

## GLOBAL WARMING UNIT PRESENTATION, 11/06

Beryl Flom

### SOME DEFINITIONS ([www.puhsd.k12.ca.us](http://www.puhsd.k12.ca.us))

The **greenhouse effect** is the warming that results when the earth's atmosphere traps the sun's heat. It is created by carbon dioxide, methane, and other atmospheric gases, which allow sunlight to reach the earth but prevent heat from leaving. These heat-trapping gases are often called greenhouse gases.

To counter greenhouse gases, plants take the gases from the air, turn them into new growth, then release them through respiration. In the ocean, the gases are stored as dissolved carbon dioxide. So carbon dioxide and other gases are continuously being exchanged between land and atmosphere. However, the plants and the rest of the land-based ecosystem, as well as the ocean, soak up less than 50% of all gases that humans release through fossil fuels. Thus, the excess gasses (like CO<sub>2</sub>) build up as a heat blanket in the atmosphere, thereby warming the planet. NASA scientists have stated that CO<sub>2</sub> levels in the atmosphere have shot up from 285 parts per million (ppm) to 377 ppm. Historically, CO<sub>2</sub> levels had only averaged between 180 and 290 ppm. Every 10 ppm increase on CO<sub>2</sub> concentration is associated with a half a degree Centigrade increase in temperature.

One of the most common types of outdoor air pollution is smog. **Smog** is a brown, hazy mixture of gases and particulates. It develops when certain gases released by the combustion of gasoline and other petroleum products react with sunlight in the atmosphere. This reaction creates hundreds of harmful chemicals that make up smog.

One of the chemicals in smog is a toxic form of oxygen called **ozone** (O<sub>3</sub>). Exposure to high concentrations of ozone causes headaches, burning eyes, and irritation of the respiratory tract in many individuals. In some cases, ozone in the lower atmosphere can cause death. Ozone can also damage plant life and even kill trees. Ground-level ozone comes from the oxidation of volatile organic compounds found in solvents. It is also a product of reactions between chemicals that are produced by burning coal, gasoline, other fossil fuels, and chemicals found in paints and hair sprays. Oxidation occurs more readily during hot weather. Vehicles and industries are major sources of ground-level ozone.

**Carbon monoxide** is produced by the incomplete burning of carbon-based fuels, including gasoline, oil and wood. It is also produced from incomplete combustion of natural and synthetic products, such as cigarette smoke. It can build up in poorly ventilated tunnels, closed garages, and along the roadside in heavy traffic.

Chemicals called **chlorofluorocarbons (CFC's)** are pollutants that destroy the ozone layer in the upper atmosphere. CFC's are used in refrigerators and air conditioners and to make plastic foam insulation. Ozone forms a protective layer in the upper atmosphere. It shields the earth's surface from more than 95 percent of the sun's ultraviolet radiation. As CFC's thin the ozone layer, more ultraviolet radiation reaches the surface of the earth. Overexposure to such radiation damages plants and greatly increases people's risk of skin cancer.

### **Replacement chemicals for CFCs:**

Hydrofluorocarbons (HFCs), hydrochlorofluorocarbons (HCFCs) and "Greenfreeze" chemicals (hydrocarbons such as cyclopentane and isobutane) have been the primary substitutes. The

primary HFC used in automobile air conditioning, HFC-134a, costs about 3-5 times as much as the CFC-12 gas it replaced. A substantial black market in CFCs has resulted.

HCFCs are considered a "transitional" CFC substitute, since they also contribute to ozone depletion (but to a much less degree than CFCs). HCFCs are scheduled to be phased out by 2030 in developed nations and 2040 in developing nations.

HFCs do not cause ozone depletion, but do contribute significantly to global warming. For example, HFC-134a, the new refrigerant of choice in automobile air conditioning systems, is 1300 times more effective over a 100-year period as a greenhouse gas than carbon dioxide. At current rates of HFC manufacture and emission, up to 4% of greenhouse effect warming by the year 2010 may result from HFCs.

**"Greenfreeze"** hydrocarbon chemicals appear to be the best substitute, as they do not contribute to greenhouse warming, or ozone depletion. Greenfreeze technology has captured nearly 100% of the home refrigeration market in many countries in Europe, but has not been introduced in North America yet due to product liability concerns and industry resistance.

