- **Share of Total Primary Energy Consumption by sector in Hawaii**



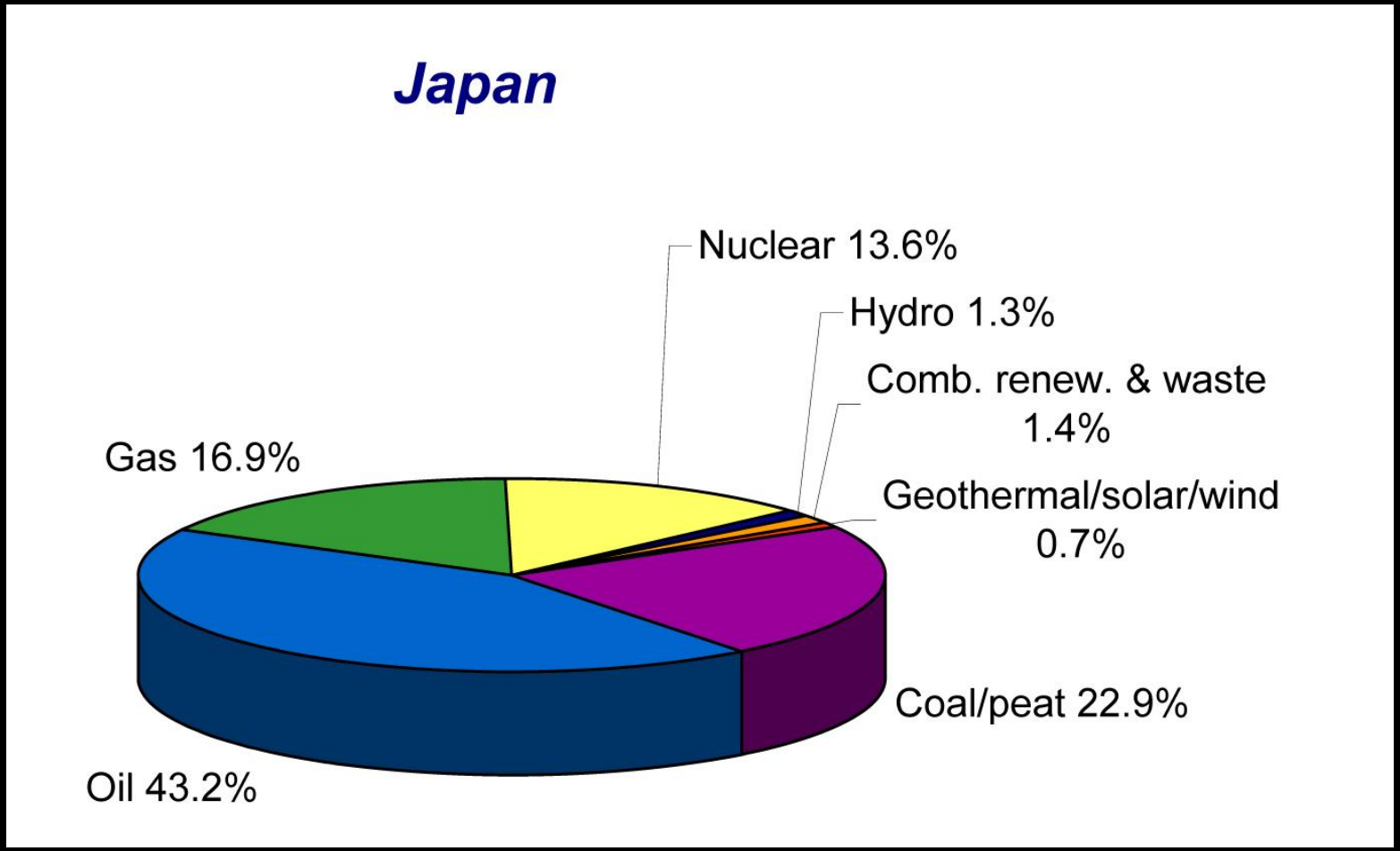
Source: State of Hawaii

- **Share of Total Primary Energy Consumption by source in Hawaii**

	Total Energy Consumption	Energy Consumption By Source % in Total				Renewable Energy % in Total				
Year	Billion Btu	Petroleum	Coal	Natural Gas	Renewable	Biomass	Geothermal	Hydro	Solar	Wind
2002	285,638	90.2	5.8	0.0	4.0	2.6	0.5	0.3	0.5	0.0
2003	303,300	88.5	6.3	0.0	5.1	3.1	1.2	0.3	0.5	0.0
2004	318,670	88.8	6.0	0.0	5.1	2.9	1.4	0.3	0.5	0.0
2005	328,793	89.4	5.5	0.1	5.1	2.9	1.4	0.3	0.5	0.0
2006	331,233	89.3	5.3	0.1	5.4	2.9	1.3	0.4	0.5	0.2
2007	343,236	88.7	5.5	0.1	5.7	2.7	1.4	0.3	0.6	0.7
2008	283,783	85.0	7.1	0.1	7.8	4.0	1.7	0.3	0.9	0.8

Source: Energy Information Administration, State Energy Data System

- **Share of Total Primary energy Supply in 2008**



Source: International Energy Agency, Key Stats 2010

- **Introduction to Energy – Energy in Japan**

The energy supply and demand in Japan in fiscal 2004 was as follows: Final energy consumption was 16,024PJ (petajoule = 1015J = thousand trillion joules).

The percentage of that consumption was 44.9% by industry, 31.0% by residential and commercial, and 24.1% by transportation.

The total primary energy supply was 23,674 PJ.

That was comprised of 48.1% petroleum, 21.4% coal, 13.9% natural gas, 10.5% nuclear power, 3.5% hydropower, 0.1% geothermal energy, and 2.5% new and renewable energy other than geothermal.

"Energy Balances in Japan" from Ministry of Internal Affairs and Communications of Japan

Energy in World

RETAIL PRICES[a] IN SELECTED COUNTRIES in USD/unit

	Heavy fuel oil for industry[b] (tonne)	Light fuel oil for households (1000 litres)	Automotive diesel oil[c] (litre)	Unleaded premium[d] (litre)	Nat. gas for industry (10^7 kcal GCV[e])	Nat. gas for households (10^7 kcal GCV[e])	Steam coal for industry[f] (tonne)	Electricity for industry (kWh)	Electricity for households (kWh)	
Australia	..	..	..	1.242	..	..	..	..	..	Australia
Austria	598.20	964.92	0.862	1.570	..	1 042.14	239.46	..	0.2623	Austria
Belgium	..	797.99	..	..	417.34	905.94	..	..	..	Belgium
Canada	555.09	841.34	0.928	0.968	..	..	..	..	..	Canada
Chinese Taipei	539.42	x	0.829	0.927	472.41	458.16	..	0.0745	0.0880	Chinese Taipei
Czech Republic	422.02	918.46	1.312	1.656	528.03	815.01	c	0.1477	0.1921	Czech Republic
Denmark	629.49	1 519.14	1.284	1.957	752.14	1 330.56	..	0.1106	0.3655	Denmark
Finland	612.17	969.51	1.231	1.910	332.76	474.36	167.23	0.0974	0.1737	Finland
France	541.97	929.63	1.261	1.817	438.88	847.88	..	0.1067	0.1592	France
Germany	515.15	822.07	1.355	1.907	..	..	..	..	..	Germany
Greece	591.21	851.74	1.260	1.679	441.15	1 041.75	..	0.1139	0.1518	Greece
Hungary	545.54	x	1.237	1.659	611.44	716.93	..	0.1597	0.2062	Hungary
India	..	..	..	..	..	..	37.38	..	..	India
Ireland	438.11	1 040.24	1.324	1.723	483.47	1 017.05	..	0.1690	0.2550	Ireland
Italy	573.52	1 560.55	1.337	1.834	557.68	1 059.58	114.01	0.2781	0.2842	Italy
Japan	..	794.26	0.959	1.416	..	..	120.90	0.1578	0.2276	Japan
Korea	620.32	908.15	..	1.463	479.48	526.12	88.74	0.0578	0.0769	Korea
Luxembourg	..	759.54	1.147	1.590	433.97	754.38	..	0.1363	0.2371	Luxembourg
Mexico	423.09	..	0.556	0.614	..	420.55	x	0.0846	0.0786	Mexico
Netherlands	497.62	..	1.292	2.031	500.11	1 162.61	..	0.1410	0.2580	Netherlands
New Zealand	621.87	..	0.697	1.228	..	..	c	..	0.1519	New Zealand
Norway	..	1 343.99	1.559	2.131	x	x	..	0.0587	0.1373	Norway
Poland	589.56	933.03	1.133	1.513	432.70	801.80	92.68	0.1197	0.1669	Poland
Portugal	669.71	1 037.40	1.383	1.842	484.12	959.68	..	0.1274	0.2152	Portugal
Slovak Republic	396.02	..	1.243	1.654	510.33	780.28	..	0.1948	0.2309	Slovak Republic
Spain	549.12	877.57	1.202	1.547	433.79	925.87	..	..	..	Spain
Sweden	1 142.98	1 541.58	1.345	1.798	585.38	1 499.00	..	0.0827	0.1940	Sweden
Switzerland	614.00	775.78	1.343	1.533	704.31	1 000.60	137.88	0.0935	0.1639	Switzerland
Turkey	930.92	1 598.74	2.015	2.437	467.62	568.99	84.42	0.1376	0.1651	Turkey
United Kingdom	c	796.97	1.518	1.763	333.67	799.69	94.93	0.1359	0.2060	United Kingdom
United States	484.44	759.84	0.753	0.716	202.61	459.98	71.57	0.0684	0.1155	United States

(a) Prices are for 1st quarter 2010 for oil products, and annual 2009 for other products. (b) High sulphur fuel oil for Canada, Ireland, Mexico, New Zealand, Turkey and the United States; low sulphur fuel oil for all other countries. (c) For commercial purposes. (d) Unleaded premium gasoline (95 RON); unleaded regular for Australia, Canada, Japan, Korea, Mexico, New Zealand and the United States. (e) Gross calorific value. (f) Brown coal for Turkey.
.. not available x not applicable c confidential

Source: International Energy Agency, Key Stats 2010

- **Renewable Energy**

a.Solar
b.Wind
c.Biomass
d.Hydroelectric
e.Geothermal

- **Nonrenewable Energy**

a.Fossil fuel
    a. Oil
    b. Natural Gas
    c. Coal
b.Nuclear
    a. Fission
    b. Fusion

