Climate Master Handbook

A GUIDE TO SHRINKING YOUR CLIMATE FOOTPRINT
AND MOTIVATING OTHERS TO DO THE SAME

Special thanks to the Eugene Water and Electric Board Partners in Education Grant for making this handbook possible.

RESOURCE INNOVATIONS

CLI
CLIMATE LEADERSHIP INITIATIVE
INSTITUTE FOR A SUSTAINABLE ENVIRONMENT
UNIVERSITY OF OREGON
http://climlead.uoregon.edu

UNIVERSITY OF OREGON

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The goal of the Climate Master program is to increase understanding among individuals and households about the causes of and solutions to climate change and to encourage and achieve reductions of personal and household greenhouse gas (GHG) emissions.

What Is a Climate Master?

Climate masters participate in thirty hours of free training on climate-change science and action strategies for reducing personal GHG emissions. The training topics include identifying and reducing embodied emissions as well as emission reduction in transportation and food choices, home energy use, and yard, consumption, and waste practices.

Volunteer Commitment

In exchange for the training, climate masters will volunteer for at least thirty hours within six months from the start of their course, sharing the information they have learned and supporting behaviors that reduce GHG emissions. Climate masters will receive their certification upon completion of their thirty hours of volunteer time. Those who do not complete their volunteer work must pay $240 for materials and instruction.

Fulfilling the Commitment

Our staff will work with volunteers directly to set up appropriate, fulfilling, and enjoyable opportunities to share their skills and knowledge. All volunteer work must be preapproved by the volunteer coordinator or it will not count toward qualifying hours. The following choices are acceptable options for fulfilling your obligation.

1. Work as a household GHG emissions consultant

We encourage volunteers to fulfill their volunteer obligation by working directly with households. This could take the form of a one-time household climate consultation or ongoing assistance. Climate masters will share tailored emission-reduction strategies with those households and ask participants to make changes they believe are possible for their household.

We will schedule consultations for you with people who contact us. We also ask that you to set up five to ten of your own consultations with people you know. When you schedule your own consultations, please use our materials and return commitment forms and surveys to us.

2. Tabling at events

The public is hungry for information on what they can do in their own lives to reduce their greenhouse-gas emissions. When we table at events, we help people calculate their carbon footprint, provide information on reducing emissions, and encourage people to sign up for household consultations, our list serve, or the next Climate Master class.

3. Other activities identified or approved by the volunteer coordinator

Other volunteer opportunities include public speaking, writing or editing materials, special events, and other opportunities suggested or approved by the volunteer coordinator. We are also open to your suggestions for ways to fulfill the volunteer commitment. Again, we prefer that most participants work directly with households, but we can discuss alternatives you may find more appropriate.

Reporting Volunteer Hours

We require that participants track their hours and turn in a monthly time sheet (available at the back of the handbook and online).

In order to assess the effectiveness of the Climate Master program, we need to know what and how much our volunteers are doing in the community. If you are not completing and reporting your volunteer hours, we cannot continue this program. Please share your outreach efforts with us and help make this program a success!

Class Information

Please ask questions if you are unclear on a topic. We ask that you avoid using instruction time by debating issues, expounding on your beliefs, or describing your knowledge of the subject to the class and the instructors. Other students will prefer to hear what the instructors have to share during their presentation time. Classes begin promptly at 6 p.m. and run until 8:45 p.m.

CONTEXT: INTRODUCTION TO CLIMATE MASTER

This handbook is intended for participants in the Climate Master training program. It is designed to provide a basic level of knowledge for each of the topic areas covered. At the end of each section you will find local resources and supplementary activities to deepen your understanding of the topic as it relates to your own life and to help you reduce your personal greenhouse-gas emissions.

The Climate Leadership Initiative developed a highly successful model for educating citizens about climate change and engaging them in activities in their household and community to help resolve the issue. That model, initiated as a research project, includes two primary components: the Climate Master train-the-trainer course and the household climate consultations conducted by trained climate masters.

Most of today's strategies to reduce greenhouse gas (GHG) emissions focus on large sources such as power plants, industrial facilities, and vehicles, with the goal of achieving the greatest results from initial efforts. Households, however, are the ultimate end-users of most energy production via home heating, cooling, appliances, food, travel, and embedded energy in products that households purchase. Therefore, households, directly or indirectly, produce significant amounts of GHG emissions. Yet the general public's understanding of climate change remains low and few people think they personally can do much about the problem.

The Climate Leadership Initiative discovered that a community-based approach can effectively reduce GHG emissions. To date, the program has resulted in average GHG emission reductions of more than 4,000 pounds per participant, increases in regular use of alternative transportation, energy-efficient purchasing, and reduced use of disposable items, among other climate-positive actions.

CLI aims to disseminate the model to communities across the region and nation, providing training, materials, ongoing technical assistance, and monitoring, with the goal of developing sustainable programs. Individuals benefit from cost savings, an increased sense of well-being, empowerment, and good health (some participants say the program changed their life). Communities benefit from reduced greenhouse-gas emissions, support for climate-positive technology and policy, increased volunteerism for climate change and energy efficiency, and leadership training, as a diverse swath of community members join around a uniting theme: acting locally to curb global climate change.

Visit the Climate Leadership Initiative website at www.climateleadership.org.

CLIMATE MASTER SAMPLE SYLLABUS

First Class: Course Introduction & Introduction to Climate Change

Topics

- Objectives and expectations of the Climate Master program
- Getting to know other participants and your lab partner
- Completion of paperwork
- Overview of climate change science

Reading

- Read handbook section one on climate change

Second Class: Home Energy

Topics

- Our local energy portfolio and the regional power grid
- Reducing energy use in home and water heating, lighting, and appliances

Reading

- Read handbook section two on home energy

First Field Trip: Consultation Techniques & Training

Topics

- Working with people in their home

Reading

- Read and prepare to answer the questions using the home energy consultation sheet
- Read handbook section nine on consultations

Third Class: Transportation

Topics

- Local options: bus, employer pass programs, carpools, vanpools, bicycling
- Using a car wisely: driving tips, alternative vehicles, biofuels

Reading

- Read handbook section three on transportation

Fourth Class: Supporting Behavior Change

Topics

- The stages of the change process
- Techniques for supporting change and when they are most useful

Reading

- Read the handout on behavior change

Second Field Trip: Alternative Building and Urban Sites

Topics

- Embodied emissions
- Recycling and precycling
- Energy in buildings and building materials
- Green building
- Conserving energy and reducing emissions at urban home sites

Reading

- Read handbook section four on green building

Fifth Class: Renewable Energy and Waste & Consumption, Part I

Topics

- Renewable energy
- Emissions from consumption and waste

Reading

- Read handbook section five on renewable energy

Sixth Class: Waste & Consumption, Part 2

Topics

- E-waste
- Voluntary simplicity

Reading

- Read handbook section seven on consumption and waste

Seventh Class: Supporting Change: Listening, Interviewing & Volunteering

Topics

- Listening and interviewing skills – motivational interviewing
- Volunteering – models and dreams

Reading:

- Read handout about listening and interviewing

Eighth Class: Yard and Garden

Topics

- Low-emissions yard care
- Home gardens
- Composting – hot, cold and with the help of worms

Preparation

- Read handbook section six on yard emissions

Ninth Class: Food Emissions & Carbon Offsets

Topics

- Food emissions along the supply chain
- Offsetting carbon emissions

Reading

- Read handbook section eight on food
- Read handbook section ten on offsets

Tenth Class: Graduation

Topics

Presentations

Graduation

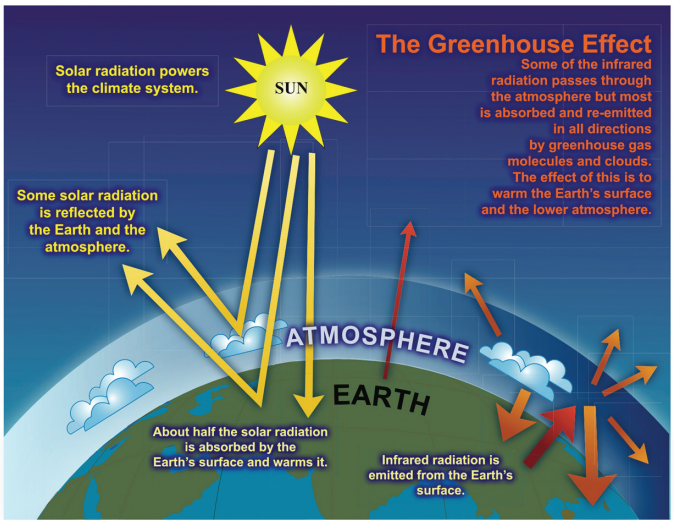
SECTION ONE: CLIMATE CHANGE 101

Key Learning Points

- Greenhouse gases
- Greenhouse effect
- Sources of carbon dioxide, methane, nitrous oxide
- Forcing, feedback, delays
- Climate change impacts and the role of humans
- Climate versus weather
- Scientific proof
- Preparation and mitigation

The materials in this chapter provide a broad overview of climate change, focusing primarily on causes and impacts. While the scientific understanding of climate change is improving so rapidly and encompasses so many fields of research that it's difficult for even climate-change professionals to stay up to date, it's important that climate masters understand the general concepts involved in climate science and know where to go for more information.

Figure 1-1. Greenhouse Effect



Greenhouse gases in the atmosphere absorb and radiate heat back into our atmosphere.

Source: Intergovernmental Panel on Climate Change Working Group I, "The Physical Science Basis," 2007. www.ipcc.ch/graphics/gr-ar4-wg1.htm.

The basics

The earth remains habitable in part thanks to gases in the atmosphere that trap a portion of the sun's energy. These are called greenhouse gases because of their ability to absorb heat, much like the windshield of a car baking in the sun will retain and radiate heat inside the vehicle. With too few of these gases, our planet would be too cold to inhabit. But recent human activity has led to a marked increase in atmospheric greenhouse gases. Scientists now recognize these gases as pollutants that are destabilizing our climate, with already apparent and potentially severe consequences.