**Acid rain** is a term for rain and other precipitation that is polluted mainly by sulfuric acid and nitric acid. These acids form when gases called sulfur dioxide and nitrogen oxides react with water vapor in the air. These gases come chiefly from the burning of coal, gas, and oil by cars, factories, and power plants. The acids in acid rain move through the air and water and harm the environment over large areas. Acid rain has killed entire fish populations in a number of lakes. It also damages buildings, bridges, and statues. Scientists believe high concentrations of acid rain can harm forests and soil. Regions affected by acid rain include large parts of eastern North America, Scandinavia, and central Europe.

**Heavy metals** include mercury and lead. Mining operations, solid waste incinerators, industrial processes, and motor vehicles can all release heavy metals into the environment. Like pesticides, they are long lasting and can spread through the environment. Also, like pesticides, they can collect in the bones and other tissues of animals. In human beings, heavy metals can damage various internal organs, bones, and the nervous system. Many can also cause cancer.

### **YOUR CARBON FOOTPRINT**

See flyer.

Sources of CO<sub>2</sub> Emissions: 35% electric generation, 27% transportation, 19% industry, 7.5% agriculture, 7 % commercial, 5% residential.

### **TYPES OF ENERGY**

**Fossil fuels** include oil and its derivatives as well as coal and gas. They are still the cheapest form of energy, but as supplies dry up, wells have to be dug deeper or in more difficult locations (under the sea or ice). The world still has plenty of coal, but the smog, acid rain, global warming and air toxics are alarming. A typical coal plant generates:

- 3,700,000 tons of carbon dioxide which causes global warming (the same amount is produced by 161 million trees).
- 10,000 tons of sulfur dioxide which causes acid rain that damages forests, lakes, and buildings

- 500 tons of small airborne particles that cause asthma and other lung diseases and cause haze
- 10,200 tons of nitrogen oxide which leads to the formation of ozone and smog and penetrates lungs
- 720 tons of carbon monoxide which causes headaches and exerts stress on people with heart disease
- 220 tons of hydrocarbons which form ozone
- 170 pounds of mercury (1/70<sup>th</sup> of a teaspoon deposited on a 25 acre lake can make the fish unsafe to eat)
- 225 pounds of arsenic which increases the cancer rate for those who drink the contaminated water
- lead and other heavy metals

In addition such a plant creates 125,000 tons of ash and 193,000 tons of sludge from the smokestack scrubber each year. (<http://www.ucsusa.org>) Coal is still the source of 51% of our energy and mainly is used to generate electricity in the U.S. today.

Natural gas, compressed natural gas, oil, gasoline, kerosene, diesel oil, airplane fuel, etc. are all big contributors to global warming and pollution.

**Ethanol** is made from plants. In Brazil, they make it from sugar cane stalks and it is much more efficient than the ethanol made from corn in the U.S. Brazil is now fueling all of its cars on ethanol. Advancements in biotechnology have reduced the production costs of ethanol by 50% over a ten year period and is expected to continue to fall. It now costs \$1.22/gallon to produce. Ethanol sells for about 60 cents more per gallon than gasoline. There is a significant reduction in carbon monoxide and hydrocarbon tailpipe emissions when ethanol is used. It is now blended into most gasoline, but it can be used exclusively in vehicles. Ethanol is considered a renewable fuel. Growing crops to produce ethanol helps to reduce carbon dioxide. (<http://www.upei.ca/>) However, I doubt that the cost of growing and harvesting the corn is included in this price.

Transportation is another contributor to global warming.

**Wind turbines** sit high atop towers, taking advantage of the stronger and less turbulent wind. A computer automatically controls each turbine and turns the rotor to face into the wind. The pitch of the blades adjust to suit the changes in the wind speed. Underground distribution lines take the converted electricity to the main substation where the voltage is stepped up and delivered to the electric grid. The cost of generating electricity with wind has dropped in the last 10 years from 30 cents to 3-6 cents/kilowatt hour. Generation of wind energy does not require any fuel. (<http://www.fplenergy.com>).

What's encouraging about Wind energy is that a growing number of energy companies and utilities now view wind power as an attractive business, and are expanding their operations in wind energy or considering moving into the market, which in 2005, created an estimated 10,000 new jobs nationwide.

Some interesting statistics are:

1. By 2020, 6% of the nation's electricity will come from wind
2. GE Energy reported wind revenue of more than \$2 billion in 2005 on the sale of 1,346 wind turbines worldwide, demonstrating a 400% increase in 4 years since it launched operations;

Oregon based Kettle Foods, maker of the nation's No. 1 selling natural potato chip, is blowing off conventional energy sources with renewable wind energy. The company

announced that starting this month it is purchasing wind energy credits to offset 100 percent of its electricity use in the U.S. By purchasing 8,750,000 kilowatt hours of renewable energy credits (REC) annually, Kettle Foods will prevent more than 12 million pounds of carbon dioxide pollution (CO<sub>2</sub>), the major contributing cause of global warming.