Photovoltaic

Image from Clean Energy Council

Green House

Image from Wikipedia

Natural Lighting

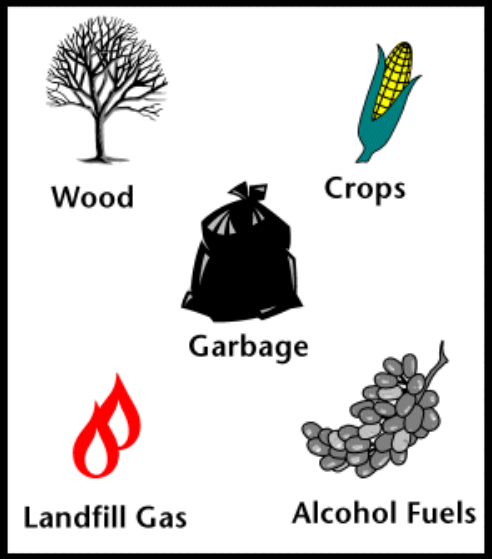
Image from Kimball Art Museum Webpage

Solar Water Heater

Image from www.solartubs.com

Wind Turbine

Image from Inhabitat



Biomass

Image from www.edinformatics.com

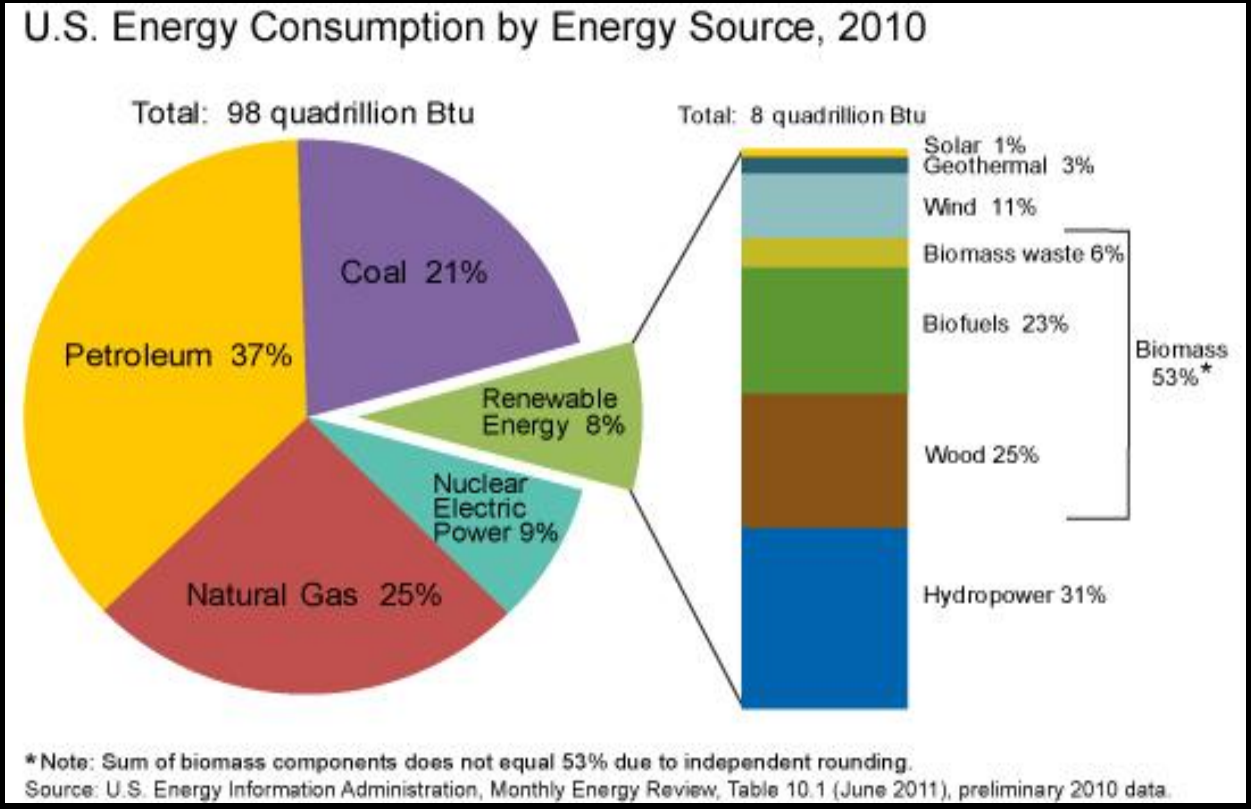
Hydroelectricity

Image from Alternative Energy Source web page

Geothermal energy

Image of Matsukawa Geothermal power station

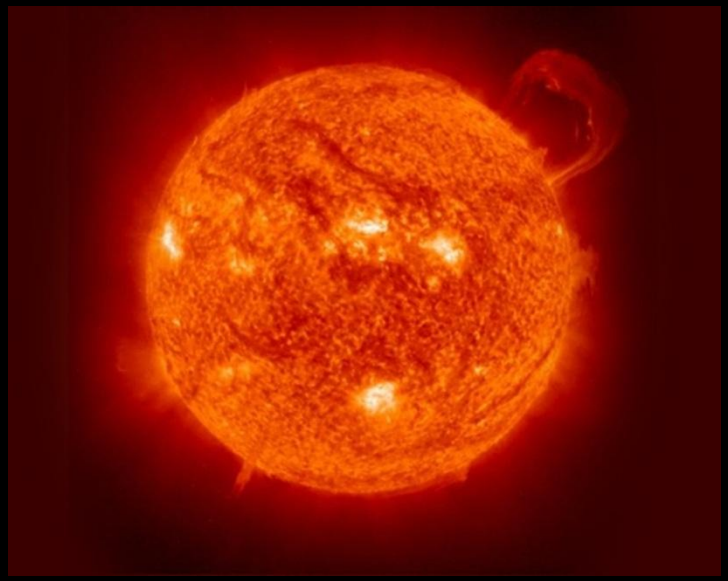
Nonrenewable energy sources come out of the ground as liquids, gases, and solids. Crude oil (petroleum) is the only commercial nonrenewable fuel that is naturally in liquid form. Natural gas and propane are normally gases, and coal is a solid.



- **Forms of Energy**

a.Radiant Energy
b.Thermal Energy
c.Motion Energy
d.Sound Energy
e.Electrical Energy

- **Radiant Energy** is electromagnetic energy that travels in transverse waves. Radiant energy includes visible light, x-rays, gamma rays and radio waves. Light is one type of radiant energy. Sunshine is radiant energy, which provides the fuel and warmth that make life on Earth possible

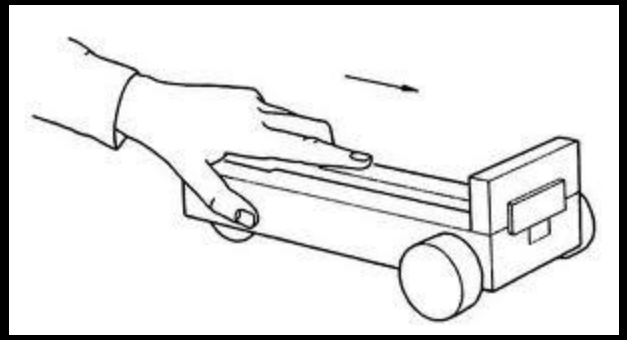


• **Thermal Energy**, or heat, is the vibration and movement of the atoms and molecules within substances. As an object is heated up, its atoms and molecules move and collide faster. Geothermal energy is the thermal energy in the Earth

Heat from the Earth, or geothermal — Geo (Earth) + thermal (heat) — energy can be and already is accessed by drilling water or steam wells in a process similar to drilling for oil. Geothermal energy is an enormous, underused heat and power resource that is clean (emits little or no greenhouse gases), reliable (average system availability of 95%), and homegrown (making us less dependent on foreign oil). Geothermal resources range from shallow ground to hot water and rock several miles below the Earth's surface, and even farther down to the extremely hot molten rock called magma. Mile-or-more-deep wells can be drilled into underground reservoirs to tap steam and very hot water that can be brought to the surface for use in a variety of applications. In the U.S., most geothermal reservoirs are located in the western states, Alaska, and Hawaii.

This 3,000 sq. ft. house in Oklahoma City has a verified average electric bill of $60 per month - using a geothermal heat pump

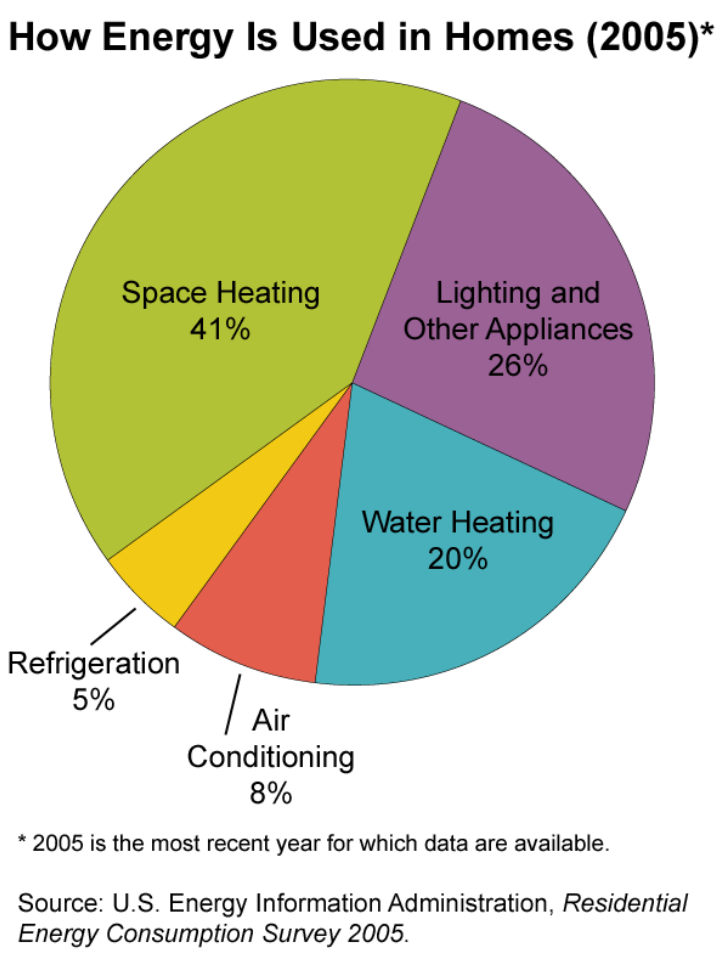
- **Motion Energy** is energy stored in the movement of objects. The faster they move, the more energy is stored. It takes energy to get an object moving, and energy is released when an object slows down. Wind is an example of motion energy. A dramatic example of motion is a car crash, when the car comes to a total stop and releases all its motion energy at once in an uncontrolled instant

