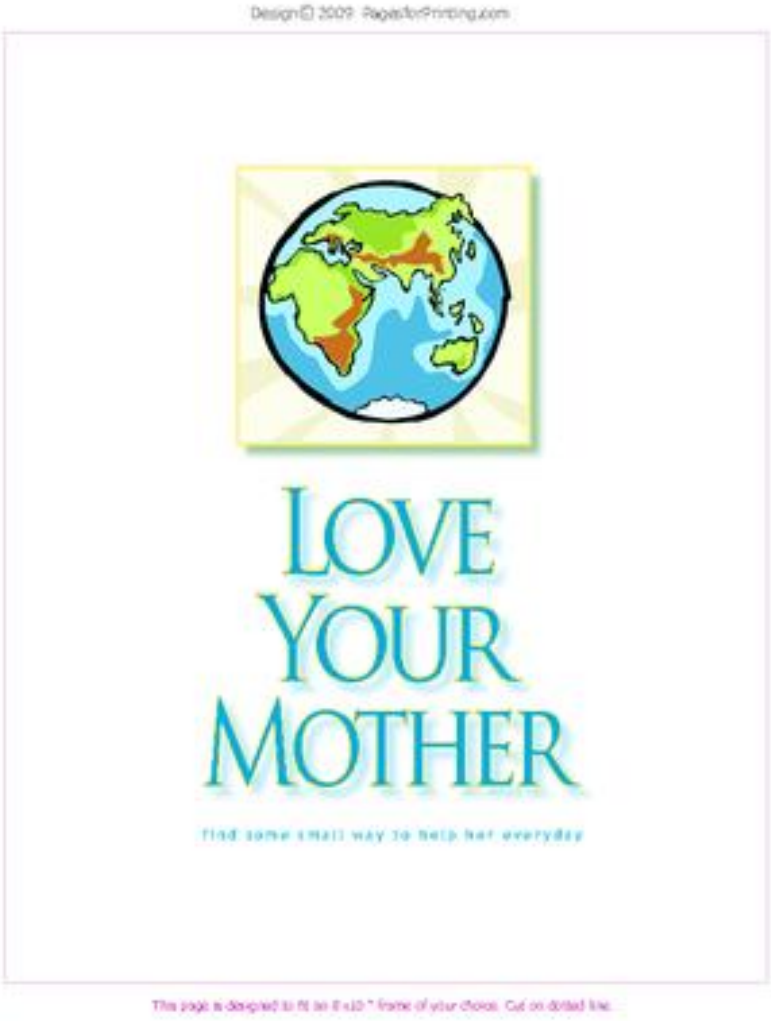
SRU Primer on Sustainability

and the

Call for Action to Avoid Catastrophic Climate Change

Why should “sustainability” be important to ME?

and other FAQ’s



A. Excerpt from the SRU Natural Resources Subcommittee of the President's Strategic Planning Committee:

"Sustainability is meeting the needs of the present without compromising the ability of future generations to meet their own needs."

Brundtland Commission, "Our Common Future, Report of the World Commission on Environment and Development." United Nations. 1987.

Trend Five: The world is reaching a point of diminishing returns regarding resource utilization.

Food, water, and energy. These are among the defining elements of survival on our planet. How well we manage these resources as well as the distribution to needed areas will determine our fate. Yet the world's rapidly growing population is outrunning the supply of these critical resources, while our use of fossil fuels threatens to change our climate and put millions at risk. Trends to consider as SRU prepares for this challenge include:

- Poor land management and the overuse of fertilizers are causing land degradation, soil erosion and desertification on a massive scale in agricultural areas from the Amazon Basin to the Yangtze River.
- By 2025, an estimated 3.5 billion people, or nearly half of the world's population, will face serious constraints on their capacity to meet water demands. Water scarcity and quality will be a prime determinant of expanding current food production. By 2020, India's demand for water will exceed all sources of supply.
- By 2025, OPEC will account for up to 50 percent of the world supply of oil. Skyrocketing demand—primarily in Asia—will drive this trend. The number of cars in China could rise from 12 million in 2004 to 500 million by 2050. In India, the number of cars could increase even faster, from 5 million to 600 million. The impact of this rise in consumption is startling in terms of potential geopolitical conflict and environmental consequences.
- Aggregate increases in other sources of energy will be overshadowed by the exponential consumption of coal, oil, and natural gas in the decades ahead.
- Current trends are not sustainable and resource availability and demand will impact political stability throughout the world.