Since 1750 and the onset of the industrial revolution, concentrations of carbon dioxide (CO_2), nitrous oxide (N_2O) and methane (NH_4) have increased significantly (by approximately 36 percent, 18 percent, and 148 percent, respectively) in the atmosphere as a result of human activity.[1] Increases in carbon dioxide are due primarily to the burning of fossil fuels and to changes in land use, such as deforestation. Agriculture is largely responsible for increases in nitrous oxide (fertilizer use) and methane (animal husbandry). Nitrous oxide is also released from fossil fuel burning and methane is also emitted from natural gas distribution and landfills.[2] Global concentrations of all three of these greenhouse gases, measured in parts per million (ppm), now far exceed preindustrial values, as determined from ice cores spanning many thousands of years. The atmospheric concentration of carbon dioxide, the most important greenhouse gas released by human activity, now exceeds by far the natural range over the last 650,000 years (that natural range is 180–300 ppm; June 2008 levels reached 383.9 ppm.).[3]

The bottom line

Perhaps the most important outcomes of the 2007 Intergovernmental Panel on Climate Change (IPCC) report[4] are the declarations that the evidence is now "unequivocal" that the Earth's atmosphere and oceans are warming, and that it is "very likely" (greater than 90 percent likelihood) that most of the increase in global-average temperatures since 1950 can be attributed to human-caused emissions of heat-trapping gases. (Note: Science does not employ the concept of "proof." Proof is a mathematical term. Science uses a "balance of evidence" approach to determine the likelihood of an event.) The report also states that greenhouse-gas emissions must peak by 2015 and decrease by 80 to 90 percent by 2050 in order to avoid dramatic temperature increases and the severe economic, social, and environmental

impacts that would accompany such increases. According to the IPCC, making this shift requires action within the next two to three years at all levels of society.

Evidence of warming

In part we know that the climate is warming because of direct observation of increased average air and ocean temperatures and widespread melting of snow and ice, alongside rising global-average sea levels. Eleven of the last twelve years rank among the twelve warmest since 1850 with average global temperatures up since the beginning of the industrial age. [5] The average temperature of the global ocean has increased to depths exceeding 9,800 feet, and the ocean has been absorbing more than 80 percent of the heat added to the climate system. This warming causes sea water to expand, contributing to sea level rise.

Other observations include changes in Arctic temperatures and ice cover, widespread changes in precipitation amounts, shifts in wind patterns, and changes in ocean salinity. Finally, observations show increases in the incidence of extreme weather including droughts, heavy precipitation, heat waves, and the intensity of hurricanes. Figure 1-2 shows a graph of the recent increases in global temperature and global sea level alongside the decrease in snow cover in the Northern Hemisphere. For more details on observed changes, see the IPCC Summary for Policy Makers.[6]

Projections of the future

For the next two decades, models project a global warming of about 0.36°F per decade, continuing a documented warming trend of about the same magnitude since 1990. The mid-range of global-average surface warming expected during the twenty-first century falls between 3.2°F and 7.2°F, while the full range for the century is 2°F to 11.5°F. According to the IPCC, global-average sea levels are projected to rise between 7 inches and 23 inches, a narrower range than prior estimates. These estimates exclude some factors, including meltwater from the Greenland and Antarctic ice sheets, for which changes cannot be forecast based on current knowledge. However, an increasing number of scientists are very concerned that accelerated rates of melting will greatly elevate sea level and lead to other global climatic changes. If James Hansen, director of the NASA Goddard Institute of Space Studies, is correct and greenhouse -gas emissions are already above the level that can trigger severe climate change, the sea level could rise by several meters within this century.

Implications for Oregon and Washington

IPCC Findings Specific to Western North America

- Greatest warming is expected at high northern latitudes
- Snow cover (and snow-water equivalency) is projected to contract
- Snow cover is projected to melt earlier, leading to higher spring flows and lower late-summer flows
- Extreme weather (heat waves, drought, and heavy precipitation events) are expected to increase
- Increases in total precipitation are very likely at high (northern) latitudes
- Ocean pH is expected to decline (a phenomenon known as acidification)

It's getting warmer, on average, and it's getting warmer faster. Models project a warmer climate for the Pacific Northwest during the twenty-first century, with temperatures increasing at a rate of 0.5°F per decade (slightly higher than the global-average warming) at least through 2050. This rate is two and one-half times faster than the warming observed in this region during the twentieth century.

Changes in precipitation appear less certain than changes in temperature. Most of the scenarios project little change to the overall amount of precipitation by mid-century. However, the models do show a little less summer precipitation and a little more winter precipitation. Because of warmer winter temperatures, we are likely to see more of that precipitation fall as rain and less as snow during winter months, especially at lower elevations.

Sea-level rise will affect coastal Oregon and Washington, but the effects are expected to be gradual over the next several decades, and they will vary due to tectonic and other vertical land motions that can accentuate, or offset, changes in sea level depending on location. The greatest impact in Oregon is likely to be from Florence northward to Astoria, where the land is subsiding.

Climate Leadership Initiative research on forest fires estimates that, compared to an "average year" during the twentieth century, an average year in the 2020s could feature a 50 percent increase in the number of acres burned, and an average year in the 2040s is projected to feature a 100 percent increase in the number of acres burned.[6] Fires are likely to become the destructive force in our area that hurricanes are in the Southeast.

Climate and Weather

From the Oregon Governor's Advisory Group on Global Warming, "Primer on Global Warming"

We all confuse the two words in everyday speech, usually with no dire effect. But for purposes of dealing with climate change, the distinctions are crucial.

Weather is changeable day by day. Cool, wet Augusts are not unknown, nor are 70-degree days in February. Local, transient phenomena produce local, transient weather effects. Can the planet truly be warming if we're having a damp and dreary summer?

Yes, because climate is "weather" averaged over time. Western Oregon's climate typically consists of cool, wet winters that build snowpack in the mountains, showery springs that last through the Rose Festival in June, and dry, warm to occasionally hot summers that end about mid-October. Eastern Oregon is colder in winter and hotter in summer, while the coast is the reverse due to climate effects of the ocean and mountains.

There are larger temporal climate effects, too. Most of us recognize that an El Niño disturbance will result in drier-than-normal weather over the year, while a La Niña will be wetter than usual. More expansively, there is a switch (known as the Pacific decadal oscillation) that seems to flip over every twenty to thirty years, going from a drier-than-usual climate to a wetter-than-usual one.

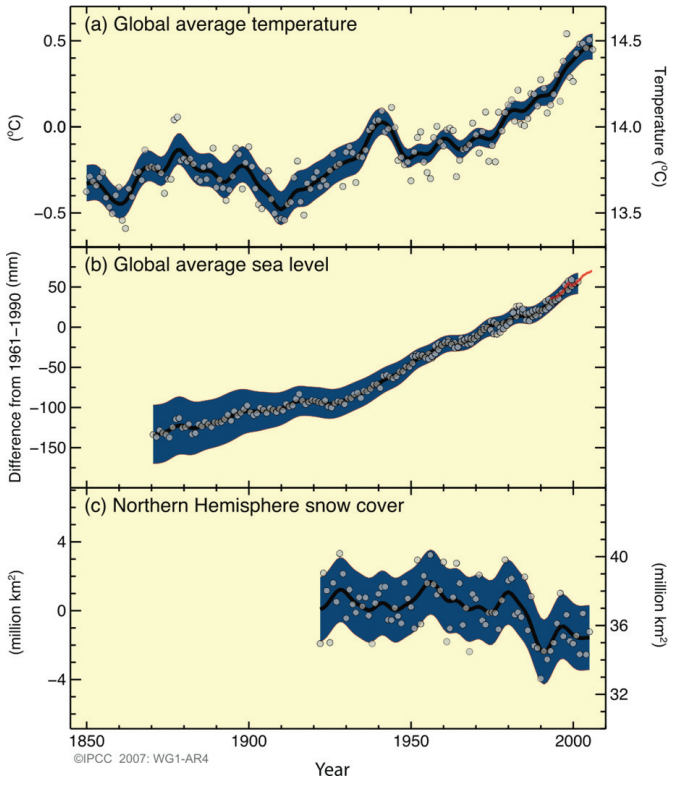
None of these tells us if it's going to rain this weekend. That's weather.

Global warming is a climate effect, a rise in average temperatures, a background effect with which shorter-term climate effects interact to produce weather. A hot year will tend to be hotter and a cool year, not as cool. A La Niña might produce more intense rain in April and less moisture in August than it would have, absent the effects of climate change. Global warming will have—is likely already having—such weather effects. Some of these are predictable: overall warmer weather year-round, less snowpack, melting glaciers, more extreme storms, and so on. Some are far harder to predict. Will it rain more or less? Will that precipitation come on the same timetable as now or will the pattern shift?

We can't use today's weather to judge in what ways climate change is already affecting us. We can look at global-average effects and effects observed over the passage of years to see where the disturbing patterns of climate change are coming into focus.

Figure 1-2. Observed Physical Change

Observed changes in (a) global-average surface temperature; (b) global-average sea level and (c) Northern Hemisphere snow cover for March–April. All differences are relative to corresponding averages for the period 1961–90. Smoothed curves represent decadal averaged values while circles show yearly values. The shaded areas are the uncertainty intervals estimated from a comprehensive analysis of known uncertainties (a and b) and from the time series (c).



Source: Intergovernmental Panel on Climate Change Working Group I, "The Physical Science Basis," 2007. www.ipcc.ch/graphics/gr-ar4-wg1.htm.

The most severe initial impacts are likely to affect the Southwest, expected to receive less rainfall and experience more warming. The snow season is expected to shorten, and total snow cover is expected to shrink. Effects on the Pacific Northwest, subject to regional factors including El Niño and ocean circulation phenomena, carry higher uncertainty.

Conclusion

All told, global climate change may be the greatest existing threat to humankind and the ecosystems we and all other organisms depend on for life. We have changed the global climate and are now beginning to observe the consequences. Some of the changes will be erratic and unpredictable, but we must prepare for the projected and the unexpected. Our other duty, and the focus of the Climate Master course, is working to slow and reverse the trend of warming by decreasing human-produced greenhouse-gas emissions. This action is referred to as mitigation.

One key point not often emphasized in mitigation is the role of individuals, as opposed to industry or the transportation sector, in the emission of greenhouse gases. Emission sources are often broken down into sectors including transportation and energy production, as well as industrial, residential, and commercial energy use. Other important sources are deforestation, changes in land use, and landfills. However, the very creation of these categories blurs the fact that individuals like you are at the root of all of these emissions. After all, there would be no transportation, energy production, industry, or commerce if it were not for our human needs and desires. Trees are cut down to build our homes, to make paper, and to clear land for agriculture—which provides food for humans and our livestock. By the same token, if we are responsible for these emissions, then we, too, have a responsibility and the power to influence the reduction of these greenhouse-gas emissions.

Tactics for reducing emissions vary from place to place and person to person. Sources of greenhouse gases diverge between communities based on land use, whether people are using hydropower or burning coal for energy, the energy and resource intensity of local industry, and other factors. On top of that, individuals have different emissions profiles based on their individual transportation patterns, their home energy use, their diet, their consumption of material goods, and how they care for their yard (if they have a yard).