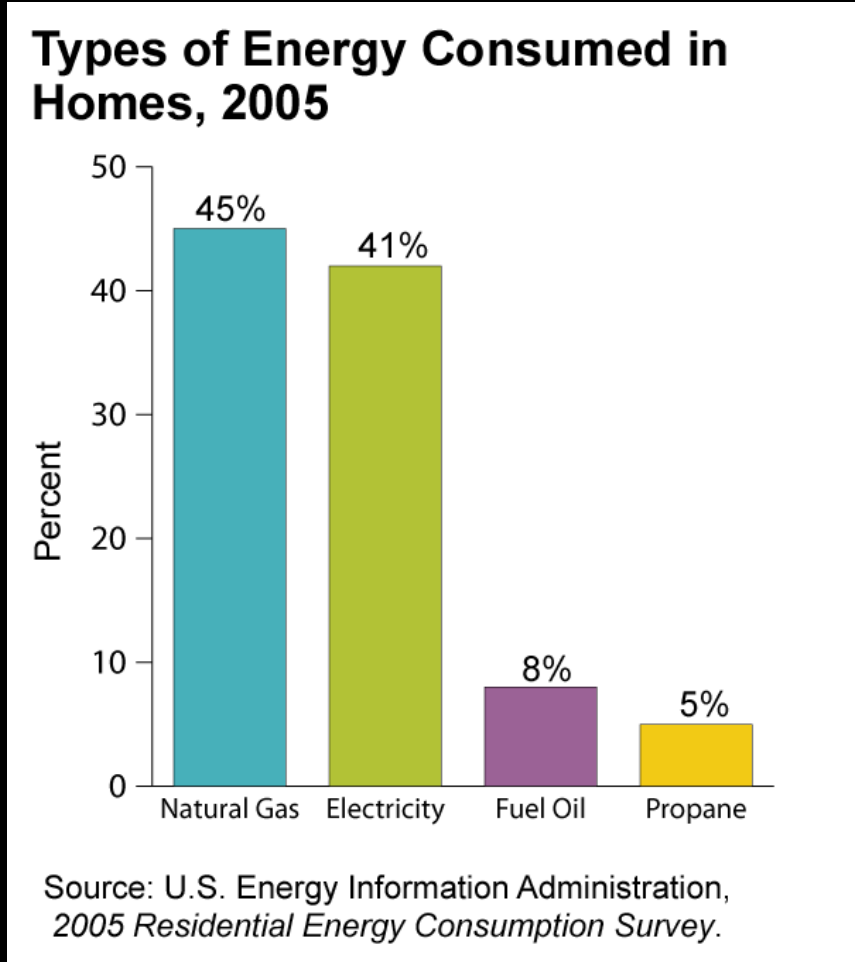


- **Sound** is the movement of energy through substances in longitudinal (compression/rarefaction) waves. Sound is produced when a force causes an object or substance to vibrate — the energy is transferred through the substance in a wave. Typically, the energy in sound is far less than other forms of energy.

- **Electrical Energy** is delivered by tiny charged particles called electrons, typically moving through a wire. Lightning is an example of electrical energy in nature, so powerful that it is not confined to a wire

- **In Home Energy Use**





- **In Home Energy Use**

Gains in Home Energy Efficiency Offset by More Electronics and Appliances

Total residential energy consumption rose approximately 13% over the past quarter century. This was lower than both the rate of population growth (+24%) and new housing starts (+36%) due to energy efficiency improvements in heating and cooling equipment, water heaters, and major appliances. Efficiency gains were offset by increases in the number of homes with clothes washers, dryers, and dishwashers. Additionally, a growing number of U.S. households now have multiple televisions, computers, and refrigerators.

The percentage of homes with central air-conditioning has more than doubled since 1980, with nearly 60% of homes having a central system. All areas of the United States show a significant increase in air-conditioning equipment and use in recent years. Cooling now accounts for 8% of total residential energy consumption in the United States, double its 1980 share

- **Take Home Message**

Renewable VS Nonrenewable Energy Sources
1.Renewable is more energy efficient!
2.We should increase our renewable energy resources.

Questions to Consider:
1.Do you know how much energy you use?
2.Is it renewable or nonrenewable energy?
3.Why should we increase our renewable energy sources?

- **Home Energy Survey**

Home Energy Survey Assignment

•Do you live in a single family home or multi-family building?
•What is a main building material of your house (i.e. wood, concrete, etc)?
•How many rooms are there (including living rooms, kitchen and bathrooms)?
- **How many lights are in each room**
- **Types of the lights (i.e. Incandescent light, CFL, etc.)**
- **Type of appliances in each room (i.e. television, computers, refrigerators, cooking stoves, etc.)**

•How many windows?
- **Orientation of each window**
- **Size of the windows**

•What color is the outer surface of your residence?
•What kind of activities you and your family members are doing in your house and how long and how often they are doing it (i.e. watching TV, working on computers, cooking, etc)?

•Formula to calculate the cost of operating a appliances in your house
- **{(Wattage x hours used) ÷ 1000 }x price per kWh = cost of electricity**

- **Home Energy Audit**

Home Energy Audit

Household Appliance	Average kw per hour	x	Hours used per day	x	Days used per week	x	Average rate per Kwh*	=	Average cost per week	Average cost per month
Clothes washer	0.425	x		x		x	$ 0.284	=	$ -	$ -
Clothes dryer	3.4	x		x		x	$ 0.284	=	$ -	$ -
Dishwasher	2	x		x		x	$ 0.284	=	$ -	$ -
Window Fan	0.2	x		x		x	$ 0.284	=	$ -	$ -
Ceiling Fan	0.12	x		x		x	$ 0.284	=	$ -	$ -
Hair Dryer	1.4	x		x		x	$ 0.284	=	$ -	$ -
Clothes iron	1.4	x		x		x	$ 0.284	=	$ -	$ -
Microwave oven	0.925	x		x		x	$ 0.284	=	$ -	$ -
Personal Computer CPU	0.12	x		x		x	$ 0.284	=	$ -	$ -
Monitor	0.15	x		x		x	$ 0.284	=	$ -	$ -
Laptop	0.05	x		x		x	$ 0.284	=	$ -	$ -
Television	0.113	x		x		x	$ 0.284	=	$ -	$ -
Flat Screen	0.12	x		x		x	$ 0.284	=	$ -	$ -
DVD	0.0225	x		x		x	$ 0.284	=	$ -	$ -
Refrigerator	0.242	x		x		x	$ 0.284	=	$ -	$ -

*Based on average Kwh in Hawaii

- **Home Energy Survey**

Typical Wattages of Various Appliances

Aquarium = 50–1210 Watts
Clock radio = 10
Coffee maker = 900–1200
Clothes washer = 350–500
Clothes dryer = 1800–5000
Dishwasher = 1200–2400 (using the drying feature greatly increases energy consumption)
Dehumidifier = 785
Electric blanket- *Single/Double* = 60 / 100
Fans
- Ceiling = 65–175
- Window = 55–250
- Furnace = 750
- Whole house = 240–750

Hair dryer = 1200–1875
Heater *(portable)* = 750–1500
Clothes iron = 1000–1800
Microwave oven = 750–1100
Personal computer
- CPU - awake / asleep = 120 / 30 or less
- Monitor - awake / asleep = 150 / 30 or less
- Laptop = 50

Radio *(stereo)* = 70–400
Refrigerator *(frost-free, 16 cubic feet)* = 725
Televisions (color)
- 19" = 65–110
- 27" = 113
- 36" = 133
- 53"-61" Projection = 170
- Flat screen = 120

Toaster = 800–1400
Toaster oven = 1225
VCR/DVD = 17–21 / 20–25
Vacuum cleaner = 1000–1440
Water heater *(40 gallon)* = 4500–5500
Water pump *(deep well)* = 250–1100
Water bed *(with heater, no cover)* = 120–380

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- **Google Sketch Up**

Google Sketch Up-Students will be provided with the sites below before course begins to explore Google Sketch Up. After the first session, students will be interacting with instructors to continue with program and ask any questions.

Related links

a. http://sketchup.google.com/

b. http://www.youtube.com/watch?v=26OtjJP-PXk

- **Questions & Answers**

- **Objectives of Session 2**

1.Describe the elements needed to have best level of energy efficiency in your home.
2.Describe how you can save on energy costs in your home and/or building. List at least 3 different methods for saving energy.

- **In Home Energy Efficient Equipment**

We All Use Energy

All of us use energy every day — for transportation, cooking, heating and cooling rooms, manufacturing, lighting, and entertainment. The choices we make about how we use energy — turning machines off when we're not using them or choosing to buy energy efficient appliances — impact our environment and our lives.

Efficiency and Conservation Are Different but Related

The terms energy conservation and energy efficiency have two distinct definitions. There are many things we can do to use less energy (conservation) and use it more wisely (efficiency).

Energy conservation is any behavior that results in the use of less energy. Turning the lights off when you leave the room and recycling aluminum cans are both ways of conserving energy.

Energy efficiency is the use of technology that requires less energy to perform the same function. A compact fluorescent light bulb that uses less energy than an incandescent bulb to produce the same amount of light is an example of energy efficiency. However, the decision to replace an incandescent light bulb with a compact fluorescent is an act of energy conservation**.**

- **In Home Energy Efficient Equipment**

Maximize Daylighting

Daylighting is the use of windows and skylights to bring sunlight into your home…

The best way to incorporate daylighting in your home depends on your climate and home's design. The sizes and locations of windows should be based on the cardinal directions rather than their effect on the street-side appearance of the house.

South-facing windows are most advantageous for daylighting and for moderating seasonal temperatures. They allow most winter sunlight into the home but little direct sun during the summer, especially when properly shaded.

North-facing windows are also advantageous for daylighting. They admit relatively even, natural light, producing little glare and almost no unwanted summer heat gain.

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- **In Home Energy Efficient Equipment**

Types of Windows and Glass

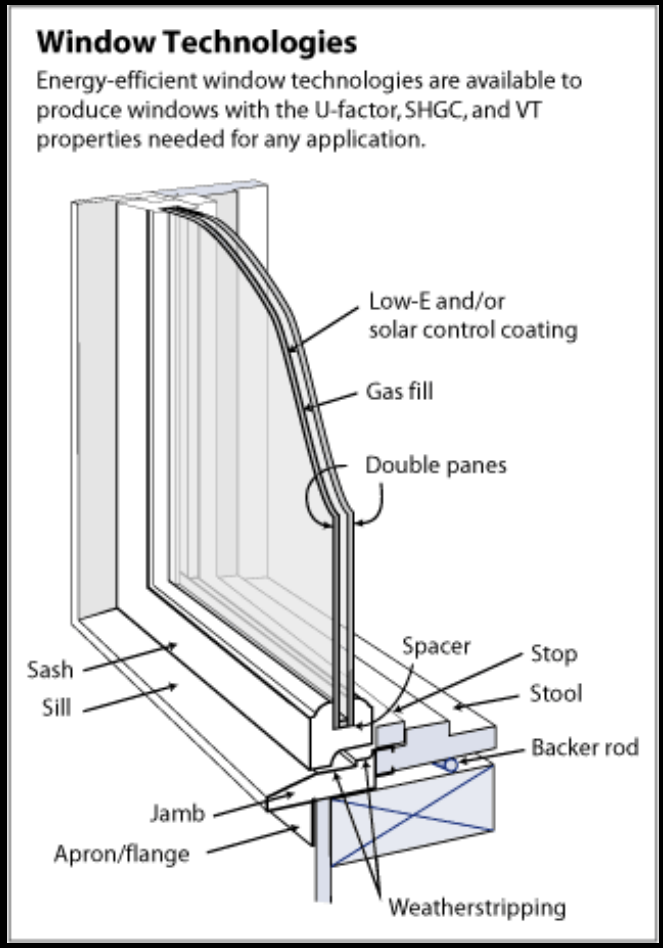
Window Gas Fills - To improve the thermal performance of windows with insulated glazing, some manufacturers fill the space between the glass panes with gas. The most common types of gas used by window manufacturers include argon and krypton

Heat-Absorbing, Tinted Window - Heat-absorbing window glazing contains special tints that change the color of the glass. Tinted glass absorbs a large fraction of the incoming solar radiation through a window.