B. FAQ's About Sustainability, Energy, and the Environment

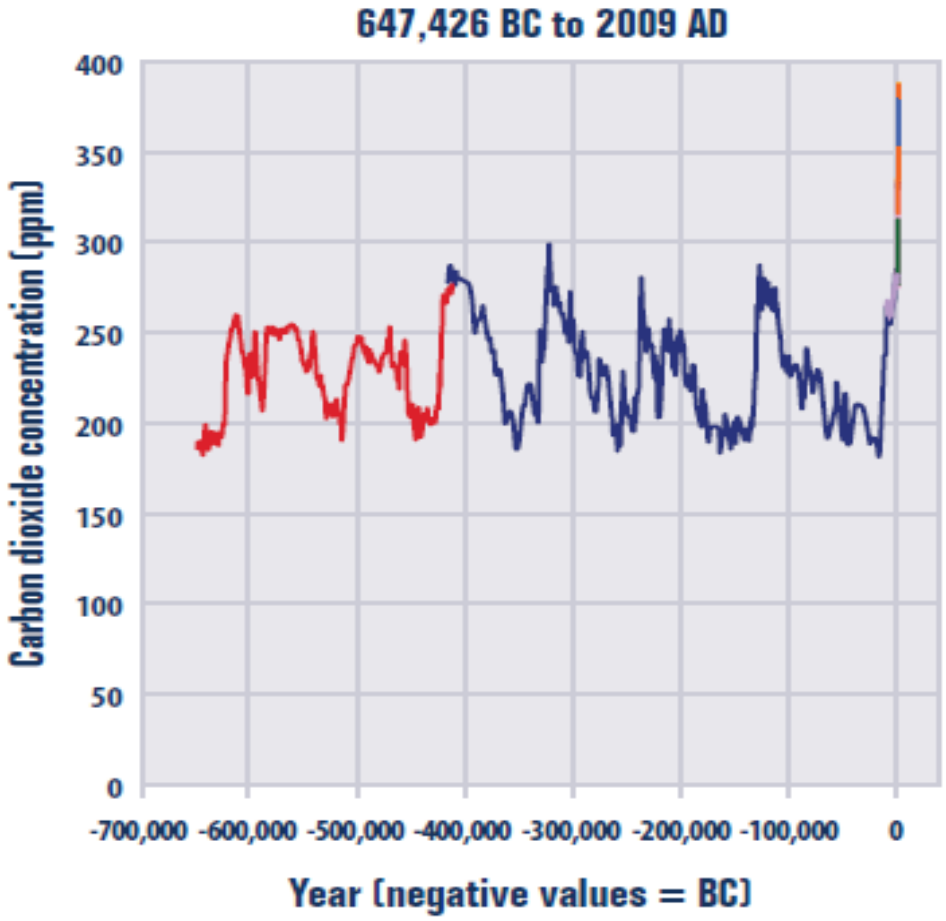
1. What are greenhouse gases?

Greenhouse gases ("GHG") are naturally present in the atmosphere and are also emitted by human activities. The primary greenhouse gases of concern that are directly emitted by human activities include carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. Greenhouse gases trap the Earth's heat that would otherwise escape from the atmosphere, and thus form the greenhouse effect that helps keep the Earth warm enough for life. However, human activities are intensifying the naturally occurring greenhouse effect by adding greenhouse gases to the atmosphere.

- Global atmospheric concentrations of carbon dioxide, methane, nitrous oxide, and certain manufactured greenhouse gases have all risen substantially in recent years.
- Before the industrial era began around 1780, carbon dioxide concentrations measured approximately 270–290 ppm. Concentrations have risen steadily since then, reaching 387 ppm in 2009—a 38 percent increase. Almost all of this increase is due to human activities.
- Since 1905, the concentration of methane in the atmosphere has roughly doubled. It is very likely that this increase is predominantly due to agriculture and fossil fuel use.
- Historical measurements show that the current global atmospheric concentrations of carbon dioxide and methane are unprecedented over the past 650,000 years, even after accounting for natural fluctuations.
- Over the past 100,000 years, concentrations of nitrous oxide in the atmosphere have rarely exceeded 280 ppb. Levels have risen steadily since the 1920s, however, reaching a new high of 323 ppb in 2009. This increase is primarily due to agriculture.

2. How do GHGs affect our climate?

Greenhouse gases, other pollutants (such as aerosols) and other human activities, such as land use changes that alter the reflectivity of the Earth's surface, can cause climatic warming and cooling effects. Natural causes also contribute to climate change, and climatic changes have occurred throughout the Earth's history. The concern now, however, is that the changes taking place in our atmosphere as a result of **the well-documented buildup of greenhouse gases due to human activities are changing the climate at a pace and in a way that threatens human health, society, and the natural environment.** Historical measurements show that the current levels of many greenhouse gases are higher than any seen in thousands of years, even after accounting for natural fluctuations. Further details can be found at: w***ww.epa.gov/climatechange/endangerment.html.***



Global Concentrations of CO_2 Over Time

3. What impacts can global warming and climate change have on our environment?

Increased greenhouse gas concentrations are very likely to raise the Earth's average temperature, influence precipitation and some storm patterns as well as raise sea levels (IPCC, 2007). The magnitude of these changes, however, is uncertain.