While the details may seem confusing, at the heart of the matter we must decrease our burning of fossil fuels and reduce our emissions from agriculture and deforestation. The Climate Master course is designed to provide you with tools to decrease the emissions you are responsible for and to motivate, educate, and inspire others to do the same. Congratulations for taking the step of joining this course!

Additional resources

Climate Leadership Initiative: Economic and greenhouse gas assessments: www.climateleadership.org

Intergovernmental Panel on Climate Change (IPCC), 2007. *Fourth Assessment Report*: www.ipcc.ch

Climate Crisis Coalition: Climate change news feed www.climatecrisiscoalition.org

University of Washington Climate Impacts Group: Interdisciplinary research on climate change impacts on the Pacific Northwest: www.cses.washington.edu/cig

Real Climate: Climate change science blog: www.realclimate.org

Environmental Protection Agency: *Glossary of Climate Change Terms:* www.epa.gov/climatechange/glossary.html

Q & A for Climate Skeptics: Answers to the Most Frequently Stated Concerns (edited by the Climate Leadership Initiative): climlead.uoregon.edu/publicationspress/ Q%26A%20for%20Climate%20Skeptics.pdf

Sample Assignment *(to be announced in class)*

Visit an online carbon calculator (such as the Climate Trust's www.carboncounter.org) to assess your personal greenhouse-gas emissions.

SECTION TWO: HOME ENERGY

Key Learning Points

- Local energy portfolio
- Typical division of home energy use (e.g., space and water heating, appliances)
- Behavioral changes to reduce emissions and save money
- Changes to energy sources, equipment, and appliances to reduce emissions
- Renewable Energy Credits (RECs) or "green tags"

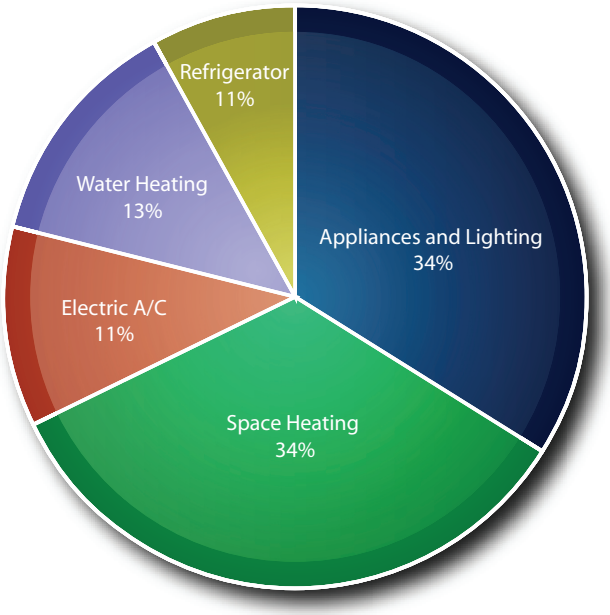
This chapter begins an exploration of the sources of our home emissions and the range of actions we can take to reduce those emissions. The materials cover energy basics, energy use, "green tags," and resources for reducing home energy use.

It is difficult to identify the percentage of our personal emissions that come from the energy used in our home, as many are difficult to quantify. For example, if one attempts to include in our personal climate footprint emissions such as those related to our food consumption (excluded by most online and community emissions calculators), then the relative standing of home energy use drops. Home-energy emissions are also highly dependent on what combination of electricity, natural gas, heating oil, and other fuels a household uses, as well as the local energy portfolio.

Typical home emissions

Figure 2-1. Typical Energy Use for U.S. Households

Heating accounts for the biggest chunk of a typical utility bill.
Source: U.S. Department of Energy, Energy Efficiency and Renewable Energy, based on 2005 Building Energy Data Book. www1.eere.energy.gov/consumer/tips/appliances.html.



We can, however, identify where energy-related emissions come from within most homes: space heating and cooling typically take the cake, constituting about 45 percent of home energy use. All the heating and cooling systems in the United States emit a combined 150 million tons of carbon dioxide annually.[1]

Appliances and lighting follow with a combined 34 percent (with the majority used by appliances). The refrigerator alone uses 8 percent of household energy; more energy than any other appliance in the house. Water heating typically comes in at around 13 percent. Although these percentages vary from household to household, these numbers give us a good idea of where to start when looking for ways to reduce energy use and energy-related emissions. Another clue to a household's energy use comes from an obvious place: the utilities. So how does this residential-energy use fit into the bigger picture of local emissions and what does all this energy contribute in terms of greenhouse gases?

Key Terms

Kilowatt hour: A kilowatt hour, or kWh, is 1,000 watt hours, which is the amount of energy used powering a one-kilowatt load for an hour. To put it another way, if you turn on ten 100-watt light bulbs for one hour, it will use up one kilowatt hour of electricity.

Megawatt hour: A megawatt hour, or MWh, is 1,000 kilowatt-hours.

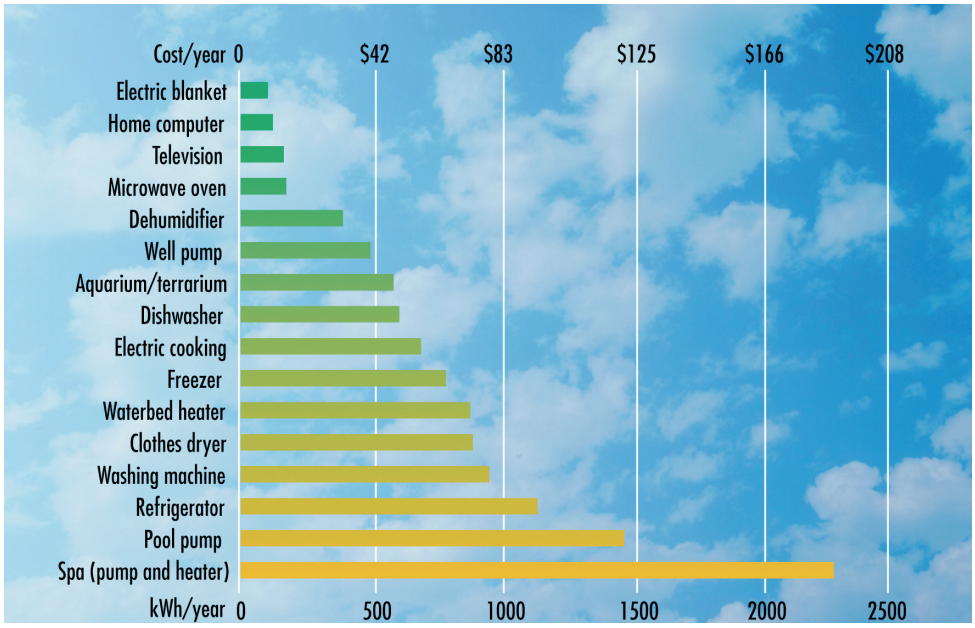
British Thermal Unit (BTU): The quantity of heat required to raise the temperature of one pound of water by 1°F at a constant pressure of one atmosphere.

Therm: A unit of heat equal to 100,000 British thermal units or 1,000 calories.

Short ton: 2,000 lbs. **Long ton**: 2,240 lbs.

Figure 2-2. Average Annual Appliance Use

This figure excludes space and water heating. A refrigerator uses about five times the energy of the average television. New Energy Star–rated refrigerators use 40 percent less energy than their conventional counterpart sold in 2001, Source: U.S. Department of Energy, Energy Efficiency and Renewable Energy, "Energy Savers." www1.eere.energy.gov/consumer/tips/appliances.html



Broader impact

There are many simple changes we can make to cut our home emissions, many of which also will save us money. Moreover, reducing electricity use even in communities with low-emission power frees extra "clean" energy for other users on the regional grid. For example, Oregon's electric system is part of a grid that extends throughout the Pacific Northwest, Canada, and California. Utilities buy and sell electricity on a quarterly and even a daily basis.

Specifically, a household in Eugene, Oregon, where the utilities use a good deal of emissions-free hydropower, that starts turning off their lights when they leave a room suddenly reduces their utility's need to provide power. The hydropower is already being generated; it's cheaper than the fossil fuels being burned for the regional system mix, so the natural gas power plants will ease their production to save money. This means that even these "low-emissions" customers can make a big difference by saving energy at home.

Regardless of the climate impact, many of the changes that individuals can make to reduce home energy use will also save them money previously wasted on unused heat, appliances, and lights. What follows is an overview of some strategies for reducing energy use and emissions in the home.

Heating and Cooling

The amount of energy used for heating and cooling a home is a function of four primary factors: 1) the desired temperature of the home, 2) the amount of time the house needs to be kept at that temperature, 3) the amount of space being heated or cooled, and 4) the efficiency of the heating or cooling system. [2] Follow these steps to improve efficiency in each of these areas.

Figure 2-3. Average Annual Energy Consumption

Aluminum smelter	300 aMW
Paper mill	110 aMW
Steel mill	46 aMW
Average home	.01 aMW
Food processor	2-3 aMW
Office building	1-5 aMW
Elementary school	4 aMW
Large hospital	5-10 aMW

Average annual energy consumption for the average household, industry, and community assets such as schools and hospitals. Energy consumed is measured in average megawatts (aMW). Source: Oregon Department of Energy, "Energy Use in Oregon," 2003.

Temperature

Heating: Keep your house at 67 degrees or less. Each degree over 67 adds 3 percent to the heating portion of your utility bill.

Air conditioning: Keep your house at 78 degrees or higher for energy-saving benefits. Each degree lower adds 3 percent to your cooling bill, while each degree higher will save you 3 percent.

Don't place lamps, TV sets, or other heat sources near your air-conditioning thermostat. The thermostat senses heat from these appliances, which can cause the air conditioner to run longer than necessary.

Digital thermostats are more accurate than nondigital ones. To ensure your nondigital thermostat is accurate, calibrate it

Local Info

According to the Eugene Water and Electric Board (EWEB), the average residential use for their customers is 1,000 kWh a month, or 12,000 kWh a year. The average residential natural gas customer in western Washington and Oregon uses 685 therms of natural gas annually.

According to the City of Eugene's Greenhouse Gas Emission Inventory, the residential sector accounted for 22 percent of total city emissions in 2005. This amounts to approximately 200,000 short tons of carbon dioxide equivalent.[4] This percentage only accounts for electricity and natural gas used in residences, and does not account for the emissions embodied by food or material goods, or for residential transportation. The other sectors the city considered are transportation (51 percent), commercial (17 percent), industrial (10 percent), and waste (0 percent, because of methane capture at the landfill; the city inventory does not account, however, for emissions related to goods we consume that are manufactured and transported outside the city).