Insulated Window - Insulated window glazing refers to windows with two or more panes of glass. They are also called double-glazed, triple-glazed, and—sometimes more generally—storm windows.

Low-Emissivity (Low-E) Window - Low-emissivity (Low-E) coatings on glazing or glass control heat transfer through windows with insulated glazing. Windows manufactured with Low-E coatings typically cost about 10%–15% more than regular windows, but they reduce energy loss by as much as 30%–50%.

Reflective Window - Reflective coatings on window glazing or glass reduce the transmission of solar radiation, blocking more light than heat.



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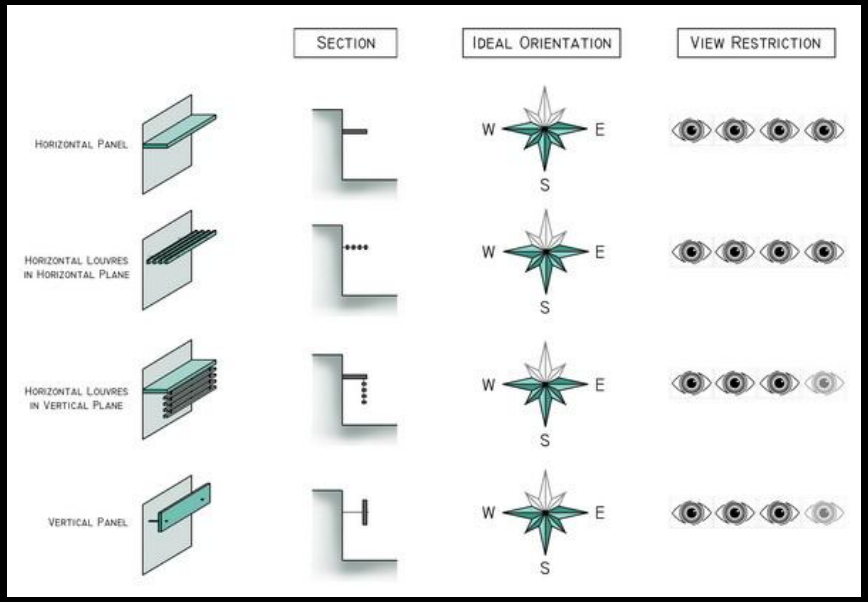
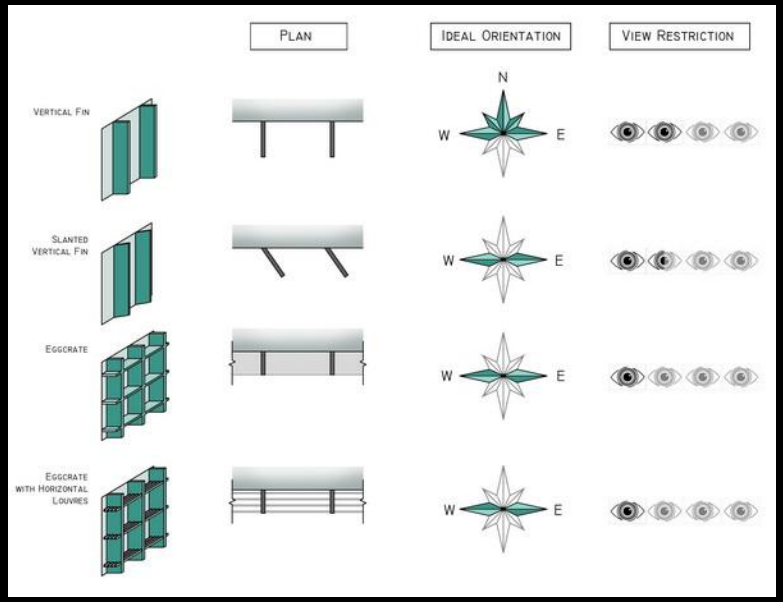
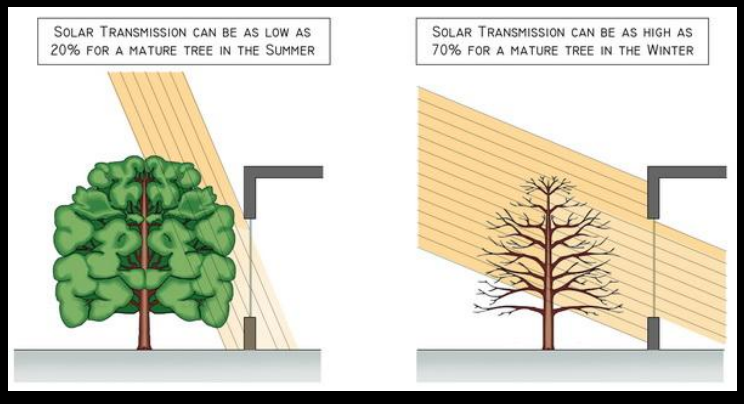
- **In Home Energy Efficient Equipment**

Shading Devices

Shading devices are used to reduce building too much sunshine and improves the daylighintg quality.







Images from American Institute of Architects Web page www.aia.org

- **In Home Energy Efficient Equipment**

Energy Efficient Lighting

Incandescent Light Bulb

Compact Fluorescent Light Bulb (CFL)

Fluorescent Light Bulb

Light Emitting Diode (LED) Light Bulb

	Efficiency (Lumens/Watt)	Life (hours)
Incandescent Light bulb	10-17	750 – 2,500
Compact Fluorescent Light Bulb (CFL)	50-70	10,000
Fluorescent Light Bulb	30-110	2,700 – 6,500
Light Emitting Diode (LED) Light Bulb	60-92	35,000 – 50,000

- **In Home Energy Efficient Equipment**

Programmable Thermostats

You can save around 10% a year on your heating and cooling bills by simply turning your thermostat back 10°–15° for eight hours. You can do this automatically without sacrificing comfort by installing an automatic setback or programmable thermostat.

Using a programmable thermostat, you can adjust the times you turn on the heating or air-conditioning according to a pre-set schedule. As a result, you don't operate the equipment as much when you are asleep or when the house is not occupied.

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- **In Home Energy Efficient Equipment**

Air Sealing, and Insulation

You can reduce your home's heating and cooling costs through proper insulation and air sealing techniques. These techniques will also make your home more comfortable.

Any air sealing efforts will complement your insulation efforts, and vice versa. Proper moisture control and ventilation strategies will improve the effectiveness of air sealing and insulation, and vice versa.

Therefore, a home's energy efficiency depends on a balance between all of these elements:

•Air sealing
•Insulation
•Moisture control
•Ventilation.

A proper balance between all of these elements will also result in a more comfortable, healthier home environment.

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- **In Home Energy Efficient Equipment**

Air Sealing

Air leakage, or infiltration, occurs when outside air enters a house uncontrollably through cracks and openings. Properly air sealing such cracks and openings in your home can significantly reduce heating and cooling costs, improve building durability, and create a healthier indoor environment.

It is unwise to rely on air leakage for ventilation because it can't be controlled. During cold or windy weather, too much air may enter the house. When it's warmer and less windy, not enough air may enter. Air infiltration also can contribute to problems with moisture control. Moldy and dusty air can enter a leaky house through such areas as attics or foundations. This air in the house could cause health problems

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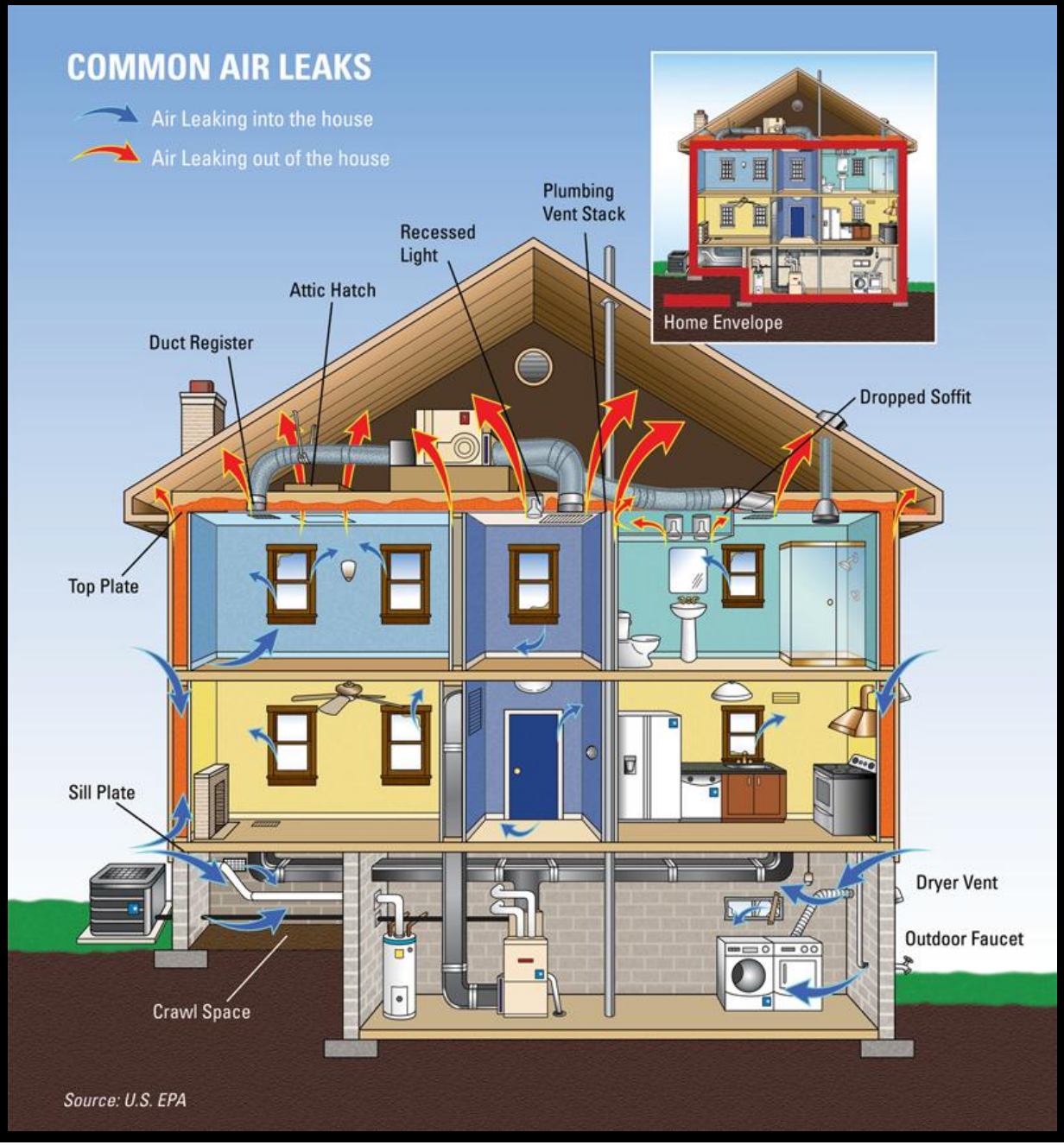

Areas can cause Air Leaks

- **Door and window frames**
- **Mail chutes**
- **Electrical and gas service entrances**
- **Cable TV and phone lines**
- **Outdoor water faucets**
- **Where dryer vents pass through walls**
- **Bricks, siding, stucco, and foundation**
- **Air conditioners**
- **Vents and fans**

- **In Home Energy Efficient Equipment**

Insulation

You need insulation in your home to provide resistance to heat flow. The more heat flow resistance your insulation provides, the lower your heating and cooling costs.