3. Any of us can actually find wind investments if we wanted;

UC/Davis has just built a pilot plant which produces **biogas** from grass clippings plus food scraps of 2000 restaurants. It has four large steel tanks for anaerobic digestion and a generator which produces methane. One ton of compost produces enough energy to run an average of 10 California homes. (<http://us.f831.mail.yahoo.com>) The hauling of waste is still a polluting factor, but one company is making these digesters to go into individual buildings and homes. This process reduces the methane coming out of landfills and compost facilities, although most of them in San Diego County now collect the methane directly to fuel their trucks.

**Solar energy** seems like a perfect answer for San Diego, although it is still more costly than fossil fuels because the panels are expensive. The silicon used to make the panels is in short supply now and the production of panels is well behind the demand for them. People who generate solar energy have times of the day where they produce more energy than they are using, so their electric meter runs backward.

Some interesting facts:

1. More than 1 million homes worldwide now get their electricity from solar
2. More than 99% of the world's energy comes from the sun
3. All the energy needs of the US could be satisfied with solar panels covering only a 100 mille x 100 mile area in the Nevada desert
4. Solar is growing on average more than 40% per year over the last eight years to retrofit an existing home with solar in a state with rebates frequently provides a return on investment greater than 10%-possibly the best investment in America today

In CA, regulators passed Solar initiative, largest solar energy policy ever enacted in the US and only second to Germany in terms of global solar policy. The goal is to put solar into 1,000,000 homes over next 11 years, and the state will offer rebates to those who go solar (starting at \$2.8 per watt and then decreasing by about 10% per year).

In addition, at the Federal level, there is a tax credit of up to \$2,000 if solar is installed .

**Nuclear energy** will be discussed at the League luncheon on November 28<sup>th</sup>. The energy used to create nuclear energy is greater than the energy it produces, but nuclear energy is considered clean. The problem is it takes fossil fuels to mine, process, and transport the raw materials. However, the nuclear waste is a very serious problem. San Diego Gas and Electric gets about 15% of its energy from the San Onofre Nuclear Generating Station. In the near future, major repairs need to be made to extend its life.

### **Geothermal**

Comparing costs:

Solar is 9-12 cents/kilowatt hour (2004)

Scrubbed coal is 3.5-4.5 cents/kilowatt hour (2004)

Gas is 2.5-4.5 cents/kilowatt hour (2004)

Geothermal is 4-14 cents/kilowatt hour (1999)

Hydropower is 7 cents/kilowatt hour (1999)

Nuclear is 19 cents/kilowatt hour (1999)

In coal and gas plants, fuel costs three to five times as much as capital costs, but in renewable fuel plants, the fuel is free. (<http://www.energyfinder.org>)

To date, economics has driven our choice of fuels. The economics of destroying our environment has not played much of a part, but it needs to be considered more. The choices are out there – are you willing to pay?

## **THE EFFECTS OF GLOBAL WARMING ON THE PLANET**

- 1) A decrease in the ozone layer which is causing a very slight average warming and more radiation from the sun. This affects the ecosystems and is forcing a migration toward the poles. It is also affecting crops, causing drought as well as more severe storms and related flooding - thus the economy of many nations.

To alleviate the problem, in 1987, the nations of the world banded together to draft the Montreal Protocol to phase out the production and use of CFCs. The 43 nations that signed the protocol agreed to freeze consumption and production of CFCs at 1986 levels by 1990, reduce them 20% by 1994, and reduce them another 30% by 1999. The alarming loss of ozone in Antarctica and worldwide continued into the 1990's, and additional amendments to further accelerate the CFC phase-out were adopted. With the exception of a very small number of internationally agreed essential uses, CFCs, halons, carbon tetrachloride, and methyl chloroform were all phased out by 1995 in developed countries (undeveloped countries have until 2010 to do so). The pesticide [methyl bromide](#), another significant ozone-depleting substance, was scheduled to be phased out in 2004 in developing countries, but a U.S.-led delaying effort led to a one-year extension until the end of 2005. At least 183 countries are now signatories on the Montreal Protocol.