The amount and speed of future climate change will ultimately depend on:

- Whether greenhouse gases and aerosol concentrations increase, stay the same or decrease.
- How strongly features of the climate (e.g. temperature, precipitation and sea level) respond to changes in greenhouse gas and aerosol concentrations.

Scientists widely agree that global climate change is already causing major environmental effects, such as changes in the frequency and intensity of precipitation, droughts, heat waves and wildfires; rising sea level; water shortages in arid regions; new and larger pest outbreaks afflicting crops and forests; and expanding ranges for tropical pathogens that cause human illness.

4. Have we actually seen climatic changes that back up the theories of climate change?

While natural forces combine with the GHG emissions caused by human activity to affect climate change, recent trends support the scientific community's concern that significant increases in GHG concentrations over the past few decades are indeed already causing climate changes, such as:

- **Increasing Tropical Cyclone Intensity -** The intensity of tropical storms in the Atlantic Ocean, Caribbean, and Gulf of Mexico did not exhibit a strong long-term trend for much of the 20th century, but has risen noticeably over the past 20 years. Six of the 10 most active hurricane seasons have occurred since the mid-1990s. This increase is closely related to variations in sea surface temperature in the tropical Atlantic.

- **Increasing Sea Levels** - When averaged over all the world's oceans, sea level has increased at a rate of roughly six-tenths of an inch per decade since 1870. The rate of increase has accelerated in recent years to more than an inch per decade. Along the U.S. coastline, sea level has risen the most relative to the land along the Mid-Atlantic coast and parts of the Gulf Coast. Sea level has decreased relative to the land in parts of Alaska and the Northwest.

- **Heavy Precipitation** - In recent years, a higher percentage of precipitation in the United States has come in the form of intense single-day events. **Eight of the top 10 years for extreme one-day precipitation events have occurred since 1990.** The occurrence of abnormally high annual precipitation totals has also increased.

- **Melting Glaciers** - Glaciers in the United States and around the world have generally shrunk since the 1960s, and the rate at which glaciers are melting appears to have accelerated over the last decade. Overall, **glaciers worldwide have lost more than 2,000 cubic miles of water since 1960, which has contributed to the observed rise in sea level.**

- **Reduced Snow and Ice** - Part of the Arctic Ocean stays frozen year-round. The area covered by ice is typically smallest in September, after the summer melting season**.** September 2007 had the least ice of any year on record, followed by 2008 and 2009. **The extent of Arctic sea ice in 2009 was 24 percent below the 1979 to 2000 historical average.**

- **Increasing Ocean Acidity** - The ocean has become more acidic over the past 20 years, and studies suggest that the ocean is substantially more acidic now than it was a few centuries ago. Rising acidity is associated with increased levels of carbon dioxide dissolved in the water. **Changes in acidity can affect sensitive organisms such as corals.**

5. What's a "climatic tipping point"?

U.S. presidential science adviser John Holdren recently told a congressional committee: "Climate scientists worry about 'tipping points' ... thresholds beyond which a small additional increase in average temperature or some associated climate variable results in major changes to the affected system."

Among the tipping points Holdren listed were: the complete disappearance of Arctic sea ice in summer, leading to drastic changes in ocean circulation and climate patterns across the whole Northern Hemisphere; acceleration of ice loss from the Greenland and Antarctic ice sheets, driving rates of sea-level increase to 6 feet or more per century; and ocean acidification from carbon dioxide absorption, causing massive disruption in ocean food webs.

A 2010 University of California, Davis, study by a top ecological forecaster says it is harder than experts thought to predict when sudden shifts in Earth's natural systems will occur -- a worrisome finding for scientists trying to identify the tipping points that could push climate change into an irreparable global disaster. "Many scientists are looking for the warning signs that herald sudden changes in natural systems, in hopes of forestalling those changes, or improving our preparations for them," said UC Davis theoretical ecologist Alan

Hastings. "**Our new study found, unfortunately, that regime shifts with potentially large consequences can happen without warning - systems can 'tip' precipitously**."This means that some effects of global climate change on ecosystems can be seen only once the effects are dramatic. **By that point returning the system to a desirable state will be difficult, if not impossible."**

6. What's the "350 ppm by 2100 Plan"?

Current CO2 levels are about 392 parts per million. Scientists predict that **if changes aren't made soon – if we can't reduce CO2 levels to 350 ppm by the year 2100 - it will be impossible to avoid some of the worst effects of global warming**, including rising ocean levels, more extreme weather events, water shortages, accelerated species loss and disrupted economies and food supplies.The **350-ppm-by-2100 plan** can be achieved by reducing global greenhouse gas pollution to 42 percent below 1990 levels by 2020. It also requires dramatic reductions in fossil fuel emissions; carbon sequestration; and an end to large-scale deforestation.