According to the same report, most of the residential emissions in Eugene come from natural gas (83 percent), with 15 percent from electricity, and 1 percent or less from wood and light fuel oil. That doesn't mean that natural gas is providing four-fifths of the energy in the area, but rather that natural gas has more associated greenhouse-gas emissions in the area than does electricity. Since 1980, electricity has accounted for about 20 percent of all power use in the area. Natural gas is predicted to increase in use because of the relatively low cost.[3]

The same does not hold for the rest of the country or even the rest of the state. EWEB's energy mix relies heavily on hydropower, which does not emit greenhouse gases and produces about 0.1 pounds of carbon dioxide (CO_2) per kWh. In contrast, other electricity providers in the state use more coal and natural gas, producing an average of 1 pound of CO_2 per kWh.

Based on anecdotal information from the planning department, we know that for the last ten years most new subdivisions are uniformly moving to natural gas, which implies that residential natural gas use will increase over time. These results imply that the greatest opportunities for reducing emissions in residential-energy use will derive from fuel switching from natural gas to biogas or electricity (but only if EWEB can maintain such a low-emission energy portfolio in the face of increased demand) and conservation in households using natural gas.

by placing a simple digital wall thermometer close by and see if they match.

Don't set your thermostat at a higher or lower temperature than normal in the hope of heating or cooling your house faster: it will not heat or cool your home any faster and could result in unnecessary expense. Remember, thermostats are a switch, not an accelerator.

Is "off" really off? Some older thermostats don't turn the heat off completely.

Time (How many hours out of twenty-four do you heat?)
Save money by allowing your home to get cooler when you're asleep or away from home. For example, set your thermostat back 10 to 15 degrees for eight hours to cut your annual heating bill by 5 to 15 percent. That's an annual saving of up to 1 percent for each degree of a setback that lasts more than eight hours, according to the U.S. Department of Energy.

Longer and larger setbacks save more energy, while shorter and smaller setbacks save less.

Space (How big of a space do you heat? How is your space set up?)
Room-by-room or "zoned" heating systems allow you to heat only those areas of the house that you use most, saving energy and money. For unused areas, heat them only enough to prevent moisture, mold and condensation. (Note: many whole-house furnace systems are not designed to shut off individual room vents because it decreases overall efficiency and may damage the system.)

Furniture: Arrange your furniture to take advantage of the heating and cooling source. Move couches, bookshelves, and beds away from vents. Face your sofa toward the vent for maximum comfort, or at least tuck your favorite spot into a warm space in the room.

Fans: Spread heated air more effectively without greatly increasing your power use by installing a ceiling fan, or simply use a floor fan pointed diagonally and upward across the room. This will make the room feel more comfortable without turning up the heat. Fans are much more energy-efficient for cooling than air conditioners.

Curtains: Close curtains to insulate your home more effectively (at night in the winter, during the day in the summer). If your heat source is under a window, tie curtains back to the wall at the bottom to ensure heat enters your room, not the window space. You can tuck the curtains behind a string pinned to each side of the window for a simple fix.

Maintenance and Efficiency (Maintaining your heating and cooling systems not only provides savings and increased comfort, but also helps ensure your safety)

Cleaning: Dust and vacuum thermostats, heating coils, fins,

and fan blades regularly to maximize efficiency.

Ducts: Seal and insulate ducts.

Filters: Change or clean your air filters every one to two months.

Regular service: Service your heat pump once every year. Furnaces should be serviced at least once every three years.

Winter air conditioning: Cover your wall unit in the winter, and remove window units during the colder months to reduce heat loss.

Woodstoves vs. fireplaces: Woodstoves are at least five times more efficient than fireplaces. Again, use a fan to distribute the heat.

Fireplace: Your fireplace is one of the most inefficient heat sources you can possibly use, since it sucks warm air from your entire house up the chimney. A few tips to reduce energy losses:

- Keep your fireplace damper closed unless a fire is going. Keeping the damper open is the same as keeping a window open in the winter.
- Install and use tempered glass doors.
- When you use the fireplace, reduce heat loss by opening dampers in the bottom of the firebox (if provided) or open the nearest window slightly—approximately one inch—and close doors leading into the room. The fire needs oxygen to burn, and will suck cold air through all the cracks in your house to get it.
- In addition, lower the thermostat setting to between 50° and 55°F when using the fireplace.

Wood heating: Don't use wood heat and other heating systems at the same time. A roaring fire can exhaust as much as 24,000 cubic feet of air per hour to the outside, which must be replaced by cold air coming into the house from outside. Your other heating system must warm up this air, which is then exhausted through your chimney.

Building "Envelope" Improvements (Warm air leaking into your home during the summer and out of your home during the winter can waste a lot of your energy dollars and send your emissions through the roof)

One of the quickest dollar-saving tasks you can do is caulk, seal, and weather strip all seams, cracks, and openings to the outside (plumbing, cable, telephone, wiring, outlets). You can use just about anything—cloth, paper, insulation—and you can save as much as 10 percent on your heating and cooling bill by reducing the air leaks in your home.

Use plastic storm windows or invest in double- or triple-paned glass or permanent storm windows. They can cut your heat loss in half.

Insulate your walls, ceiling, and floor.

Close your fireplace damper.

Check exhaust fans when not in use to make sure the dampers are closed. If the damper is open, your fan is now a chimney.

Garage: Using a light bulb or bulbs instead of a portable heater can reduce energy costs and help keep moisture problems at bay. A portable heater can cost twenty dollars a month to operate (1,500 watts for five hours per day average).

Outbuildings and RVs: Energy consumption can be as much as a small house. Follow the same efficiency practices you would at home.

Appliances

Buying a new appliance? Look for the Energy Star label and an energy use guide when buying. Check with your local utility for rebates and incentives, state and federal tax credits, and manufacturer's rebates.

Refrigerator (energy hog of the appliance world)

- Set your refrigerator temperature to 38–42 degrees. Measure by placing a thermom-eter in a glass of water.
- Locate it away from heat sources and away from items or walls that could block airflow to the coils.
- Cleaning: Unplug the refrigerator at least once a year to clean the dust off the coils (often located underneath, or on the back in older models). When the coils are dirty, the refrigerator works harder and runs longer.
- Gaskets: Clean the gasket and the face of the cabinet. Test for fit by placing a dollar bill between the gasket and the cabinet. If you can slide it out with the door closed, you need to replace the gasket.
- Cool food before you place it in the refrigerator. Immersion in cold water is a safe option for rapid cooling.
- Keep it full—even if only with water jugs. Mass stays cold more easily than does air.
- Unplug and get rid of your second refrigerator. By eliminating an older, energy-inefficient refrigerator or freezer, you can save ten to twenty dollars a month.
- Refrigerators have become dramatically more efficient

over the last thirty years. Find the energy usage of your refrigerator by visiting the Home Energy website at www.homeenergy.org/consumerinfo/refrigeration2refmods.php and typing in the model number.

- When buying a new refrigerator, reduce emissions by buying only the size you need and choosing a model with the freezer on top or underneath.

Cooking

- Use small appliances when suitable, e.g., a toaster oven or microwave instead of a stove.
- Preheat the oven only for five minutes or less.
- Use glass pans; you can set your oven 25 degrees lower than normal.
- Use a timer and don't peek! Opening the door drops the temperature by 25 degrees and wastes power.
- Turn off your oven fifteen minutes before the end of baking time.
- Cook more than one thing at a time.
- Use the self-clean function sparingly (if at all).
- Cover pots and pans with lids to use a third less energy.
- Use pots and pans with flat bottoms and tight lids, and use the same size burner as the pan.
- Don't use foil on the burner pans or in the oven. It decreases efficiency and the life of the elements.

Freezer

- Set the thermostat between zero and 10 degrees for product, not air temperature. Test by packing a thermometer tightly in frozen foods.
- Keep the freezer full. Use water jugs if needed.

Dishwasher

Use the "air dry" selection or turn the dishwasher off and open the door at the end of the wash cycle. This can save 40 percent of the energy cost.

Wash full loads only.

Washer

- Wash clothes in cold or warm water. Using cold water reduces your washer's energy use by 75 percent. Always rinse in cold water.
- Try to wash full loads only and don't overload. If you don't have a full load, adjust the water level to fit the size of your load.
- Minimize the amount of detergent used. The washer's motor works harder with more suds.

Dryer

- Using a dryer costs approximately twenty-five cents a load (using 2,500 watts for thirty minutes). You can save energy and money if you follow these tips:
- Clean the lint trap. This can reduce energy use by 5–10 percent as it improves airflow.
- Replace the vent cover with a louver-type cover. This will increase airflow by 20–50 percent.
- Don't overload the dryer.
- Sort loads by clothing weight and material type. For instance, dry towels and heavier cottons in a separate load from lighter-weight clothes.
- Use an extra spin cycle in your washingmachine to get as much water out as possible.
- Use the sun and line-dry your clothes, which is recommended by clothing manufacturers for some fabrics.

Television and other electronic devices

- Unplug small appliances and electronic devices, or put them on a switched outlet or power strip that you can click off when not in use. Many TVs, DVD players, computer peripherals, and chargers use electricity even when they are switched off. For instance, the "phantom load" from a TV alone can easily cost $100 a year, even if it's never turned on. Anything with a light or a clock is using energy.
- Don't keep your TV on just for "noise."
- Lighting
- Use fluorescent instead of incandescent lights: compact fluorescent light bulbs (CFLs) are three to five times more efficient and last ten times longer than incandescent. Although early fluorecent lighting products rendered colors poorly when compared to incandescent light, today's Energy Star–qualified lighting performs well and has high color rendering index (CRI) scores (a measure of how accurately an artificial light source displays colors).
- Use task lighting to focus light where you need it, rather

than brightly lighting an entire room.

- Take advantage of daylight by using light-colored, loose-weave curtains to allow outside light in while preserving privacy.
- Turn off the lights in any room you're not using, or consider installing timers, photocells, or occupancy sensors to reduce the amount of time your lights are on.