Heat flows naturally from a warmer to a cooler space. In the winter, this heat flow moves directly from all heated living spaces to adjacent unheated attics, garages, basements, and even to the outdoors. Heat flow can also move indirectly through interior ceilings, walls, and floors—wherever there is a difference in temperature. During the cooling season, heat flows from the outdoors to the interior of a house.

Where to Insulate

- Attic spaces
    - Attic access doors to unfinished attics
    - Knee walls in finished attics
- Ducts in unconditioned spaces
- Cathedral ceilings
- Exterior walls
- Floors above unheated garages
- Foundations
    - Basements
    - Crawl spaces
    - Slab-on-grade floors.

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Energy Efficient Equipment

- **In Home Energy Efficient Equipment**

Solar Power Basics

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- **In Home Energy Efficient Equipment**

Solar Power

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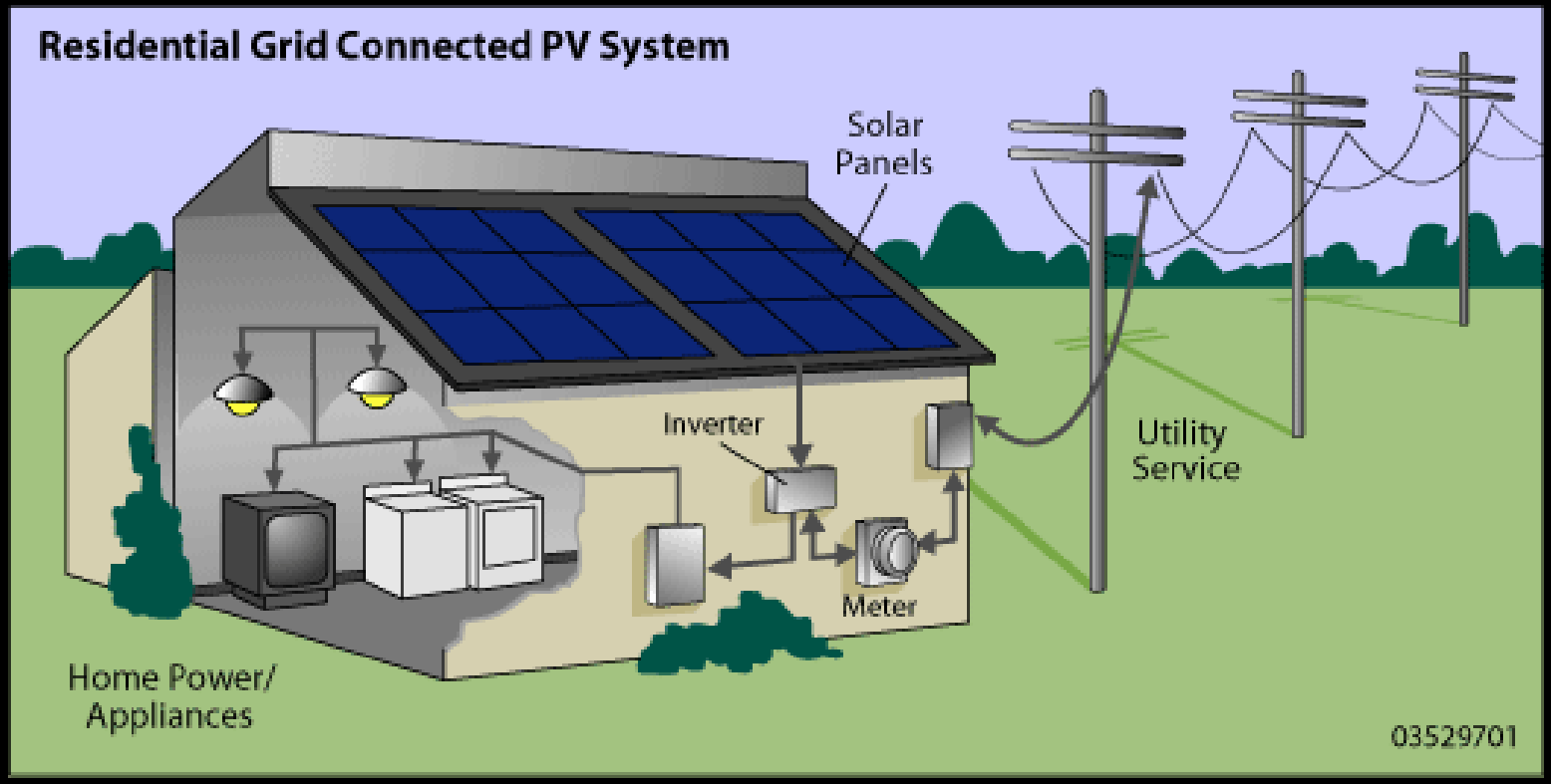
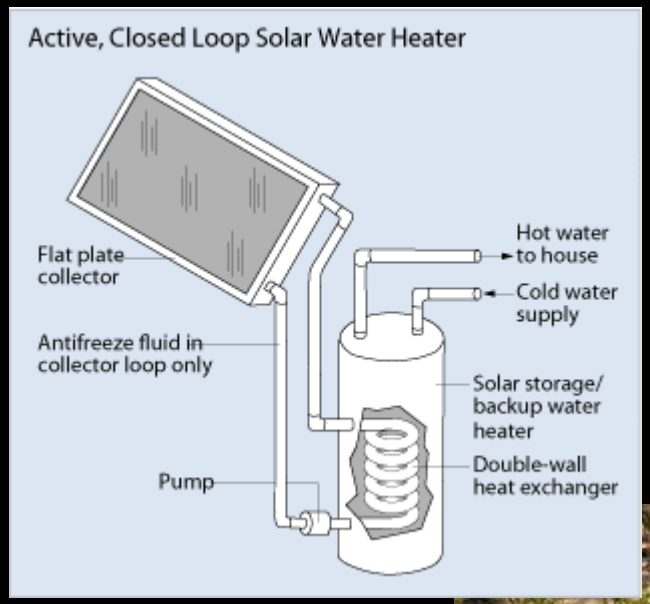
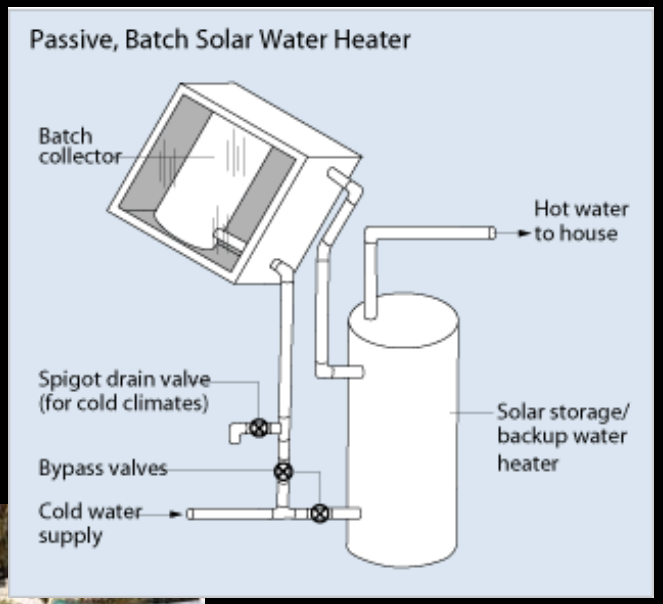


- **In Home Energy Efficient Equipment**

Solar Water Heaters

Solar water heaters—also called solar domestic hot water systems—can be a cost-effective way to generate hot water for your home. They can be used in any climate, and the fuel they use—sunshine—is free.





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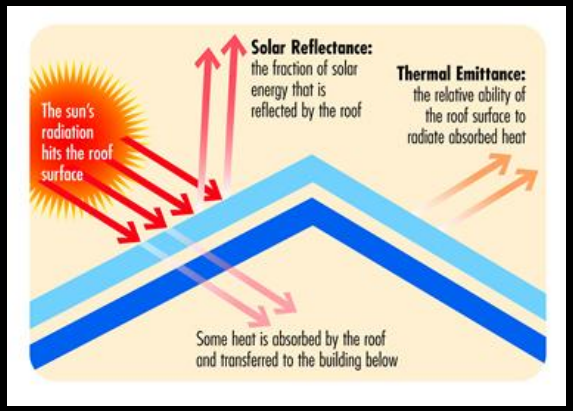
- **Passive Cooling Techniques Used in Hawaii**

Natural Ventilation

In mild climates like Hawaii's, natural ventilation can provide cooling during summer months to reduce air conditioning costs. Hawaii's trade winds can be an excellent source of summer cooling.

Cool Roofs

Cool roofs can reduce the amount of solar heat that enters the home. Cool roofs are often white or light colors to reflect solar energy.



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- **Houses in Japan**

Facts

Housing in Japan includes modern and traditional styles. Two patterns of residences are predominant in contemporary Japan: the single-family detached house and the multiple-unit building (Multi-family residential), either owned by an individual or corporation and rented as apartments to tenants, or owned by occupants. Additional kinds of housing, especially for unmarried people, include boarding houses (which are popular among college students), dormitories (common in companies), and barracks (for members of the Self-Defense Forces, police and some other public employees).

Statistics

In 1998, 52% of all dwellings in Japan were found to consist of detached houses owned by their residents, 36% were rented dwellings in apartment complexes, 8% were owned dwellings in apartments complexes, and 4% were rented detached houses. In 2008, it was estimated that six out of ten Japanese lived in single-family houses.

- **Houses in Japan**

Architecture in Japan

Tatami (畳) - is a type of mat used as a flooring material in traditional Japanese-style rooms

Organic Plan - Traditional Japanese housing does not have a designated use for each room aside from the entrance area (genkan, 玄関), kitchen, bathroom, and toilet. Any room can be a living room, dining room, study, or bedroom.

Heating - Space heating, rather than central heating, is normal in Japanese homes. Kerosene, gas, and electric units are common. Dwellings are commonly sold and rented without heating or cooling equipment. Occupants purchase appliances and take them when they move.