The Montreal Protocol is working, and ozone depletion due to human effects is expected to start decreasing in the next 10 years. Observations show that levels of ozone depleting gases are at a maximum now and are beginning to decline. Provided the Montreal Protocol is followed, the Antarctic ozone hole is expected to disappear by 2050.

- 2) More frequent and bigger hurricanes/extreme heat/cold. Researchers report the number of Category 4 & 5 hurricanes, the strongest storms, which are often accompanied by huge storm surges, has increased by 80% in the last 30 years. In fact, in 2005, the Atlantic hurricane season included more hurricanes than ever before, and three were among the six strongest ever recorded.
- 3) Melting of ice caps, particularly at the north pole – create a rise in water levels of the oceans and the rivers. Usually sea levels rise between three and four millimeters a year, which would mean it would take at least 250 years for the seas to rise one meter. But this rate has doubled over the last century. In southern Greenland, the country's largest glacier, Jakobshavn Isbrae, has doubled its rate of slide to the sea between 1997 and 2003. This glacier alone has contributed 4% to the rise in world sea levels.

If no action is taken, the seas could be 10 feet higher in a mere 60 years (due to the ice sheets of Antarctica starting to collapse), which means that many coastal cities in the U.S., Europe, and Asia would no longer exist. 400 million people would immediately be impacted and the world map would no longer be recognizable.

However, even with a one meter rise in water would adversely affect 150+ million people mostly in third world countries (17.5% of Bangladesh would be submerged, 72 million in China, etc). Furthermore, 9% of rice production would be lost.

As a result of rising water, Hong Kong has built land reclamation projects up to 12 meter higher, and the Netherlands build up to a 10,000 year standard. Does anyone know if New Orleans has similar type rebuilding criteria?

What's also alarming are two recent NASA studies which reveal that the Arctic sea ice is melting in "winter" far faster than before. According to the first study, for last 25 years, Arctic sea ice has slowly diminished in winter by about 1.5% per decade. But in the last two years, the melting has occurred at rates 10 to 15 times faster. From 2004 to 2005, the amount of ice dropped 2.3%, and over the past years, it's declined by an additional 1.9%.

The second study found that the winter sea ice melt in one region shrunk about 40% in just the past two years. Another international study predicts that by 2100, all "summer" ice will disappear,

The effect of these studies is bad news for the ocean because this type of ice, when it melts in summer, provides a crucial breeding ground for plankton.

Polar bears are also suffering because with less ice, they are forced to swim sometimes up to 60 miles to an ice barge. As a result, visiting scientists have seen more dead and/or exhausted polar bears. According to the Canadian wildlife service, in 1980, the average weight of adult females in western Hudson Bay was 650 pounds. Their average weight in 2004 was just 507 pounds. Their numbers have also decreased by 250 since 1989. This will also adversely affect the indigenous people.

- 4) Similar to melting ice, melting Arctic permafrost is producing the colorless, odorless methane (which is 23 times more powerful than CO<sub>2</sub>) at five times faster than thought. Warming thaws the permafrost (mostly in Siberia), which is soil that has been continuously frozen for thousands of years. When methane was released 250 million years ago, scientists believed it killed 94% of all marine species known from fossil records, taking 100 million years to recover. Today, monitoring of the tundra has shown that the amount of time it is frozen in winter has been cut in half from 200 to 100 days. Already in Alaska's Kenai Peninsula, what were lakes and wetlands are giving way to woodlands.
- 5) Increased asthma and other diseases.
- 6) Limit ability to manage wildland fires. The Association for Fire Ecology advises that under future drought and high heat scenarios, fires may become larger more quickly and be more difficult to manage. Fire suppression costs may continue to increase, with decreasing effectiveness under extreme fire weather and fuel conditions. They are observing wildland fire conditions previously considered rare, such as extreme wildfire events (high heat release and severe impact to ecosystems, lengthened wildfire seasons, and large-scale wildfire in fire-sensitive ecosystems. For more information, google the sight, as they are holding a conference in San Diego this week.

- 7) Seafood stocks to disappear. You may recall last week's Tribune article in which Scientists predict the collapse of all commercial seafood stocks in the wild by mid-century. While overfishing and a deterioration of the marine habitats are two main reasons for this dire prediction, acidification of the ocean is the sleeping giant of global warming.