Water Heating

- Temperature: Lower your thermostat to 120 degrees. Every ten-degree reduction in temperature will save you approximately ten dollars a month on your electricity bill, or eight dollars a month if you use a gas water heater.
- Timer: Use a timer on your water heater, or manually use the circuit breaker to turn off your electric water heater while you're asleep or away from the house. The cost of a twenty-dollar timer can be recouped in just two or three months of use.
- Turn it off: When you leave the house for three days or more, be sure to turn off your electric water heater, or turn your gas heater to the "pilot" setting.
- Insulation: Insulate the first six feet of the hot and cold water pipes connected to the water heater.
- Tank location: Placing a "thermal break" between a heat-absorbing concrete floor and your tank can save approximately twenty dollars a year.
- Keep the tank clean: Periodically drain off the sediment in the bottom of the tank. Sediment buildup can insulate the water from the heating element. Open the drain valve or faucet at the base of the water tank and drain a gallon or two of water into a container until it runs clean (see your manufacturer's instructions).
- Stop leaks: Cold water leaks cost you money in water and sewer fees. Hot water leaks are even more costly, since you not only pay for the lost water, but also for the electricity or gas to heat its replacement. Replace washers in faucets to prevent and repair leaks. For toilets, find leaks by placing colored water in the tank (a tea bag or food coloring works well). If after an hour the color appears in the toilet bowl, the flapper valve is leaking and should be replaced.
- To determine if you have "invisible" leaks in your pipes, first read your water meter. Don't use any water in the house for one hour. If the meter has moved, you have a leak somewhere in the system. Once it's fixed, notify the city to avoid sewer charges for all that water.

Tools for Saving Energy

Digital wall plate thermometers (Plate Pals)

This device measures the actual temperature in the room.

The thermostat may be set to 68 degrees, but the actual temperature may be different. Thermostats, especially older models, are frequently off by a number of degrees.

Take the face plate off of a light switch in a room you use frequently and replace it with the digital wall plate thermometer. An inside wall is preferable to one on an exterior wall.

If the digital wall plate thermometer indicates the temperature is 70 degrees or higher, turn the heat down.

We recommend 67 degrees or less when people are home and awake, and 58 degrees or less at night or when no one is at home.

Hot water thermometer

Use a pencil-like thermometer to measure the temperature of your hot water.

Wait two hours after use of hot water to measure.

Measure the water temperature at the sink closest to the water heater. (If you are not sure where your water heater is, use any sink).

Turn on the hot water and let it run until it is at its maximum

temperature.

Put a container in the sink under the stream of hot water. Place the thermometer in the container (remove the sheath) as the hot water is collecting and refilling under the stream of hot water in your sink.

When the dial on the thermometer stops rising, note the temperature. This is the temperature of your hot water.

The ideal temperature is 120 degrees. If the temperature level of your hot water is higher—130 degrees or more—turn down the temperature on your water heater. It is wasting energy and could scald or burn you. If the temperature is less than 120 degrees—110 or below—adjust the temperature on your water heater to avoid bacteria growth.

Adjust the temperature on your water heater

Turn off the water heater at the breaker in your electrical panel.

Using a screwdriver, remove the small door that houses the thermostat. Actually, there are two on most electric water heaters, so make sure to change both thermostats.

Move aside the fiberglass insulation. You will see a small dial with numbers indicating temperature: 110, 120, 130, 140, and so forth. Insert a screwdriver into the groove and adjust the temperature to 120 degrees. Repeat for the second thermostat. (Some water heaters use A, B, C or high, medium, low settings instead of degrees.)

Replace the fiberglass and the metal covers, then turn on the water heater at the breaker to resume operation of your tank.

Once you've adjusted the setting, recheck using the thermometer for accuracy.

Refrigerator-freezer thermometer

This squat, square thermometer measures the temperature in your refrigerator and freezer.

Leave it in the refrigerator overnight, and note the temperature when you open it in the morning (or when it hasn't been opened for a few hours).

On the following day, check the freezer using the same process.

The ideal refrigerator temperature is 38–40 degrees; ideal freezer temperature is 0–10 degrees.

If temperatures are lower than this, your appliance is wasting energy. If the temperatures are higher than this, your food may spoil or could become unsafe. Set your refrigerator and freezer to the proper temperature.

Recheck in twenty-four hours for accuracy.

Switch and outlet sealers (Foam)

These foam pads keep the cold air outside from entering through light switches and plug-in outlets inside your home.

First, remove the switch or plug plate with a screwdriver. Then, install one foam pad for each plate, taking care to use them only on outside walls, not on walls between rooms.

Compact Fluorescent Light Bulbs (CFLs) (14-watt CFL = 60-watt incandescent; 20-watt CFL = 75-watt incandescent; 23-watt CFL = 100-watt incandescent)

Install these bulbs in lamps or light fixtures that are used the most in your home.

Read packaging for how to use them.

Please remember to recycle your CFLs, as they contain a minute amount of mercury.

Additional Resources on Reducing Household Emissions

Do-It-Yourself Home Weatherization Guide, Bonneville Power Administration. www.bpa.gov/energy/n/energy_tips/weatherization

A Consumer's Guide to Energy Efficiency and Renewable Energy, U.S. Department of En- ergy's Energy Efficiency and Renewable Energy website. Useful information about selecting doors, windows, and other energy-efficiency measures: www.eere.energy.gov/ consumer

City of San Jose Home Energy Saving Hints: www.sanjoseca.gov/esd/natural-energy-resources/ER-Tips-home.htm

U.S. Department of Energy "Energy Saver$" Tips: www1.eere.energy.gov/consumer/tips/pdfs/energy_savers.pdf

Information on compact fluorescent lights:

fcgov.com/conservation/lighting-faq.php

Sample Assignment *(to be announced in class)*

Check your refrigerator's energy consumption at Home Energy magazine's site: www.homeenergy.org/consumerinfo/refrigeration2/refmods.php

Implement one or more actions off the list above to reduce emissions in your home and save money.

State of Oregon tax credits are available for:

Clothes washers

Dishwashers

Refrigerators

Fuel cells

Heating, ventilation, air conditioning (HVAC)

Air-conditioning systems

Combination water- and space-heating systems

Ducts

Furnaces and boilers

Ground-source heat pumps

Heat pump and air conditioner testing

Heat pump systems

Heat-recovery and energy-recovery systems

Wastewater heat recovery

Solar space heating

Solar water heating

Alternative fuel vehicles

Hybrid vehicles

Water heaters

Wind systems

For lists of specific qualifying appliances and equipment, application forms, and instructions, visit oregon.gov/ENERGY/CONS/RES/RETC.shtml.

Local Resources for Home Energy Savings

Eugene CFL Recycling Centers

Aqua Serene……2836 West 11th Ave.
Brighter Homes Lighting……1968 West 6th Ave.
Emerald People's Utility
District Energy Store……33733 Seavey Loop
Eugene True Value Hardware……2825 Willamette St.
Greater Goods……515 High St.
Heinke Electrical & Lighting……645 Adams St.
Jerry's Home Improvement…2600 Highway 99 North
Lane Electric Co-op……787 Bailey Hill Rd.
Next Step Recycling……2101 West 10th Ave.

Springfield CFL Recycling Locations

B & I True Value Hardware……5790 Main St.
Jerry's Home Improvement……2525 Olympic St.
Oregon's Constant Gardener……423 Q St.

Additional Resources for Reducing Household Emissions

Eugene Water and Electric Board (EWEB): Programs, incentives, audits, and energy-saving tips: www.eweb.org/home/energy/index.htm

Energy Trust of Oregon: Incentives for Northwest Natural Gas customers: www.energytrust.org/residential/index.html

Home Energy Calculator, Emerald People's Utility District. Easy-to-use tool for various home energy saving measures. The tool calculates electricity costs and provides details on how to implement changes: www.epud.org/hec.aspx?section=home

State of Oregon tax credits: Lists of specific qualifying appliances and equipment, application forms, and instructions: oregon.gov/ ENERGY/CONS/RES/RETC.shtml

SECTION THREE: TRANSPORTATION

Key Learning Points

- Behavioral changes to reduce transportation emissions and save money
- Changes to vehicles for reducing emissions
- Biofuels
- Long-distance travel
- Impact of transportation on climate

The average American drives twenty-nine miles a day, spends fifty-five minutes each day behind the wheel, and spends nearly a fifth of household income on transportation. In the U.S., 65 percent of households own two or more vehicles. However, the $6,214 that a household spends on an average car annually does not account for the full social and environmental costs of driving (see Table 1, below).[1]

Transportation makes up more than one quarter of our greenhouse-gas emissions in the United States.[2] That figure would be even greater if you accounted for "life-cycle" emissions from vehicle manufacturing, road construction and maintenance, and the extraction and refining of fuel. In addition, transportation is the fastest growing sector of greenhouse-gas emissions in the country.[3] The carbon dioxide emissions that result from the burning of gasoline and diesel fuel are on the rise, with CO_2 emissions making up 80 percent of total U.S. greenhouse-gas emissions, based on global warming potential. Although our transportation habits can be among the most entrenched, and few people want to or will accept decreased mobility or access, simple changes can result in significant emissions reductions.

In the United States, the average vehicle emits about one pound of CO_2 per mile.

Here's why: burning a gallon of gasoline results in the release of about twenty pounds (19.4 pounds exactly) of carbon dioxide into the atmosphere. Diesel burning results in 22.2 pounds of CO_2 per gallon. The average mileage in the U.S. is 20.3 miles per gallon, when combining cars and light trucks.[4] So a car getting twenty miles a gallon, with a gallon of gasoline emitting about twenty pounds of carbon dioxide, is emitting a pound of CO_2 for each mile driven.

Table 3-1: Driving Costs

Driving costs	Small sedan	Medium sedan	Large sedan	Average
Total cost per mile*				
10,000 miles per year	per year	per year	per year	per year
Cost per mile x 10,000 miles	$1,240	$1,490	$1,620	$1,450
Cost per day x 365 days	$4,357	$5,636	$6,950	$5,648
Decreased depreciation**	-$550	-$950	-$1,150	-$883
Total cost per year	$5,047	$6,176	$7,420	$6,214
Total cost per mile***	$.505	$.618	$.742	$.621

* Assumes gas price is $3.45/gal

**decreased depreciation for milage under 15,000 annually

***total cost per year/total miles per year

American Automobile Association, "Your Driving Costs" (2007 edition). www.aaapublicaffairs.com/Assets/Files/20073261133460.YourDrivingCosts2007.pdf

The Rocky Mountain Institute (RMI) writes, "The average American personal vehicle uses 570 gallons of gasoline per year, which results in the emission of 11,400 pounds of carbon dioxide. Since, on average, each household owns 1.85 vehicles, this means that the average household emits 21,000 pounds of carbon dioxide annually."

As mentioned above, a gallon saved is twenty pounds of CO_2 kept out of the atmosphere.