Insulation - Japanese buildings traditionally do not use insulation, and insulation is frequently omitted even in modern construction; nor is insulated glazing traditionally used in windows, with these being generally single-pane. This is changing, with newer buildings increasingly being insulated and centrally heated.

Electricity - Japanese dwellings connected to the nation's power grid have 100 V AC electricity at outlets throughout the home. The line frequency is 50 Hz in eastern Japan, and 60 Hz in the western part of the country.



- **Google Sketch Up**

Google Sketch Up-Students will be provided with the sites below before course begins to explore Google Sketch Up. After the first session, students will be interacting with instructors to continue with program and ask any questions.

Related links

a. http://sketchup.google.com/

b. http://www.youtube.com/watch?v=26OtjJP-PXk

• Biggest Energy Loser Challenge

For the Biggest Loser Challenge, each group will be given the same residence (Sketch Up Model) to make energy efficient and save the largest amount of money. Use the information learned over the three week lecture series to determine the right decisions when making the building more energy efficient in regards to building site placement, building materials used (exterior and interior), lighting, alternative energy sources used, etc. In addition to altering the Sketch Up model, each group must also explain their design alterations, types of materials, finishes and appliances used and any other pertinent information in a word document

Students will be allowed to change or manipulate:

- Building & Window
- Materials and construction of the building
    - Wall
    - Floor
    - Roof
    - Windows
- Lighting
- Alternative Energy Source
- Energy Efficient Appliance

After design/redesign complete, students will compare percentage of energy cost before and after.

Thank you

Questions and Answers

Powerpoint Slide Script

Session 1

Slide #1 – Middle School Energy Curriculum. This curriculum project was developed by Southern University and A&M College in Baton Rouge, Louisiana. The curriculum project is funded by Oak Ridge National Laboratory and the United States Department of Energy.

Slide #2- The objectives of Session 1:

1. Compare the different types of energy.
2. Describe the types of renewable energy.
3. Describe the types of nonrenewable energy.
4. Describe the types of energy used in buildings.

Slide #3 - Buildings use 49% of total energy which consumed in the U.S. If you compare that with other sectors, transportation use about 28% and industry use about 22%. Specially, in the transportation sector, people try hard to reduce their energy use and increase mile per gallon (MPG) by developing electric cars or hybrid cars. Now it is the time to improve energy efficiency in buildings which use about 1/2 of total energy used in the U.S.

Slide #4 - When you examine the world energy consumption by sector, on average the U.S. uses more energy in transportation and Japan uses more energy in buildings. However, both of the countries use about 30% to 40% energy used in buildings.

Slide #5 - For Hawaii, Hawaii has most energy that comes from non-renewable energy source. Most of the energy, used in Hawaii, comes from petroleum. Also, renewable energy source percentage is very low.

Slide #6 - Energy consumption in Hawaii is unique. Most of energy used in Hawaii, more than 50% is used in transportation. Also, large percentage of the energy in transportation used for air transportation, such as airplane.

Slide #7 - Briefly, about 8% of total energy used in Hawaii comes from renewable energy source.

Slide #8 - When you look at the energy use in Japan, about 13.6% comes from Nuclear and about 3.5% of total energy comes from renewable energy in 2008.

Slide #9 - The percentage of that consumption was 44.9% by industry, 31.0% by residential and commercial, and 24.1% by transportation.

Slide #10 - When you compare the electricity price between Japan and U.S., 22.76 cent per kW/h in Japan, 11.55 cent per kW/h in U.S. Electricity in Japan is about twice more expensive than in U.S.

Slide #11 - When you divide the energy sources into two big categories, first will be "renewable energy source" and the other will be "nonrenewable energy source". Under "renewable energy source" you can find five different energy sources. First, solar energy which comes from the Sun. Second, wind energy, which is created from wind, such as wind mills or wind turbines. Third, biomass is the energy which comes from wood, crops, garbage, etc. Fourth, hydroelectricity is a form of energy comes from kinetic water energy. Finally the fifth energy source is geothermal energy, the energy comes from the heat inside

of the earth. On the other hand, under "nonrenewable energy source" you can find fossil fuel and nuclear. Fossil fuel will have oil, natural gas and coal under it.

Slide #12 - These are the examples of solar energy use. Photovoltaic will generate electric energy from sunshine. Solar water heater will generate hot water with solar energy. Green house will store heat inside of a building for heating. Also, natural lighting will use sunshine to light up a building.

Slide #13 - these are the examples of other renewable energy sources such as "wind turbine", "biomass", "hydroelectricity", and "geothermal energy". Wind turbine is an equipment that generates electricity from wind. Biomass is uses garbage and wood for energy source. Hydroelectricity is a form of energy that comes from kinetic water energy. Geothermal energy comes from the heat inside of the earth.

Slide #14- this graph shows that only 8% of total energy used in the U.S. came from renewable energy sources such as solar, wind, biomass, hydropower and others. Meanwhile, 83% of total energy came from carbon based fossil fuel and 9% came from nuclear power sources.

Slide #15 - There are five forms of energy, especially in kinetic energy. They are radiant, thermal, motion, sound, and electric energy. Out of these five forms of energy, radiant and thermal energy is important to make buildings sustainable. Radiant Energy is electromagnetic energy that travels in transverse waves. Radiant energy includes visible light, x-rays, gamma rays and radio waves. Light is one type of radiant energy. Sunshine is radiant energy, which provides the fuel and warmth that make life on Earth possible.

Slide #16 - Thermal energy is heat energy. Geothermal energy is heat energy from the earth. "Geo" means earth and "thermal" means heat. Geothermal resources range from shallow ground to hot water and rock several miles below the Earth's surface. Also, there is another geo-thermal system called Ground Source Heat Pump (GSHP) which can save energy with using the earth to cool and heat their system.

Slide #17 - Motion and sound energy are forms of kinetic energy. However, these two forms of energy are not very common inside of buildings.

Slide #18 - Electrical Energy is delivered by tiny charged particles called electrons, typically moving through a wire. Lightning is an example of electrical energy in nature, so powerful that it is not confined to a wire. Electrical energy is the most common form of energy used inside of buildings. In the U.S., energy star will be given to the appliances or equipment which use less energy.

Slide #19 - According to the DOE, space heating is the most energy consuming thing in residential buildings in the U.S.. Also, for residential buildings, natural gas and electricity are the most common source of the energy.

Slide #20 - Total residential energy consumption rose approximately 13% over the past quarter century. This was lower than both the rate of population growth (+24%) and new housing starts (+36%) due to energy efficiency improvements in heating and cooling equipment, water heaters, and major appliances.

Slide #21 – The Take Home Message of Session 1:

We discussed Renewable VS Nonrenewable Energy Sources.

1. Renewable is more energy efficient!
2. We should increase our renewable energy resources.

Some questions to consider:

1. Do you know how much energy you use?
2. Is it renewable or nonrenewable energy?
3. Why should we increase our renewable energy sources?

Slide #22 – Students will calculate the cost of energy that is used by their family per week and then per month. The table allows students to input data for some common household items and appliances. Students are free to add additional items that are not listed. They should look on the appliance to determine wattage and then calculate cost.

Slide #23 - The table on the slide is example table for a "home energy audit". You can fill the cells on "hours per day" which means how many hours you use the equipment per a day. Also, on "days used per week" is a column where you can put how many days per week you use the equipment. When you put the numbers on the excel file, it will generate average energy cost per week and per month, automatically. The numbers you put on those columns will be based on your "Home Energy Survey Assignment".

Slide #24 - If you don't find equipments from the audit table, you still can estimate energy use manually. Using " {(Wattage x hours used) ÷ 1000 }x price per kWh = cost of electricity" formula. Other equipments can be found from the table on the slide. In addition, you can find wattage on appliance labels (it usually located on the back of larger appliances like the refrigerator and clothes washer and dryer).

Slide #25 - Google Sketch Up
The students will be using Google Sketch up for the final activity. There are several tutorial videos on the web for students to review before and during the sessions. We suggest the two below:

i. http://sketchup.google.com/
ii. http://www.youtube.com/watch?v=26OtjJP-PXk

Slide #26 - Q & A

Session 2

Slide #27 – Objectives of Session 2:

1. Describe the elements needed to have best level of energy efficiency in your home.
2. Describe how you can save on energy costs in your home and/or building. List at least 3 different methods for saving energy.

Slide #28 - All of us use energy every day — for transportation, cooking, heating and cooling rooms, manufacturing, lighting, and entertainment. The choices we make about how we use energy — turning machines off when we're not using them or choosing to buy energy efficient appliances — impact our environment and our lives. The terms energy conservation and energy efficiency have two distinct definitions. There are many things we can do to use less energy (conservation) and use it more wisely (efficiency). Energy conservation is any behavior that results in the use of less energy. Turning the lights off when you leave the room and recycling aluminum cans are both ways of conserving energy. Energy efficiency is the use of technology that requires less energy to perform the same function. A compact fluorescent light bulb that uses less energy than an incandescent bulb to produce the same amount of

light is an example of energy efficiency. However, the decision to replace an incandescent light bulb with a compact fluorescent is an act of energy conservation.

Slide #29 - Daylighting is very important. According to the session #1, in home, about 26% of energy is used for lighting and other appliances. If you design commercial buildings, that percentage will increase. Before you think about putting in energy efficient artificial lighting, when you design new buildings, put more windows and/or skylights for more daylighting/natural lighting. For orientation of the windows, south facing windows are always most advantages with proper shading device. North facing windows are good too. North facing windows will not have direct sunlight. If possible, avoid east and west oriented windows because you will have sunlight, however, east and west windows will have a lot of heat with the sunlight.

Slide #30 - There are many types of energy efficient windows and glass. During summer time, you want to let daylight in but you don't want heat come with daylight. During winter time, you don't want heat to escape through windows. First, Window Gas Fills - To minimize the heat that comes in or leaks out through windows, some manufacturers fill the space between the glass panes with gas. Second, Heat-absorbing window glazing contains special tints that change the color of the glass. Tinted glass absorbs a large amount of heat coming with the sunshine through a window. Third, Insulated Window - Insulated window glazing refers to windows with two or more panes of glass. They are also called double-glazed, triple-glazed, and—sometimes more generally—storm windows. Fourth, Low-Emissivity (Low-E) Window - Low-emissivity (Low-E) coatings on glazing or glass control heat transfer through windows with insulated glazing. Windows manufactured with Low-E coatings typically cost about 10%–15% more than regular windows, but they reduce energy loss by as much as 30%–50%. And finally, Reflective Window - Reflective coatings on window glazing or glass reduce the transmission of solar radiation, but it is blocking more light than heat.

Slide #31 - Shading Devices. Shading devices are used to reduce building too much sunshine and improves the daylighing quality. Horizontal shading device is more effective on south windows. Also, vertical ones are more effective on east and west windows. Trees are very effective shading device, too. Because, trees will block sunshine during summer time with its leaves, and will let the sunshine pass through without its leaves.