Since 1800, the oceans have absorbed 525 billion tons of carbon dioxide-about 25% of the amounts produced by humans. However, increasing amounts of CO<sub>2</sub> are entering the world's oceans every day-now at 22 million tons. As more CO<sub>2</sub> is absorbed by the ocean, it interacts with the seawater to form carbonic acid. Since it takes about 1500 years for the CO<sub>2</sub> to mix completely in the oceans, the oceans have grown more acidified (meaning their pH is lower), which in turn, decreases the availability of chemical building blocks called carbonate ions that many marine organisms require to make their calcium carbonate shells and skeletons. Many species of plankton (mussels, clams, scallops, sea urchins and starfish) as well as the coral reefs, which provide critical habitats for numerous species of fish, are therefore threatened.

- 8) Tropical rain forests will shrivel. Traditionally, rainforests are regarded as carbon sponges as they absorb and store atmospheric carbon. However, as the earth warms, the thick, lush, and sky reaching tropical rain forests will dry up, creating more open land mass. Furthermore, as these tropical trees die, they actually release more CO<sub>2</sub>, both through decomposition and fires that are more prevalent in dry climates.

### **WHAT'S BEING DONE TO MAKE US LESS DEPENDENT ON FOSSIL FUELS**

- 1) While extensive R & D continues in alternative fuels throughout the world via government, states, non-profits, one interesting research idea is "carbon sequestration". This refers to the provision of long term storage of carbon in either the terrestrial biosphere, underground or the ocean so that the buildup of CO<sub>2</sub> will reduce or slow. This would be done by maintaining or enhancing natural processes. For example, for carbon sequestration of the terrestrial biosphere would remove CO<sub>2</sub> from the atmosphere by vegetation and storage in biomass and soils, whereas sequestration of the oceans would involve fertilization of phytoplankton with nutrients and injecting CO<sub>2</sub> to ocean depths greater than 1000 meters, where it won't adversely affect the sea life.
- 2) The Kyoto Treaty still has not been signed by the United States. The Republican led federal government appears to be in denial about the cause of global warming, so many states and cities are taking the lead on a more local level. Rich countries are concerned that poor countries have no means to cut their emissions and then they can continue to underprice countries with a higher standard of living.  
FYI, though, the protocol is an agreement made under the UN Framework Convention on Climate Change in which 166 countries have signed (effective 16<sup>th</sup> Feb 2005) to reduce their emissions of CO<sub>2</sub> and five other gases. Industrialized countries will reduce their collective emissions of greenhouses gases by 5.2% compared to the year 1990 (but note that, compared to the emission levels which would be expected by 2010 without the protocol, this target represents a 29% cut) by 2012, although the actual cut per country varies. If a country fails to satisfy the emission requirement, it will be penalized by having its reduction targets decreased by 30% in the next period.

The reason the US has not signed the treaty is because the Bush administration believes that China, which is classified as a developing country, should also sign the agreement, since it is the second largest emitter of CO<sub>2</sub>, after the US (in 2003, it emitted 78% of what the US emitted). However, in total, other developing countries only account for 37% of greenhouse gas emission, but by 2050, their share is projected to increase to 55%.

Instead the US signed the Asia Pacific Partnership on Clean Development and Climate, a pact that allows those countries to set their goals for reducing greenhouse gas emissions individually, but with no enforcement action. The US has committed to reduce its carbon intensity by 18% by 2012. While supporters of the pact see it as complementing the Kyoto Protocol while being more flexible, critics have said that the pact will be ineffective without any enforcement measures.

It is also interesting to note that Australia also has not ratified the Kyoto protocol for similar reasons to the US, and Canada has advised that it will not be able to satisfy emission reductions.

- 3) In line with Kyoto, for some developed countries which have already complied with the rules, they can sell their "emission credits" to countries that are experiencing difficulty to comply.
- 4) Emission Trading is now done around the world. For example, the Emission- Trading Scheme adopted by Europe, which limits how much carbon dioxide producers can emit, allows companies to buy and sell emission credits. So if one company is allowed to emit, say \$1,000 of pollution, but only emits \$300, it can sell its \$700. Another example is an industrial company in Germany, which finances pig farmers in Mexico to make biogas from the manure. The German company gets credit for its pollution.
- 5) CA is the 10<sup>th</sup> largest emitter of CO<sub>2</sub> in the world. The California Global Warming Solutions Act of 2006 does little more than establish the goal of reducing the state's greenhouse gas emissions by 25% by 2020. The implementation of it has been left to companies, local governments, institutions, and individuals. If California took its 14 million cars off the road, it would only be half way toward this goal! (SDUT, 10/6/06)

However, the CA government also has taken two actions against automakers. In 2004, it adopted rules to require car makers to force cuts in tailpipe emissions. While automakers have effectively blocked those rules, they may now comply in light of a lawsuit against them. In late September, the CA government also filed suit against six of the world's largest automakers, charging that their vehicle emissions have contributed significantly to global warming and have harmed the resources, infrastructure and environmental health of the most populous state in the US. The government is seeking millions in damages. While a similar suit filed in NY was dismissed, it is on appeal.