Here are some simple ways to save big:

- Carpooling cuts those emissions at least in half, depending on how many people you fit in the car. The more the better!
- Once-a-week carpooling will cut the average commuter's emissions by half a ton a year, according to the RMI.
- Choose the household's most efficient vehicle each time you drive.
- Better yet, for those shorter trips, leave the car at home and hop on a bike, a bus, or just walk for zero emissions, zero cost, and a breath of fresh air.
- Combine errands.
- Try to live as close to where you work and shop to minimize transportation emissions.
- Commuter Solutions offers multiple programs to support people in leaving their car at home or living vehicle-free. Become familiar with their offerings as well as bicycle and mass transit resources. www.ltd.org/cs/csindex.html

Cutting Vehicle Emissions

When you cannot avoid driving, simple techniques can cut gasoline use and greenhouse-gas emissions.

Keeping vehicles well-tuned can increase fuel efficiency by up to 30 percent, particularly if there are significant repair needs.

Maintaining recommended tire pressure can cut fuel use by 3 percent.

Changing air filters cuts a hefty 10 percent.[5]

Cleaning out the stuff sitting in the trunk is another way to save fuel; every extra 100 pounds you haul takes 1-2 percent off your fuel efficiency.[6] Rooftop storage does not just add weight; the drag costs you money and emissions as well.

You can also drive smarter. Although every car is different, fuel economy typically plummets at speeds higher than 60 m.p.h. Excessive acceleration and braking will also cut your efficiency by about a third on the highway and 5 percent in town.[7] Idling gets zero miles per gallon, so if you are stopping for more than about thirty seconds, turn off the car. Most cars run better when warmed up by driving than by idling, so avoid polluting your neighborhood with excess exhaust.[8]

Then there are the dollar savings that accompany decreased driving or reducing the number of cars in the household. The American Automobile Association (AAA) calculates that it costs fifty-seven cents a mile for the average sedan that is driven 12,500 miles a year (the costs are less per mile, but greater overall, as the annual mileage increases). AAA estimates the total annual cost of driving 12,500 miles as $7,015, including operating costs and ownership costs. In some cases, getting rid of a car in exchange for car rentals or participation in a car share can make a lot of financial sense. Imagine what you could do with an extra $7,000 in your pocket each year.

For those interested in purchasing a vehicle, consider the energy and emissions involved in manufacturing new vehicles. Multiple studies have determined that vehicle replacement every eighteen years minimizes life-cycle energy use (energy used in manufacturing, driving, and disposal) and carbon dioxide emissions for a generic sedan driven 12,000 miles annually. However, shorter life spans minimize regulated pollutants like carbon monoxide and oxides of nitrogen.5 One option is buying a used, fuel-efficient vehicle or one that can run on alternative fuels.

If you're still interested in buying new, consider fuel economy

TAKE ACTION	SAVE MONEY	SAVE CO_2 (lbs.)
To improve fuel efficiency by up to 30 percent, tune and maintain your car:		
Check tire pressure regularly and inflate as needed to save up to 3 percent of fuel	$38	305
Change air filters to save up to 10 percent of fuel	$128	1,018
Keep engine tuned to save up to 4 percent of fuel	$51	407

and alternative fuel options. Check fuel economy labels and buy the most fuel-efficient vehicle possible. This usually means a smaller, hybrid, or even completely electric engine. Visit www.fueleconomy.gov to compare fuel efficiencies. If you're thinking about a hybrid, be sure that it matches your driving needs, as these vehicles are most efficient for in-town driving. A locally made electric vehicle may suit your needs if you don't need to transport a lot of materials or people and if you travel primarily (or solely) in close range.

Another option is to go for a dual-fuel vehicle that can run on E85 (a blend of 15 percent gasoline and 85 percent ethanol), or a diesel vehicle that you can fill with biodiesel. Although the exact emissions from biofuels depends on the feedstock and the refining process, using 99 percent biodiesel typically results in 75 percent fewer greenhouse-gas emissions than diesel; using 85 percent ethanol generally results in 18 percent fewer greenhouse-gas emissions than gasoline. [9] However, the use of biofuels is highly contingent on the existing infrastructure. If there's nowhere to fill up on E85, then you're stuck with fossil fuels.

Visit the National Ethanol Vehicle Coalition, www.e85fuel.com/e85101/flexfuelvehicles.php, or the EPA's Alternative Fuels and Advanced Vehicles Data Center, www.eere.energy.gov/afdc/afv/afdc_vehicle_search.php, to find biofuel-compatible vehicles. See section five for more on biofuels.

Air Travel Emissions

Air travel is a form of transportation with a heavy environmental impact, resulting in about 1.26 pounds of carbon dioxide equivalent (CO_2e) per passenger mile, or more than 2.5 tons of CO_2e for a roundtrip flight from coast to coast. [10] Compare this to the one pound per mile in the average U.S. vehicle (meaning .5 pounds per passenger mile when you ride with a friend, or .3 pounds with two people), 0.42 pounds per passenger mile on a bus, and 0.35 pounds per passenger mile for travel by train (depending on the efficiency of the actual train or bus and the number of passengers). Short-haul flights result in greater emissions per mile than do long-haul flights, due to the extra energy needed for takeoff and landing.

In 1992, aircraft accounted for 2 percent of anthropogenic (human-caused) carbon dioxide emissions, or 13 percent of transportation-related emissions. [11] These numbers may not seem like much until you consider the small percentage of the population taking those flights and just how vital—or unnecessary—those flights are.

The Intergovernmental Panel on Climate Change (IPCC) estimates that the flights taken in 1992 contributed about 3.5 percent of anthropogenic climate change that year. [12] The difference between the two percentages reflects the emission of other gases such as nitrous oxide, sulfur oxides, and water vapors, and the greater warming potential of nitrous oxide when released high in the atmosphere. Contrails, or the water vapor crisscrossing the sky after planes pass overhead, have an unclear effect on warming. When contrails spread and linger, they behave like cirrus clouds, and we do know that cirrus clouds stop heat from leaving the atmosphere. The impact of air travel on cirrus cloud formation is not included in the 3.5 percent mentioned above. All told, the IPCC estimates that the total climate impact of flying is about two to four times that of the CO_2 emissions alone.

Unfortunately, small comfort can be taken from recent and future gains in efficiency: While air travel is increasing at about 5 percent a year, fuel use is still increasing by around 3 percent a year.

So what can we do? Carefully consider every flight and every trip. Try to make the most of each journey and cut out those that are not top priority. You'll save money, the stress of delayed or cancelled flights, and literally tons of greenhouse-gas emissions. As much as possible, book direct routes with few landings and takeoffs. When possible, travel by bus, train, or a fuel-efficient car full of people. Each flight you avoid takes a major bite out of your personal emissions and is something to be proud of.

Additional Resources

Vehicle Resources

Fueleconomy.gov contains information on driving efficiently, vehicle mileage, biofuels, and hybrids. www.fueleconomy.gov

The U.S. Environmental Protection Agency's Green Vehicle Guide has the stats on the latest fuel-efficient vehicles. www.epa.gov/greenvehicles

40mpg.org provides hybrid advocacy, information about the fuel efficiency of various vehicles, and calculators. www.40mpg.org

Sample Assignment *(to be announced in class)*

Reduce one vehicle trip this week. If you don't drive, try to help someone else avoid using their car one time this week.

Local Transportation Resources

Vehicle

Commuter Solutions provides employer programs, Smart Ways to School, car- and vanpools, and other local transportation options. www.ltd.org/cs/csindex.html

Keep Us Moving is a user-friendly site that contains regional information about the transportation planning process, current projects, and information about transportation options. The site is maintained by the Lane Council of Governments. www.keepusmoving.info

Bicycle

The City of Eugene website contains bike maps and resources for biking in Eugene. www.eugene-or.gov/bicycle

Greater Eugene Area Riders (GEARS) invites the community to join club members on several weekly bike rides. Rides vary in location, distance, and terrain. The main purpose of GEARS is to foster bike riding. www.eugenegears.org

The Eugene Bicycle Coalition holds meetings on the fourth Monday of each month from 6:00 p.m. to 7:30 p.m. in the Lyle Conference Room located in the Public Works Building at 858 Pearl Street, Eugene. For more information, contact them at (541) 345-2110. www.efn.org/~bicycle

The Center for Appropriate Transportation is a nonprofit organization committed to community involvement in manufacturing, using, and advocating sustainable modes of transportation. The center provides Pedalers Express delivery service, education and youth programs, Oregon Cycling magazine, and more. www.catoregon.org

The UO Department of Public Safety strongly encourages bicycling as a way of responsible transportation. This site lists the availability of covered parking, safety recommendations, and local shops where you may purchase adequate gear for the conditions. safetyweb.uoregon.edu/bicycling/index.htm

The Oregon Department of Transportation website includes links to the Oregon Bicyclist Manual and information on laws and regulations as well as a list of bike travel web resources. www.oregon.gov/ODOT/HWY/ BIKEPED

Lane Community College is currently offering classes on bicycle maintenance and marathon training. For a full list of courses, visit www.lanecc.edu

The University of Oregon Craft Center frequently offers classes on bicycle maintenance. Visit craftcenter.uoregon.edu/#9 for more information

SECTION FOUR: GREEN BUILDING

Key Learning Points

- Embodied emissions
- Impact of buildings during use
- Passive solar

According to the U.S. Green Building Council, in the United States, buildings account for

- 30 percent of greenhouse-gas emissions
- 36 percent of total energy use; 65 percent of electricity consumption
- 30 percent of raw materials use
- 30 percent of waste output (136 million tons annually)
- 12 percent of potable water consumption

Greenhouse-gas emissions derive from energy used throughout the life of the home and those embodied within building materials (although that may not be reflected in the greenhouse gas emission numbers above). Thus the emissions come from the entire life cycle of a building—from raw materials extraction, product manufacturing, construction, or renovation, operation and maintenance, through to decommissioning. Below are a few rules of thumb for reducing emissions in buildings.

Build for efficiency. Of the above-mentioned emissions, the largest portion usually comes from operation and maintenance. Thus, it is important to design buildings for energy efficiency, maximizing passive solar heating and cooling as well as "daylighting" (placing windows and reflective surfaces to most effectively use daylight for illumination).

Energy-efficient windows can be costly up front, but save thousands over the long run. Look for low-E windows (heat reflective) with low U-factors (U-value describes how much heat passes through the window considering all combined components—sash, glass, and frame. The lower the U- factor, the better). EWEB's incentives only apply to windows with U-factors of 0.30 or less. Many energy-efficient windows are made of vinyl, which is toxic in manufacturing and can off-gas in the home. Wood and fiberglass are less toxic window materials. Consider triple-paned windows.

Sufficient insulation is key, and the needs vary depending on your location and the part of your home. Attic spaces need the greatest levels of insulation, as a poorly insulated attic will allow heat to rise right out of your home. Higher R-values (the opposite of U-factors) are more resistant to heat loss.