Slide #32 - When you have proper and enough daylight system, artificial lighting is a supplementary lighting system. There are so many different lighting bulbs, but the incandescent light bulb and Compact Fluorescent Light (CFL) bulb are the most popular artificial light sources in residential use. CFL light bulbs are about 5 times more efficient than regular (incandescent) light bulbs. Also CFL last about 5 to 10 times longer than regular (incandescent) light bulbs. With advance of technology, there are LED bulbs. LED light bulbs will use less energy than CFL and last longer than CFL.

Slide #33 - You can save around 10% a year on your heating and cooling bills by simply turning your thermostat back 10°–15° for eight hours. You can do this automatically without sacrificing comfort by installing an automatic setback or programmable thermostat. Using a programmable thermostat, you can adjust the times you turn on the heating or air-conditioning according to a pre-set schedule. As a result, you don't operate the equipment as much when you are asleep or when the house is not occupied. Picture below is example of programmable thermostat.

Slide #34 - You can reduce your home's heating and cooling costs through proper insulation and air sealing techniques. These techniques will also make your home more comfortable. Any air sealing efforts will complement your insulation efforts, and vice versa. Proper moisture control and ventilation strategies will improve the effectiveness of air sealing and insulation, and vice versa. Therefore, a home's energy efficiency depends on a balance between all of these elements: Air sealing, Insulation, Moisture

control, and Ventilation. A proper balance between all of these elements will also result in a more comfortable, healthier home environment.

Slide #35- Air leakage, or infiltration, occurs when outside air enters a house uncontrollably through cracks and openings. Properly sealing such cracks and openings in your home can significantly reduce heating and cooling costs, improve building durability, and create a healthier indoor environment. It is unwise to rely on air leakage for ventilation because it can't be controlled. During cold or windy weather, too much air may enter the house. When it's warmer and less windy, not enough air may enter. Air infiltration also can contribute to problems with moisture control. Moldy and dusty air can enter a leaky house through such areas as attics or foundations. This air in the house could cause health problems.

Slide #36 - This is a typical air leakage in a residential building. Treated air from a house will leak out through any gaps, cracks, and openings. Also, untreated air will penetrate into a house through them, too.

Slide #37 - Next one is insulation you need insulation in your home to provide resistance to heat flow. The more heat flow resistance your insulation provides, the lower your heating and cooling costs. Heat flows naturally from a warmer to a cooler space. In the winter, this heat flow moves directly from all heated living spaces to adjacent unheated attics, garages, basements, and even to the outdoors. Heat flow can also move indirectly through interior ceilings, walls, and floors—wherever there is a difference in temperature. During the cooling season, heat flows from the outdoors to the interior of a house. Location of insulation might be different based on buildings, but basically, insulation would work better on the perimeter of buildings including roof and foundations

Slide #38 - this is a slide showing typical location of insulation and different types of insulation

Slide #39 - Next, we are going to talk about solar energy. Let's watch the movie clip from the U.S. Department of Energy. (Movie script will be provided separately.)

Slide #40 - For residential application of PV system, PV with regular grid system is one of the most feasible ways. PV will produce electricity, and if you need more electricity you can get it from energy companies.

Slide #41 - One of the other solar systems is solar hot water heater. Solar water heaters—also called solar domestic hot water systems—can be a cost-effective way to generate hot water for your home. They can be used in any climate, and the fuel they use—sunshine—is free.

Slide #42 – On this slide we will investigate the passive cooling techniques used in Hawaii. Natural Ventilation, In mild climates like Hawaii's, natural ventilation can provide cooling during summer months to reduce air conditioning costs. Hawaii's trade winds can be an excellent source of summer cooling. Cool roofs also help with natural ventilation because cool roofs can reduce the amount of solar heat that enters the home. Cool roofs are often white or light colors to reflect solar energy.

Slide # 43 - On this slide, we will investigate the Japanese housing culture. Housing in Japan includes modern and traditional styles. Two patterns of residences are predominant in contemporary Japan: the single-family detached house and the multiple-unit building (Multi-family residential). In 1998, 52% of all dwellings in Japan were found to consist of detached houses owned by their residents, 36% were rented dwellings in apartment complexes, 8% were owned dwellings in apartments complexes, and 4% were rented detached houses. In 2008, it was estimated that six out of ten Japanese lived in single-family houses.

Slide #44- **Tatami (畳)** - is a type of mat used as a flooring material in traditional Japanese-style rooms. **Organic Plan** - Traditional Japanese housing does not have a designated use for each room aside from the entrance area (genkan, 玄関), kitchen, bathroom, and toilet. Any room can be a living room, dining room, study, or bedroom. **Heating** - Space heating, rather than central heating, is normal in Japanese homes. **Insulation** - Japanese buildings traditionally do not use insulation, and insulation is frequently omitted even in modern construction; nor is insulated glazing traditionally used in windows, with these being generally single-pane. **Electricity** - Japanese dwellings connected to the nation's power grid have 100 V AC electricity at outlets throughout the home. The line frequency is 50 Hz in eastern Japan, and 60 Hz in the western part of the country.

Slide #45- Take Home Message of Session 2:

1. Home energy efficiency depends on 4 elements: air sealing, insulation, moisture control and ventilation

2. Solar Energy can be used in many ways in our homes.

Slide #46 - Google Sketch Up questions and answers

The students will be using Google Sketch up for the final activity. There are several tutorial videos on the web for students to review before and during the sessions. We suggest the two below:

i. http://sketchup.google.com/
ii. http://www.youtube.com/watch?v=26OtjJP-PXk

Slide #47 - Biggest Energy Loser Challenge (See Rubric)

Slide #48 - Q &A

Session 3

Students will work in teams on challenge project. After project is completed, the students will submit the project and it will be judged using rubric. After judging is complete, the students will present their home designs and the instructors will present the Biggest Energy Loser! Each student will receive a certificate for participation and completion of the course.

Activities

The activities to follow are to compliment the information presented in the course. The website scavenger hunt can be done as an individual or as a group. We recommend the home energy audit and Biggest Energy Loser Challenge are done as group activities.

Website Scavenger Hunt

ALL ABOUT ENERGY

Activity Sheet to be used with www.EIA.GOV/kids

1. What is Energy
    a. Define the two types of Energy
        i. _____
        ii. _____
    b. What form of energy is
        i. Hydropower _____
        ii. Wind energy_____
2. Energy Sources
    a. Give an example of
        i. Renewable Energy_____
        ii. Non-Renewable Energy _____
    b. _____, _____, _____ and _____ are all considered fossil fuels.
    c. Non-biomass renewable sources of energy

        _____

        _____.
3. Using and Saving Energy
    a. _____ things we can do to use less energy
    b. _____ use of energy more wisely
    c. _____ and _____ are both ways of conserving energy.
4. History of Energy
    a. Match the name with their activity in history

_____ Tesla	A. Developed wireless telegraphy or radio
_____ Faraday	B. Developed technique for removal of Smoke from buildings
_____ Curie	C. Discovered alternating current (AC)
_____Marconi	D. Father of Electric Motor
_____ Gourdine	E. Developed X-rays

5. Games & Activities
    a. Explore as many as possible.
    b. Complete
        i. the Energy IQ Quiz
        ii. Puzzle on Greenhouse Gases

ALL ABOUT ENERGY-Answer Key

Activity Sheet to be used with www.EIA.GOV/kids

1. What is Energy
    a. Define the two types of Energy
        i. Stored (potential)
        ii. Working (kinetic)
    b. What form of energy is
        i. Gravitational Energy (potential)
        ii. Motion Energy (kinetic)
2. Energy Sources
    a. Give an example of
        i. Biomass, geothermal, hydropower, Solar, Wind
        ii. Oil (Petroleum), Natural Gas, Coal, Uranium (Nuclear)
    b. Coal, Petroleum, natural gas and Propane
    c. Non-biomass renewable sources of energy do not directly emit greenhouse gases.
3. Using and Saving Energy
    a. Conservation
    b. Efficiency
    c. Turning off the lights when you leave a room and recycling aluminum cans
4. History of Energy
    a. Match the name with their activity in history

        Tesla-C.
        Farrady-D.
        Curie – E.
        Marconi – A.
        Gourdine – B.

Home Energy Audit

You can fill the cells on "hours per day" which means how many hours you use the equipment per a day. Also, on "days used per week" is a column where you can put how many days per week you use the equipment. When you put the numbers on the excel file, it will generate average energy cost per week and per month, automatically. The numbers you put on those columns will be based on your "Home Energy Survey Assignment".

To calculate energy cost manually,

{(Wattage **X** hours used) ÷ 1000} **X** price per kWh = cost of electricity"

In addition, you can find wattage on appliance labels (it usually located on the back of larger appliances like the refrigerator and clothes washer and dryer).

This document is provided here as a fill-in for students to compute manually and can be provided as an excel spreadsheet for students to enter data.

Home Energy Audit for Hawaii

Household Appliance	Appliance wattage (kW)	x	Hours used per day	x	Days used per week	x	Average rate per kWh*	=	Average cost per week	x 4	Average cost per month
Clothes washer	0.43	x		x		x	$ 0.284	=	$ -	x 4	$ -
Clothes dryer	3.40	x		x		x	$ 0.284	=	$ -	x 4	$ -
Dishwasher	2.00	x		x		x	$ 0.284	=	$ -	x 4	$ -
Window Fan	0.20	x		x		x	$ 0.284	=	$ -	x 4	$ -
Ceiling Fan	0.12	x		x		x	$ 0.284	=	$ -	x 4	$ -
Hair Dryer	1.40	x		x		x	$ 0.284	=	$ -	x 4	$ -
Clothes iron	1.40	x		x		x	$ 0.284	=	$ -	x 4	$ -
Microwave oven	0.93	x		x		x	$ 0.284	=	$ -	x 4	$ -
Personal Computer CPU	0.12	x		x		x	$ 0.284	=	$ -	x 4	$ -
Monitor	0.15	x		x		x	$ 0.284	=	$ -	x 4	$ -
Laptop	0.05	x		x		x	$ 0.284	=	$ -	x 4	$ -
Television	0.11	x		x		x	$ 0.284	=	$ -	x 4	$ -
Flat Screen	0.12	x		x		x	$ 0.284	=	$ -	x 4	$ -
DVD	0.02	x		x		x	$ 0.284	=	$ -	x 4	$ -
Games Console (PS3, Xbox,Nintendo)	0.01	x		x		x	$ 0.284	=	$ -	x 4	$ -
Refrigerator	0.24	x		x		x	$ 0.284	=	$ -	x 4	$ -

Household Items	Average Cost per Hour*	x	Hours Per Week	x	Number of Bulbs	=	Average cost per week	x 4	Average cost per month
100 watt Incandescent Light Bulb	0.682					=	$ -	x 4	
15 watt Compact Fluorescent Light bulb (CFL)	0.1020						$ -	x 4	
5 watt LED Light Bulb	0.034						$ -	x 4	
	TOTAL COST					=	$ -	x 4	$ -