7. What's the connection between human activities, energy use and GHG Emissions?

Worldwide, emissions of greenhouse gases from human activities increased by 26 percent from 1990 to 2005. Emissions of carbon dioxide, which account for nearly three-fourths of the total, increased by 31 percent over this period. Like in the United States, **the majority of the world's emissions are associated with energy use.**

In the United States, greenhouse gas emissions caused by human activities increased by 14 percent from 1990 to 2008. Carbon dioxide accounts for most of the nation's emissions and most of this increase. **Electricity generation is the largest source of greenhouse gas emissions in the United States, followed by transportation.** Carbon dioxide concentrations in the atmosphere will increase throughout the 21st century according to all IPCC scenarios. Without dramatic action, the scenarios project CO2 concentrations ranging from 535 to 983 parts per million (ppm) by 2100, which is 41 to 158 percent higher than current levels (IPCC, 2007).

Key Points :

• Global atmospheric concentrations of carbon dioxide, methane, nitrous oxide, and certain manufactured greenhouse gases have all risen substantially in recent years.

• Before the industrial era began around 1780, carbon dioxide concentrations measured approximately 270 - 290 ppm. Concentrations have risen steadily since then, reaching **387 ppm** in 2009 - a 38 percent increase. Almost all of this increase is due to human activities.

• Since 1905, the concentration of methane in the atmosphere has roughly doubled. It is very likely that this increase is predominantly due to agriculture and fossil fuel use.

• Historical measurements show that the current global atmospheric concentrations of carbon dioxide and methane are unprecedented over the past 650,000 years, even after accounting for natural fluctuations.

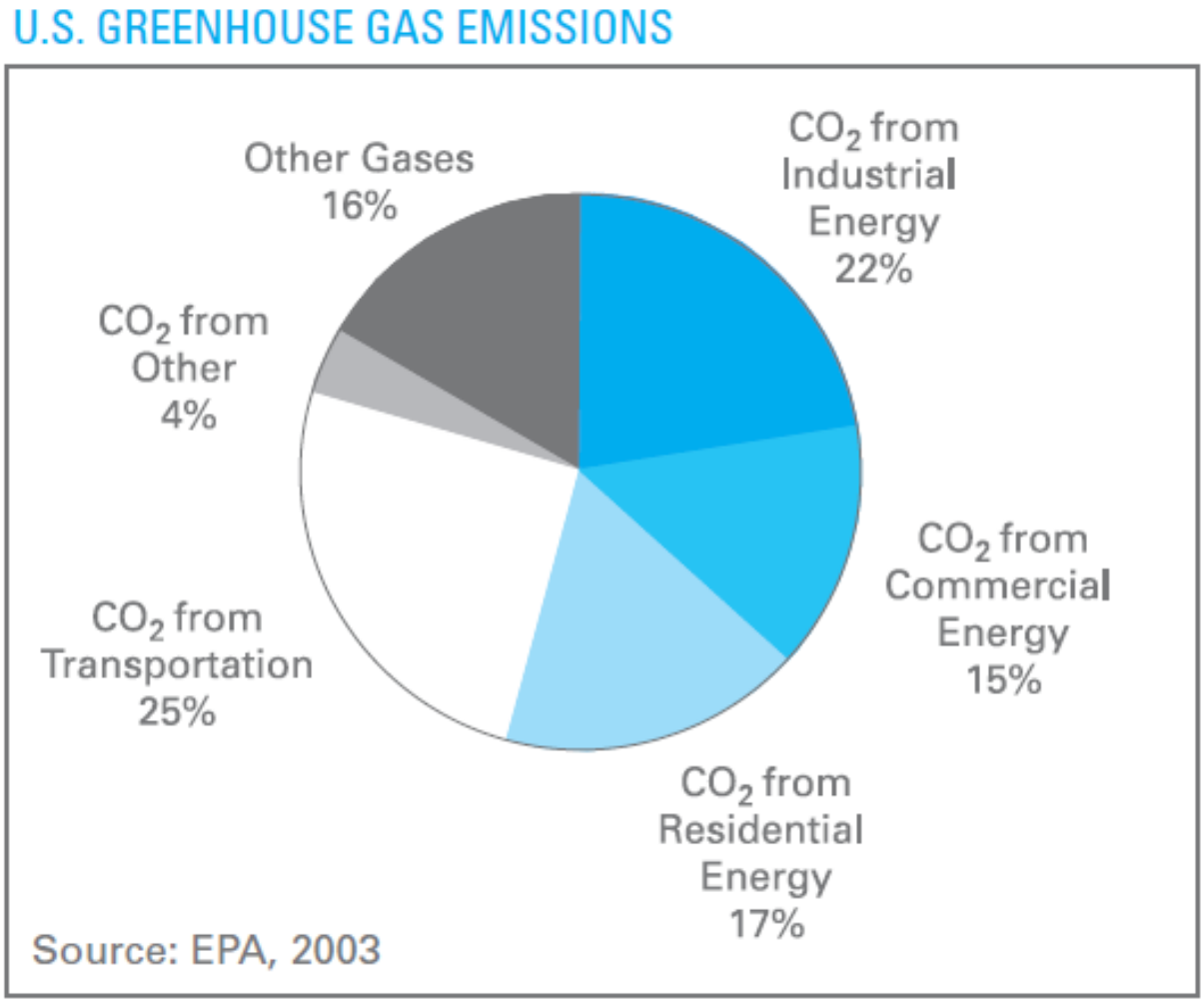
• Over the past 100,000 years, concentrations of nitrous oxide in the atmosphere have rarely exceeded 280 ppb. Levels have risen steadily since the 1920s, however, reaching a new high of 323 ppb in 2009. This increase is primarily due to agriculture.