Install energy-efficient heating and cooling systems, and ensure that ducts are well insulated and sealed.

A well-placed overhang, awning, or blind can cut the need for summertime cooling dramatically.

Light-colored or "living roofs" reduce summer heat absorption. Metal roofs are durable, recyclable, and energy efficient—yet more costly up front than asphalt.

Consider setting up plumbing and wiring to be compatible with solar hot water and electricity.

Size matters. Bigger buildings require more materials, more space heated or cooled, and they provide more room to fill with products, some high in embodied emissions.

Reuse. Avoid the emissions involved in resource extraction and production by reusing building materials. BRING Recycling is a great place to start your search.

Reduce. Eliminate or reduce construction waste. Again, contact BRING for deconstruction projects.

Think lifecycle. Ask about the lifecycle emissions of the materials you use. Seek out those with low-embodied emissions and low toxicity. Concrete has very high amounts of greenhouse-gas emissions associated with its production. Using local materials can reduce transportation-related emissions. "Rapidly renewable" materials such as cork, straw, and bamboo quickly convert carbon dioxide into biomass. These materials regenerate in less than ten years.

Go for durability. Save money in the long run and decrease embodied emissions by avoiding frequent replacement and waste. If reroofing with asphalt composite, consider a forty-year roof instead of the standard twenty-year roof.

Use the sun. Orient the longer axis of the house east to west. When the sun travels low in the winter sky, the long southern face of the home will absorb heat through walls or, better yet, a good portion of the home's windows. The rooms on the south side should be those where most activity takes place. Overhangs can shield against summer sun.

According to the Northwest Ecobuilding website, "Many aspects of a green building are concrete and specific: the high-efficiency lighting, the properly shaded south-facing window that admits winter sun but blocks summer sun, or the living room floor made of salvaged wood. These are the manifestations of a green building that are easy to see; that you can touch; that you can list in a spreadsheet... But the principles that green buildings embody also require attention to other more complex or subjective questions: How will present and future occupants use the building? What does the site suggest about where the building should be located? What's the value of cleaner indoor air? Is the building's general design and appearance consonant with

its surroundings? How much more is given back to the community by supporting local builders and retailers? What's the future economic value of energy self-sufficiency?"

These questions are worthy of consideration, and highlight the need for systems thinking, a mode that considers broad effects of our actions and constructions, when making decisions.

Lower-cost energy efficiency opportunities

There are numerous technologies available to improve energy efficiency. The following ideas have been adapted from suggestions by the Energy Information Administration. Savings in both energy consumption and money are available by installing insulation, maintaining and upgrading existing equipment, and practicing energy-efficient behaviors as described in section two of this handbook. A two-degree adjustment to the thermostat setting (lower in winter, higher in summer) can reduce heating bills by 4-6 percent and prevent 500 pounds of carbon dioxide from entering the atmosphere each year.[1] Programmable thermostats automatically control temperature for time of day and season.

Heating and Cooling Systems. For those purchasing new systems, efficient options include air-source heat pumps, geothermal heat pumps, a high-efficiency gas furnace, electric heating, low-intensity infrared space heating, and programmable thermostats.

Insulation and Weatherization. Investing in insulation and weatherization products can reduce heating and cooling needs. Warm air leaking into indoor spaces during summer and out during winter can waste a lot of energy. Insulation wraps indoor spaces in a nice warm blanket, but air can still leak in or out through small cracks. Often the effect of small leaks is the same as leaving a door open. One of the easiest money-saving measures is to caulk, seal, and weather-strip all the cracks to the outside.

Doors and Windows. Energy-efficient doors are insulated and seal tightly to prevent air from leaking through or around them. If your doors are in good shape and you don't want to replace them, make sure they seal tightly and have door sweeps at the bottom to prevent air leaks. Installing insulated storm doors provides an additional barrier to leaking air. Replacing older windows with new energy-efficient ones can reduce air leaks and utility bills, as described above. The best windows shut tightly and are constructed of two or more pieces of glass separated by a gas that provides an insulating barrier. If older windows cannot be replaced, an option is to caulk any cracks around the windows and make sure they seal tightly, then add storm windows or sheets of clear plastic to the outside to create additional air barriers. Windows, doors, and skylights are part of the government-backed Energy Star program that certifies energy-efficient products. To meet Energy Star requirements, windows, doors, and skylights must meet requirements tailored for the country's three broad climate regions.

Electricity and Appliances. When you shop for a new appliance, look for the Energy Star label—your assurance that the product saves energy. Energy Star appliances have been identified by the EPA and Department of Energy as the most energy-efficient products in their classes. Appliance manufacturers are required to display Energy Guide labels on most major appliances—another useful way to compare appliances. Labels don't tell you which appliance is the most efficient, but they display the energy usage and operating cost of each appliance to aid in comparing products.

The scope of information on buildings is too vast to encompass in one short chapter, but for those embarking on a project, the resources at the end of the chapter are good starting points, particularly the City of Portland's downloadable green-building guides.

Additional resources

The Building Green website houses the industry's often-used Green Spec guide, a source book for green-building materials, as well as articles on policy, siting, energy, materials and more. www.buildinggreen.com/ menus

The U.S. Green Building Council serves as a gateway to information on case studies, research centers, design and materials resources, and more. www.usgbc.org/DisplayPage.aspx?CMSPageID=76&#13

Sample Assignment *(to be announced in class)*

Take one step to increase the efficiency of your building shell, either by adding insulation, sealing air leaks, or by increasing or reducing solar heat and light (depending on the season).

Local Green Building Resources

Information on green-building basics, permits, and local demonstration projects in Eugene: www.eugene-or.gov/greenbuilding

The City of Portland's Green Building Program website: www.portlandonline.com/osd/index.cfm?c=ebeib

BRING Recycling sells reusable building supplies and offers deconstruction services for salvaging materials. www.bringrecycling.org

Useful fact sheets on the Northwest Ecobuilding Guild's website: www.ecobuilding.org

Green-building news, products, and books.:oikos.com

SECTION FIVE: RENEWABLES

Key Learning Points

- Transportation and biofuels
- Renewable energy at home: solar water heating and photovoltaic systems
- Buying renewables or "green tags" from your utility

This section builds upon the home energy and transportation sections to continue an exploration of tools and strategies available to reduce individual and household greenhouse-gas emissions. Once a household implements efficiency measures, renewable energy sources are a means of cutting greenhouse-gas emissions associated with the burning of fossil fuels.

Renewable energy can be defined as energy derived from sources other than fossil fuels that can be continually produced without reducing key natural resources or negatively affecting people, e.g., wind, wave, tidal, and solar electric production, solar water heating, passive solar, small-scale hydro, and biomass.

The first step in reducing our home energy climate footprint begins with making our home as energy efficient as possible. The next step is to purchase renewable energy systems (or renewable power from our utility) for what remaining power is needed.

Home Installations

It makes sense to install solar water heaters before installing solar photovoltaic panels: Why make electricity to heat your water when you can just use the sun to heat the water directly?

After investing in efficiency, check out your "solar window" to decide if solar electricity or water heating are right for your home. A solar array should face south (although east or west is okay in some cases) and should have unshaded exposure to the sun between 9:00 a.m. and 3:00 p.m. year-round. In addition, there must be sufficient room for all the panels. Typically, a solar water heater can provide about 50 percent of a household's needs in even the Pacific Northwest throughout the year.[1] The percentage of electricity that photovoltaics can cover depends on the household's use and the size of the array.

There are numerous tax credits and rebates available from utilities, the state, and the federal government. Visit the Database of State Incentives for Renewables and Efficiency at www.dsireusa.org to find out what incentives are offered in your area.

Green tags and renewable energy certificates

While some households will be able to install systems to produce renewable energy, many people will choose to buy renewable energy from their utility or renewable energy certificates, or "green tags," instead.

The Eugene Water and Electric Board explains green tags as follows: "Renewable energy certificates (REC), sometimes called 'green tags,' represent the positive environmental attributes or benefits of renewable generation like wind, solar, and geothermal power. Renewable generation displaces less environmentally friendly forms of energy production that burn fossil fuel and cause air and water pollution. The electricity produced by renewable generation is the same as conventional generation. However, the displacement of fossil-fuel generation leaves a positive environmental impact by comparison. In essence, the REC is a record of the positive environmental attribute produced when the renewable generation displaces fossil-fuel generation."

Renewable energy certificates are a method of documenting and tracking the environmental attributes of renewable energy generation. RECs can only be produced in an equal amount to the amount of electricity generated from a qualifying new renewable generator. RECs are traded in wholesale markets between suppliers and organizations that use the certificates to meet regulatory requirements for investments in renewable energy, and in retail programs similar to EWEB's Greenpower.

Ask your electricity or fuel provider about options for purchasing renewable energy or green tags. Many utilities and independent companies now sell RECs in blocks of 100 or 1,000 kilowatt hours or for an extra charge per kilowatt hour (one cent, in the case of EWEB). EWEB currently sells RECs per kilowatt hour or in blocks. While you will not

necessarily be receiving the actual electrons generated by the renewable power plant, your additional contribution provides the funding to support the generation of power from renewable sources. Locally, the Emerald People's Utility District sells wind power, of which EWEB has now sold out.

Transportation

Biofuels are alternatives or additives to fossil-based fuels made from organic materials. The most widely used biofuels are biodiesel and ethanol. Due in part to cost, limited supply, and some vehicle limitations, most biofuels are sold blended with petroleum-based fuels. Blends are represented by the first letter of the biofuel and the percentage of that biofuel (e.g., 100 percent biodiesel is B100, 85 percent ethanol is E85).

Biodiesel derives from vegetable or animal fats such as rapeseed (canola), soy, other oilseed crops, used cooking oil, or animal tallow through a process called transesterification, in which alcohol is reacted with the oil to remove the glycerin. The fuel can be blended with or substituted for diesel fuel in compression-ignition (diesel) engines with no modification to the vehicle. However, the solvent properties of biodiesel may necessitate filter changes and other maintenance for vehicles, equipment, and storage devices previously used for older diesel as the biodiesel cleans out the petrodiesel deposits. In cold weather, pure biodiesel gels, so it is necessary to use a biodiesel blend at those times.

Ethanol is made from converting the carbohydrate portion of biomasses such as corn, sugar beets, wood waste, and straw into sugar, which is then fermented into ethanol, a form of alcohol. More than 3 million flexible-fuel vehicles that can run on E85 or higher-percentage blends have been sold in the United States, although many of their owners remain unaware of this option.[2] Most gasoline-powered vehicles can run on E10.