*Based on average kWh in Hawaii

Home Energy Audit for Louisiana

Household Appliance	Appliance wattage (kW)	x	Hours used per day	x	Days used per week	x	Average rate per kWh*	=	Average cost per week	x 4	Average cost per month
Clothes washer	0.43	x		x		x	$ 0.099	=	$ -	x 4	$ -
Clothes dryer	3.40	x		x		x	$ 0.099	=	$ -	x 4	$ -
Dishwasher	2.00	x		x		x	$ 0.099	=	$ -	x 4	$ -
Window Fan	0.20	x		x		x	$ 0.099	=	$ -	x 4	$ -
Ceiling Fan	0.12	x		x		x	$ 0.099	=	$ -	x 4	$ -
Hair Dryer	1.40	x		x		x	$ 0.099	=	$ -	x 4	$ -
Clothes iron	1.40	x		x		x	$ 0.099	=	$ -	x 4	$ -
Microwave oven	0.93	x		x		x	$ 0.099	=	$ -	x 4	$ -
Personal Computer CPU	0.12	x		x		x	$ 0.099	=	$ -	x 4	$ -
Monitor	0.15	x		x		x	$ 0.099	=	$ -	x 4	$ -
Laptop	0.05	x		x		x	$ 0.099	=	$ -	x 4	$ -
Television	0.11	x		x		x	$ 0.099	=	$ -	x 4	$ -
Flat Screen	0.12	x		x		x	$ 0.099	=	$ -	x 4	$ -
DVD	0.02	x		x		x	$ 0.099	=	$ -	x 4	$ -
Games Console (PS3, Xbox,Nintendo)	0.01	x		x		x	$ 0.099	=	$ -	x 4	$ -
Refrigerator	0.24	x		x		x	$	=	$ -	x 4	$ -

							0.099					
Household Items	**Average Cost per Hour***		**x**	**Hours Per Week**	**x**	**Number of Bulbs**	**=**	**Average cost per week**		**x 4**	**Average cost per month**	
100 watt Incandescent Light Bulb	**$**	**0.2376**					**=**	**$**	**-**	**x 4**	**$**	**-**
15 watt Compact Flourescent Lightbulb (CFL)	**$**	**0.0356**						**$**	**-**	**x 4**	**$**	**-**
5 watt LED Light Bulb	**$**	**0.0119**						**$**	**-**	**x 4**	**$**	**-**
		TOTAL COST					**=**	**$**	**-**	**x 4**	**$**	**-**

*Based on average kWh in Louisiana with Entergy.

Biggest Energy Loser Challenge Description

For the Biggest Energy Loser Challenge, each group will be given the same residence (Sketch up Model) to make energy efficient and save the largest amount of money. Use the information learned over the three week lecture series to determine the right decisions when making the building more energy efficient in regards to building site placement, building materials used (exterior and interior), lighting, alternative energy sources used, etc. In addition to altering the Sketch Up model, each group must also explain their design alterations, types of materials, finishes and appliances used and any other pertinent information in a word document. Each group will be graded on the following criteria:

- Building & Window Orientation – Building orientation, north facing (southern hemisphere) or south facing (northern hemisphere), type and location of shading devices, orientation of windows for natural lighting to maximize day lighting
- Materials and construction of the building – Use of materials in the model building
    - Wall: Type of exterior wall finishes used (i.e. wood, siding, brick, stucco, metal panels, etc.), type of interior wall finishes used (gypsum board, wood, etc.), color of paint used (lighter colors reflect sunlight and darker colors absorb sunlight)
    - Floor: Type of floor finishes used (i.e. tile, carpet, wood, etc.)
    - Roof: Type of roof material (i.e. shingles, clay tile, metal, etc.), and color used (lighter colors reflect sunlight and darker colors absorb sunlight)
    - Windows: Type of window (i.e. awning, casement, double hung, bay, jalousie, hopper, etc.), and glazing used (i.e. single-glazed, double-glazed, tinted, low-e, etc.)
- Lighting – Type of lighting used (i.e. LED, fluorescent, CFL, incandescent, etc.)
- Alternative Energy Sources – Type and location of alternative energy sources used (i.e. solar panels, wind power, etc.)
- Energy Efficient Appliances – Type of appliances used in the residence (i.e. 5 star or better - dishwasher, fridge, stove, air conditioner, etc.)

Biggest Energy Loser Challenge Student Check List

Criteria	Objective	
Passive Solar		
	Building orientation, north facing (southern hemisphere) or south facing (northern hemisphere), type and location of shading devices, orientation of windows for natural lighting to maximize day lighting	
Materials		
	Wall: Type of exterior wall finishes used (i.e. wood, siding, brick, stucco, metal panels, etc.), type of interior wall finishes used (gypsum board, wood, etc.), color of paint used (lighter colors reflect sunlight and darker colors absorb sunlight)	
	Floor: Type of floor finishes used (i.e. tile, carpet, wood, etc.)	
	Roof: Type of roof material (i.e. shingles, clay tile, metal, etc.), and color used (lighter colors reflect sunlight and darker colors absorb sunlight)	
	Windows: Type of window (i.e. awning, casement, double hung, bay, jalousie, hopper, etc.), glazing used (i.e. single-glazed, double-glazed, low-e, etc.)	
Lighting		
	Type of lighting used (i.e. LED, fluorescent, CFL, incandescent, etc.)	
Alternative Energy Sources		
	Type and location of alternative energy sources used (i.e. solar panels, wind power, etc.)	
Energy Efficient Appliances		
	Type of appliances used in the residence (i.e. 5 star or better - dishwasher, fridge, stove, air conditioner, etc.)	

Notes: _____

Evaluators Guide

For the evaluators, grade each criterion on a score from A – F. A is worth 9-10 points; B is worth 7-8 points and so on. The evaluation criteria are below. When grading if a score of A is given for a particular criterion, the point value (deciding between 9 or 10 points) should be determined based on the quality of the solution. For example if a group decides to use LED lighting over fluorescent lighting this might cause for a score of 10 instead of a 9 because of the better quality of light, if the space is appropriate for its use. When adding all the scores if two groups tie in point value, the group with the higher number of A and B scores should be the winner, if they are still tied, the group with the better quality solution should be the winner. If the groups are still tied the group with the better explanation of their solution should be declared the winner.

Project Name _____ Name of Person Completing Assessment _____ Date of Assessment _____

Criteria	Evaluation				
	A 9 - 10 pts. (for 10 points max) 36 - 40 pts. (for 40 points max)	**B** 7 - 8 pts. (for 10 points max) 28 - 35 pts. (for 40 points max)	**C** 5 - 6 pts. (for 10 points max) 20 - 27 pts. (for 40 points max)	**D** 3 - 4 pts. (for 10 points max) 12 - 19 pts. (for 40 points max)	**F** 1 - 2 pts. (for 10 points max) 1 - 11 pts. (for 40 points max)
Building and Window Orientation (10 pts. max)	• 80-100% of the requirements were addressed • Building was located on the site to utilize all landscaping features • Shading devices were placed on all east, west and south facing windows	• 60-80% of the requirements were addressed • Buildings were located to utilize some landscaping features • Shading devices were placed on 2 of the three (east, west and south) facing windows	• 40-60% of the requirements were addressed • Buildings were located to utilize some landscaping features • Shading devices were placed on 1 of the three (east, west and south) facing windows	• 20-40% of the requirements were addressed • Building was located with landscaping features adjacent to building but not utilizing them • Shading devices placed on some windows on east, west or south	• 0-20% of the requirements were addressed • Buildings were located with no thought to orientation • No shading devices were used
Materials (grade each element separately, record a max score of 10 pts., then add for a total of 40 pts. max)	• 80-100% of the requirements were addressed • Appropriate finish, color and type used for the space	• 60-80% of the requirements were addressed • Appropriate finish and type used, but the color was not appropriate for the space	• 40-60% of the requirements were addressed • Appropriate finish and color used, but the type used was not appropriate for the space	• 20-40% of the requirements were addressed • Appropriate finish used, but the color and type used was not appropriate for the space	• 0-20% of the requirements was addressed • No finish, color and type used for the space
Lighting (10 pts. max)	• 80-100% of the requirements were addressed • Efficient lighting types chosen for all spaces	• 60-80% of the requirements were addressed • Efficient lighting types chosen for all 4 spaces	• 40-60% of the requirements were addressed • Efficient lighting types chosen for 2 spaces	• 20-40% of the requirements were addressed • Efficient lighting types chosen for 1 space	• 0-20% of the requirements was addressed • No efficient lighting types chosen for any of the spaces
Alternative Energy Sources (10 pts. max)	• 80-100% of the requirements were addressed • Alternative energy sources were used throughout the building and the type and locations were appropriate for the design	• 60-80% of the requirements were addressed • Alternative energy sources were used throughout the building, the type was acceptable but the location was not appropriate	• 40-60% of the requirements were addressed • Alternative energy sources were used throughout the building, the location was acceptable but the type was not appropriate	• 20-40% of the requirements were addressed • Alternative energy sources were used throughout the building but the location and type were not appropriate for the design	• 0-20% of the requirements was addressed • No alternative energy sources were used throughout the building
Energy Efficient Appliances (10 pts. max)	• 80-100% of the requirements were addressed • Energy efficient appliances chosen for **ALL** spaces	• 60-80% of the requirements were addressed • Energy efficient appliances chosen for 4 spaces	• 40-60% of the requirements were addressed • Energy efficient appliances chosen for 2 spaces	• 20-40% of the requirements were addressed • Energy efficient appliances chosen for 1 spaces	• 0-20% of the requirements was addressed • No Energy efficient appliances chosen

Evaluation Sheet

Criteria	Objective	Grade					
		A	B	C	D	F	Score
Passive Solar							
	Building orientation, north facing (southern hemisphere) or south facing (northern hemisphere), type and location of shading devices, orientation of windows for natural lighting to maximize day lighting						
Materials							
	Wall: Type of exterior wall finishes used (i.e. wood, siding, brick, stucco, metal panels, etc.), type of interior wall finishes used (gypsum board, wood, etc.), color of paint used (lighter colors reflect sunlight and darker colors absorb sunlight)						
	Floor: Type of floor finishes used (i.e. tile, carpet, wood, etc.)						
	Roof: Type of roof material (i.e. shingles, clay tile, metal, etc.), and color used (lighter colors reflect and darker colors absorb sun light)						
	Windows: Type of window (i.e. awning, casement, double hung, bay, jalousie, hopper, etc.), glazing used (i.e. single-glazed, double-glazed, low-e, etc.)						
Lighting							
	Type of lighting used (i.e. LED, fluorescent, CFL, incandescent, etc.)						
Alternative Energy Sources							
	Type and location of alternative energy sources used (i.e. solar panels, wind power, etc.)						
Energy Efficient Appliances							
	Type of appliances used in the residence (i.e. 5 star or better - dishwasher, fridge, stove, air conditioner, etc.)						
Total Score (80 points max)							

Notes: _____

_____

Additional Resources

- www.eia.gov/kids
- www.doe.gov
- www.sketchup.google.com
- www.hawaiicleanenergyinitiative.org
- http://www.hawaiienergy.com/

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