8. What is "Climate Forcing"?

Climate or “radiative” forcing is a way to measure how substances such as greenhouse gases affect the amount of energy that is absorbed by the atmosphere. An increase in radiative forcing leads to warming while a decrease in forcing produces cooling. **From 1990 to 2008, the radiative forcing of all the greenhouse gases in the Earth’s atmosphere increased by about 26 percent. The rise in carbon dioxide concentrations accounts for approximately 80 percent of this increase.**

9. What are the main sources of CO2 Emissions?

As shown below, transportation, residential and commercial energy use account for almost 60% of total U.S. CO2 emissions:



10. How would driving a more efficient car or making use of carpooling, help?

Difference between a car that gets 20 vs. one that gets 40 MPG:

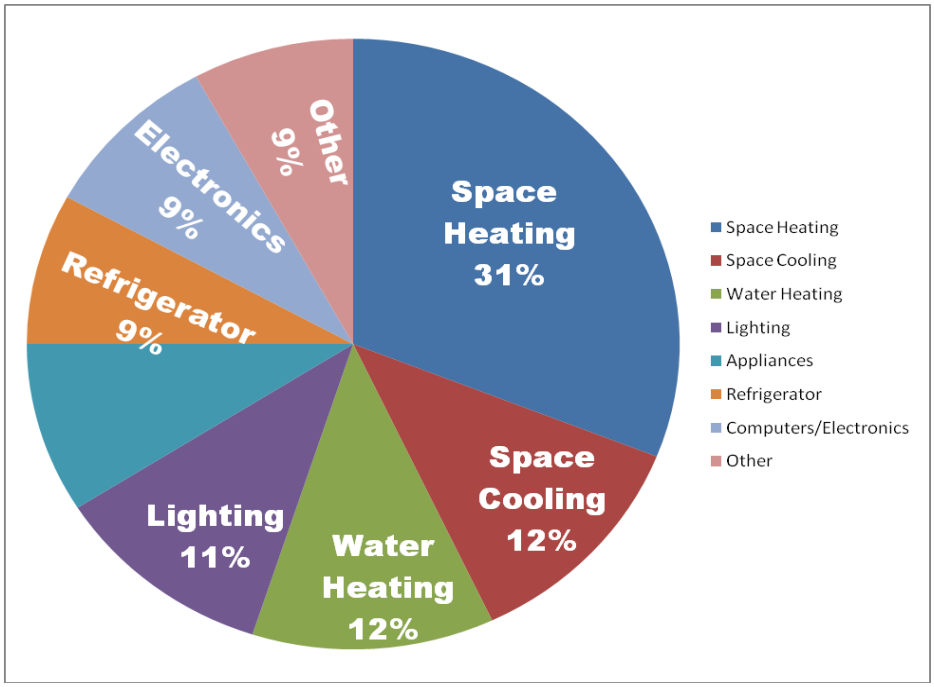
- The average American drives 12,400 miles per year – about 35 miles per day
- A 20 MPG improvement = 310 gallons gas/year saved = 6,000 # CO2 reduction
- Improving gas mileage by 20 MPG for one year (or reducing miles driven per year in a 20 MPG car by 50%) is equivalent to:
  - Planting 71 tree seedlings that grow for 10 years
  - Carbon sequestered by 0.588 acres of pine trees
  - Preserving 0.026 acres of forest
  - Recycling 0.928 tons of waste

Resource: There's a cool website where you can calculate CO2 emissions equivalencies like those shown above for the actions you take to reduce energy and transportation emissions:

http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results

11. How is energy used in the average U.S. home?

The average home (of 2,000 square feet of space) consumes about 168 million Btus of energy each year (that's the equivalent of burning 168 million kitchen matches), and pays approximately $1,900 in energy bills each year.