- 6) The U.S. Mayors Climate Protection Agreement has now been signed by about 600 Mayors throughout the country. It requires reducing greenhouse emissions to 15% below 1990 levels by 2010 which San Diego is doing by capturing methane at landfills and sewage treatment plants. ). SD also has been taking measures to reduce global warming by using ultra-low sulfur diesel in some city vehicles as well as reducing their number. Garbage routes have been rerouted to reduce driving time/cut emissions which will save the taxpayers \$1 million. They have also installed solar panels.



Interesting to note though, that City services only contribute 3% of total greenhouse emissions generated in SD, so up to us to work on the rest.

- 7) In 2000, the California Air Resources Board adopted a diesel Risk Reduction Plan which will have stricter emissions standards for new diesel-fueled engines and vehicles, the replacement of older diesel engines with newer ones, low-sulfur diesel fuel, and emission controls on diesel engines. In 2004, they added regulations which prohibit idling large diesel vehicles for more than five minutes. (LWV Bay Area Monitor, August & September 2005)
- 8) The Sierra Club various cities and states, and political leaders are part of a nationwide coalition petitioning the US Supreme Court in a case that will decide if the EPA must regulate CO2 emissions, which they have not done thus far.

No doubt these groups feel confident after a 2004 Federal court rules that the US EPA must set standards to control storm water pollution (which is causing beach closings, waterborne disease, flooding contaminated drinking water and dead fish). from strip malls, subdivisions and other new developments.

Finally at the business level, while it's encouraging that measures are being undertaken to alleviate an environmentally catastrophic situation, governments also are cognizant of the negative economic impact imposing immediate reductions of pollution, etc can have on a company, and if many are affected, of triggering a depression. However, if the costs of complying will outstrip a company's profits, a company may be forced to close and lay off its employees. The challenge for a government thus, is to impose "reasonable" measures over a period of time which can both alleviate global warming as well as keep companies, and thus, the economy afloat.

### **WHAT YOU CAN DO**

- 1) Drive 55 mph or slower, be sure your tires are inflated, engine is running clean, and air conditioner is operating properly
- 2) Use public transportation, bike, walk
- 3) Buy a vehicle with better mileage that uses less gasoline (or is a hybrid); don't drive old cars.
- 4) Do not refuel on high ozone days – try to refuel after dark.
- 5) Switch to electric mowers and trimmers; get rid of gas powered equipment
- 6) Eat locally grown food
- 7) Limit dry cleaning – don't buy clothes that require it, if possible.
- 8) Try to avoid painting with oil based paint.
- 9) Use energy efficient appliances – even replace your old refrigerator – look for the star rating.
- 10) Put more insulation in your home.
- 11) Reduce consumption of electricity by turning off lights in unoccupied rooms, switching to fluorescent bulbs, unplugging appliances when they are not in use, lowering your heat and using less air conditioning, and using a clothes line instead of a dryer
- 12) Use small instant water heaters near each faucet rather than the large ones most of us have. You can also lower the temperature of the hot water in your heater.
- 13) Heat rooms you are using, not the whole house – use space heaters. The edenpure brand ([www.edenpure.com](http://www.edenpure.com)) boasts its advanced technology will reduce your energy costs by 50%

- 14) Plant more shade trees and protect our forests.
- 15) Create less waste – reduce what you purchase and recycle everything possible
- 16) Buy compact fluorescent (CFL's) bulbs which use 2/3's less energy than incandescent bulbs and last 10 times longer. While they will cost \$3 more than a regular bulb, they will save you \$30 in electricity costs over their lifetime and prevent more than 450 pounds of greenhouse emissions. Start by replacing bulbs in the rooms you use the most. See handout for how to dispose
- 17) Consider solar. A ballpark calculation is:
  - A) take you daily utility usage by dividing the kilowatt hours(kWh) used on an average month bill/30;
  - B) Divide that number by 5 (average # of peak sun hours in the US) and multiply by 1.43 to account for system losses
  - C) Multiply that number by \$9,000 (\$9/watt installed) for a ballpark cost
  - D) Offset by Federal and State tax credits (JE to add to this)
- 18) Learn more by getting involved-attend the Museum of Natural History lecture series