12. What metrics can we use to evaluate CO2 emissions caused by our use of household energy?

100 # CO2 emitted per Millon Btu (MCF) natural gas burned

- A typical U.S. home uses about 52 million Btus of natural gas for space heating, causing 5,200 # of CO2 emissions each year.

204 # CO2 are emitted per Million BTU coal burned

- If SRU's campus heating system used 100% coal as its fuel source, it would consume approximately 200,000 Million Btus of coal and emit 40,800,000 million # of CO2 (18,511 metric tons at 2204 # per metric ton) each year.

2 # of CO2 emitted per Kwh electricity used from coal-fired electrical generation plant

- Most of Pennsylvania's electricity is produced by coal-fired generating plants

- 1 Kwh of electricity = one 100w light bulb burning for 10 hours
- The average household uses 12,733 Kwh of lighting energy each year = 25,466 # CO2 (11.5 metric tons CO2) emissions each year
- SRU's campus consumes approx. 30 million Kwh/year, causing 60 million # CO2 emissions (27,223 metric tons) per year – even after retrofitting much of the campus with new, energy efficient lamps!

18 # CO2/gallon gas used

- Driving an SUV w/ 17 MPG for one year (12,400 miles) = 13,129 # C02 emissions, which would require the carbon uptake of 66 mature trees to offset!

Resource to calculate your carbon footprint:
http://www.epa.gov/climatechange/emissions/ind_calculator.html

13. What's "carbon sequestration"?

Carbon sequestration is the process of absorbing CO2 from the earth's atmosphere. This can occur naturally, (as in trees absorbing CO2 to produce oxygen) or artificially (through systems designed to absorb carbon emissions from large coal-fired utility plants – still a prohibitively expensive and unproved methodology).

Carbon sequestration metrics:

- **A medium growth coniferous tree seedling growing 10 years will absorb 86 # of CO2, or an average of 2.3 # (0.039 tons) of CO2**
- **One mature tree (40 – 50 ft. high, 30 – 40 yrs old) will absorb 200# CO2 over its lifetime**
- **One acre of mature forest preserved (rather than being converted to pasture or crop land) will absorb 231,420 # (105 metric tons) of CO2 over its lifetime**
- **One metric ton of waste recycled offsets 6,546 # (2.97 metric tons) of CO2**
    - SRU recycles approx. 500 tons of waste each year – that's the equivalent of preserving 14 acres of forest land each year!

14. Why is recycling so important?

Manufacturing using recycled materials often takes less energy that it would take to manufacture using the original raw materials. For example:

- Aluminum from recycled materials saves 95 percent of the energy
- Steel from recycled steel saves 60 percent of the energy
- Newspapers from recycled paper save 40 percent of the energy
- Plastics from recycled plastic save 70 percent of the energy
- Glass from recycled glass saves 40 percent of the energy

If we translate that energy savings into actual household energy, many hours of energy are gained, and many environmental benefits are obtained. For example:

- A ton of paper manufactured from recycled paper can save about 4,000 kilowatt hours of energy, which is equal to $280 at $0.07/Kwh, avoids 8,000 # of CO2 emissions from a coal-fired electric generation plant, and avoids approximately 6,546 # of CO2 emissions from landfills!
- One glass bottle or jar manufactured from recycled glass saves enough energy to power a 100 watt light bulb for four hours.
- One pound of steel manufactured from recycled steel can power a 60-watt light bulb for over a day.

- One year of aluminum production from recycled aluminum saves enough energy to power 18 million households for a year.

Resource on Recycling Metrics: http://greenliving.lovetoknow.com/United_States_Recycling_Statistics

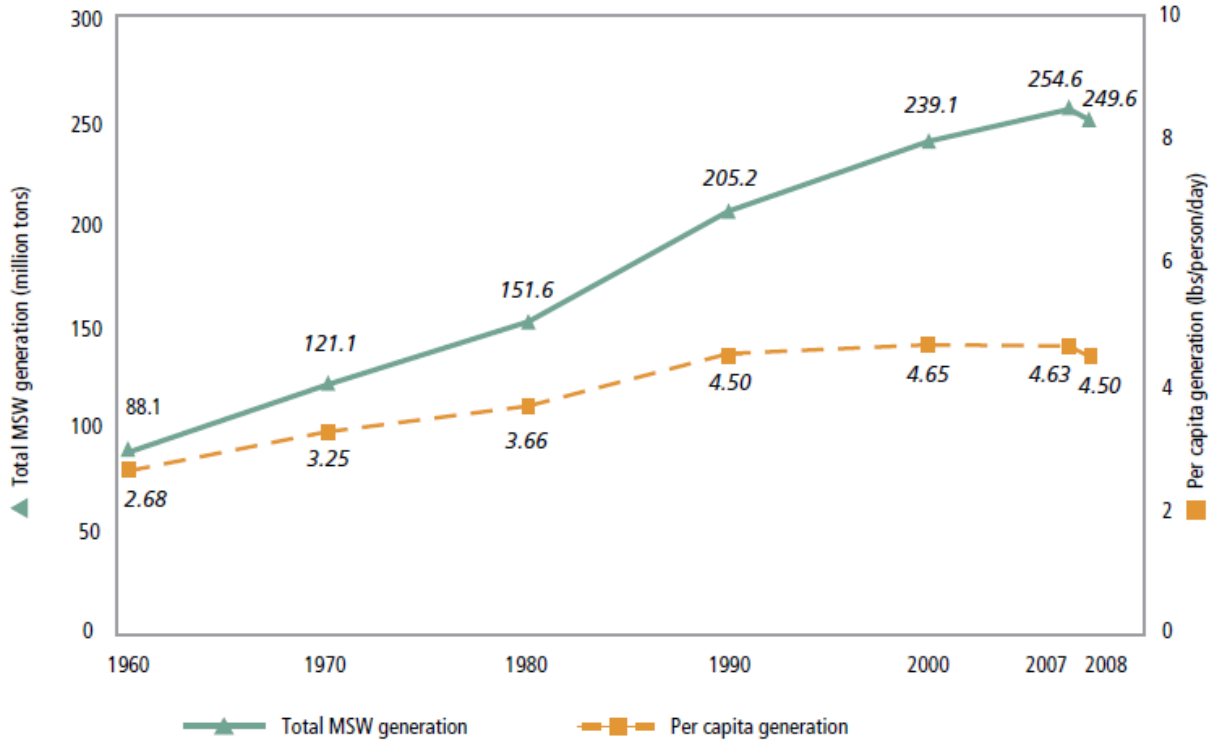
15. OK, so how much waste is actually generated in the U.S. each year?

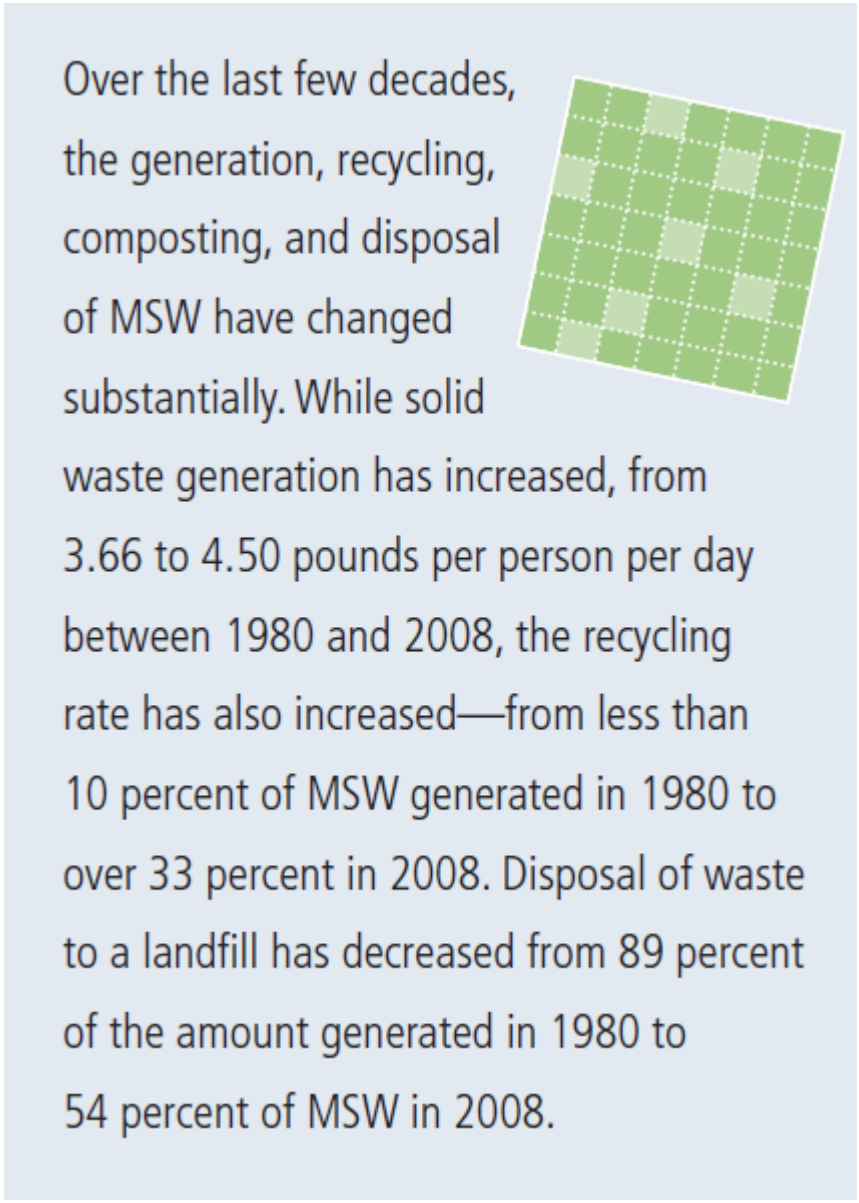
Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2008

The U.S. Environmental Protection Agency (EPA) has collected and reported data on the generation and disposal of waste in the United States for more than 30 years. We use this information to measure the success of waste reduction and recycling programs across the country. These facts and figures are current through calendar year 2008.

In 2008, Americans generated about 250 million tons of trash and recycled and composted 83 million tons of this material, equivalent to a 33.2 percent recycling rate* (see Figure 1 and Figure 2). On average, we recycled and composted 1.5 pounds of our individual waste generation of 4.5 pounds per person per day.

Figure 1. MSW Generation Rates, 1960 to 2008





17. Can you give me a few practical examples of the total benefits my personal behavior can achieve?

Example 1: Replace two 60 watt incandescent lights with two 13w CFL lamps:

Even if the lights are on only 3 hours/day, savings total 100 Kwh/year, saving $7/year at $0.07/Kwh, and avoiding 206 # of CO2 emissions from a coal burning utility plant – equivalent to planting 2 seedings that grow for 10 years, recycling 48 # of waste, or preserving 0.0007 acres of forest.

Example 2: Reduce SRU campus thermostat settings by 2F in winter:

This would save an estimated $37,386 per year in space heating costs, reduce CO2 emissions by 378 tons each year – equivalent to planting 8,793 seedlings that grow for 10 years, recycling 127 tons of waste, or preserving 3.3 acres of forest.

18. So… what can *I* do to reduce my energy use and CO2 emissions?

Many universities today are asking their staff and students to sign an energy pledge and select a few personal, everyday actions to make a part of their lifestyle. Such personal lifestyle choices or behavioral changes might include:

- ☐ Power down my computer and printer at night
- ☐ Plug my home electronics, such as TVs and DVD players, into power strips; turn the power strips off when the equipment is not in use (TVs and DVDs in standby mode still use several watts of power).
- ☐ Turn off my lights when I'll be out of the room for more than 10 minutes
- ☐ Unplug my cell phone charger or appliances that draw "vampire" power
- ☐ Avoid the use of space heaters and instead wear a sweater or hoody
- ☐ Print or copy on both sides of paper instead of one
- ☐ Reduce the temperature setting on my thermostat by 2 degrees F in winter
- ☐ Reduce car use by carpooling and/or walking or bicycling to school, between classes
- ☐ Wait till I have a full load of clothes before washing/drying clothes
- ☐ Not waste food (it requires a lot of chemicals and vehicle fuels used to grow and transport it – buy local when possible)
- ☐ Recycle religiously
- ☐ Replace at least 2 incandescent bulbs with free CFL lamps
- ☐ Lower the thermostat on my hot water heater to 120F
- ☐ Air dry dishes instead of using my dishwasher's drying cycle.
- ☐ Drive sensibly - Aggressive driving (speeding, rapid acceleration and braking) wastes gasoline.
- ☐ Use cloth grocery bags to reduce the use of paper and plastic bags

Resource - visit **http://www.energysavers.gov/** for more energy-saving ideas.

19. Are there other reasons why sustainability should be important to me?

Yes! Being knowledgeable about sustainability:

- **Improves employment opportunities in both mainstream companies and in the growing "green technologies" industry.**
- **Improves basic life skills (e.g., managing household energy costs and developing healthy lifestyles) that can be carried over into future work and home environments**
- **Helps build a better environment for future children and grandchildren**