Biofuels are a move toward sustainability because they are a renewable resource, can be produced domestically, are biodegradable and nontoxic, and produce fewer emissions than fossil fuels. The final greenhouse-gas emissions are less for biofuels than for fossil fuels, by about 18 percent for E85 and about 75 percent for B100, depending on production method and feedstock.[3] This is because of the carbon sequestered in the growing of feedstocks for the fuels and because of decreased tailpipe emissions. While the carbon dioxide emissions released into the atmosphere when biofuels are burned is equivalent to the amount absorbed by the feedstock plants as they grew, there are other emissions to consider. It requires energy sources other than sunlight to grow those feedstocks. Some of those sources include fossil fuels burned in tractors and made into fertilizers and pesticides, and those fuels needed to transport the final product.

As the demand for biofuels grow, peat swamps and forests are being cleared for biofuel crops, releasing stored carbon. Controversy rages about the impact of rising demand for corn-based ethanol on the food supply. The International Food Policy Research Institute estimates that biofuels account for as much as one-third of the price increase for global commodities. In short, the issues with biofuels illustrate the fact that we are part of a complex system in which there are not likely to be simple fixes.

Visit the National Ethanol Vehicle Coalition website, www.e85fuel.com/e85101/flexfuelvehicles.php, or the EPA's Alternative Fuels and Advanced Vehicles Data Center, www.eere.energy.gov/afdc/afv/afdc_vehicle_search.php, to find biofuel-compatible vehicles.

Additional resources

Database of State Incentives for Renewables and Efficiency for local information on incentives and rebates across the nation: www.dsireusa.org

The National Biodiesel Board, the trade association for biodiesel with information on location of biodiesel dealers. www.biodiesel.org

Green Car Congress, with news on sustainable transportation and links for biofuels, electric vehicles, and more. www.greencarcongress.com/topics.html

U.S. Department of Energy's Energy Efficiency and Renewable Energy site: Beyond the basics on solar power, wind, hydro, and other renewables. www.eere.energy.gov

Home Power magazine: Useful articles on various topics in renewable energy systems for homes. www.homepower.com

Sample Assignment *(to be announced in class)*

Investigate the feasibility of a home installation of renewable energy.

If you cannot generate your own renewable energy and you're not already doing it, sign up for green power or RECs. If you are already enrolled, talk to a friend or family member about signing up.

Find out if your car can run on biofuels and where biofuels are available.

Local Renewables Resources

Eugene Water and Electric Board (EWEB) information on their Greenpower program. www.eweb.org

Emerald People's Utility District website. www.epud.org/renewnrg.aspx?section=e

SECTION SIX: YARDS

Key Learning Points

- Composting reduces emissions from waste
- Trees cool the home in summer and sequester carbon dioxide
- Push mowers and rakes reduce emissions
- Chemical yard care products are sources of yard emissions
- Planting and yard care using fewer energy-burning tools reduces emissions

Emissions in our yard come from

- synthetic, fossil fuel–based fertilizers, pesticides, and herbicides
- gas and electric mowers, edgers, and leaf blowers
- embodied emissions in yard furniture and tools
- outdoor heaters
- waste sent to a landfill, where it decomposes anaerobically and releases methane

Opportunities to reduce emissions in our yard:

- reducing the use of synthetic products
- switching to human powered (or at least electric) equipment
- buying preowned or recycled furniture and equipment
- composting food and yard waste
- planting trees for shade and carbon sequestration
- growing food

By composting food and yard waste, planting trees and plants that require little applied water or fertilizer, using push mowers, and practicing yard care that requires expending few natural resources, we can reduce emissions around our home and at the landfill. We can further reduce our food-related emissions by growing some of our food at home, discussed in section eight of this handbook.

Composting food waste at home reduces .86 tons of CO_2e per ton of food waste.[1] the bacteria inside the compost pile prevent methane emissions from entering the atmosphere.1 The compost pile releases CO_2 rather than methane as the organic matter decomposes. Although both are greenhouse gases, methane has 25 times the warming potential of carbon dioxide. [2] Making a compost pile also reduces emissions from transportation of waste, frees space in the landfill, and may allow people to save money by decreasing their trash services. And finished compost can be used as a fertilizer in flower and vegetable beds instead of petroleum-based fertilizers (discussed below). For those who live in apartments or don't have adequate room for a compost pile, a worm bin can be another means of disposing of organic waste without sending it to the landfill. See the resources at the end of this section to get started.

Planting trees at home serves two important purposes for reducing emissions: regulating temperature in the home and storing carbon. Trees draw carbon dioxide out of the atmosphere and convert it into sugars, which stores carbon for the tree. Softwood trees can sequester 26 pounds of carbon annually, or about a ton over their lifetime.[3]

When placed correctly, trees can shade the home or, at the very least, the home's air conditioning unit and can save electricity used to cool the house. If planted to shade an air conditioning unit or the south and west sides of a home, the shading can reduce the costs of cooling by an average of $175 a year.[4] Planting deciduous trees will allow for sunlight to enter the home in the winter while providing shade in the summer. In addition, trees or high shrubs planted along the north side of a home can reduce heating costs in the winter by providing a wind block.

Lawns are just about the most resource-intensive landscape. Part of the problem is the large amounts of energy and natural resources needed to achieve the ideal that many people strive for with their lawns, roses, and other such plantings. An easy way to reduce energy and resource use is to change our standards. Mowing a little higher, accepting a lighter lawn color and the occasional weed can cut down on emissions with very little effort. Reducing lawn size is another simple way to trim emissions (if replaced by plants with little need for applied water or fertilizer). Instead of using gas lawnmowers, try an electric or, better yet, a push mower. If you mow your lawn regularly (so that it is never more than two or three inches long), you can "grasscycle" your yard clippings. "Grasscycling" means leaving or spreading the clippings on the lawn or other parts of the yard. The mulch provided by the cut grass decomposes and provides nutrients for your yard. Leaves and other lawn debris can provide a cover for the compost or garden beds. Grasscycling, mulching, and leaf cover all reduce the need for chemical fertilizers and water. These fertilizers require large amounts of fossil fuels in production and distribution, and the nitrous oxide released from these fertilizers as they break down in the soil is 310 times more potent than carbon dioxide.[5] On top of that, many homeowners overfertilize their lawns, resulting in further unnecessary emissions.

By planting non-resource-intensive species in our yards, we can reduce our emissions and save water. Native plants are adapted to the regional climates, and they provide an alternative to grass, roses, and other needy plants in landscaping. These plants tend to require less fertilizer and summer water—although they still will require some upkeep to look picture-perfect. Planting native species provides the additional benefit of creating habitat and forage for local fauna.

If you are working with a landscaper or landscaping company, ask them to take up climate-friendly practices. Provide them with the resources at the end of this section for more information.

If you are barbecuing, lump charcoal produced from sustainably managed forests offers an alternative to briquettes for charcoal enthusiasts. If charcoal is your fuel of choice, use a chimney tower instead of lighter fluids, which contain volatile organic compounds. These compounds contribute to ground-level ozone pollution, which can cause health problems. Chimney towers are easy to use, reduce the amount of time needed to prepare the coals, and require no lighter fluid. And, if you've already got a charcoal grill and want to switch to gas or propane, try to find a used one to decrease the emissions involved in mining and manufacturing. For no-emissions meals, consider building a solar oven for summertime outdoor use.

Outdoor patio heaters also contribute to your household's carbon emissions. These heaters use propane gas, and not very efficiently. According to a report by the United Kingdom's Market Transformation Programme, outdoor patio heaters on average consume 8.9 kilowatts of energy. That means for every hour an outdoor heater is used, 495 compact fluorescent lamps could be powered up instead. Wear a sweater or jacket instead of firing up your heater.

In general, the more new items we purchase to fill out outdoor living spaces, the more embodied emissions we rack up. Each chair, table, umbrella, hammock, fire pit, or bench has greenhouse-gas emissions associated with the mining or harvesting of materials, the energy used in manufacturing, the transportation of each item, and in some cases the energy used by the final product. Buy used items and those made from recycled materials to decrease the embodied emissions associated with your outdoor living space.

Additional Resources

Composting

Compost Guide: www.compostguide.com

Cornell Waste Management Institute
cwmi.css.cornell.edu/smallscalecomposting.htm

GreenGuardian.com: Food Waste
greenguardian.com/throw2_food.asp

Landscaping

Greenscaping Your Lawn and Garden, U.S. Environmental Protection Agency
www.epa.gov/epaoswer/non-hw/green/owners.htm

Tree Planting and Backyard Conservation, Natural Resources Conservation Service
www.nrcs.usda.gov/Feature/backyard/treeptg.html

Native Plants

Plant Native, www.plantnative.org/index.htm

Moss Gardening and Transplanting www.mossacres.com

Water Conservation

Saving Water Partnership, an extremely useful website covering natural yard care, plant selection, composting, soil, rain barrels, and more. www.savingwater.org/outside.htm

Drip Irrigation: www.irrigation.org and www.rainbird.com

Sample Assignment *(to be announced in class)*

If you don't use a compost pile or a worm bin, set one up. If you already have one, mentor an interested friend and get them started. Take a step toward reducing the need for heavy expenditures of natural resources for your outdoor space through reducing your lawn size, changing your standards, or switching to manual raking and mowing.

Local Yard Resources

Master Gardener Program, OSU Extension Service: extension.oregonstate.edu/mg

Emerald Chapter, Native Plant Society of Oregon, www.emeraldnpso.org

SECTION SEVEN:CONSUMPTION AND WASTE

Key Learning Points

- Reduce waste at the source
- Reuse items before recycling
- Recycle as necessary
- Compost organics (typically food and yard waste)
- Buy products made with postconsumer recycled content

Greenhouse-gas emissions are associated with material goods at nearly every phase of their life cycle, from extraction, to production, to use (in some cases), through to the methane released from decomposition in the landfill. US residents generated an average of 4.6 pounds of waste per person per day in 2006, for a grand total of 251.3 million tons that year.[1] If we're tossing that much away, think of all that we're consuming. Knowing that a ream of nonrecycled content paper is associated with 35.7 pounds of carbon dioxide emissions makes it easier to conceive of all the embodied energy and emissions associated with the goods we consume and throw away.[2]

The Environmental Protection Agency estimates that residential waste makes up 55 to 65 percent of the nation's waste stream, but even industrial and construction waste results from demand by individuals. According to the United Nations Systemwide Earthwatch initiative, those of us in industrialized countries account for only 20 percent of the world population but consume 86 percent of aluminum, 81 percent of paper, 80 percent of iron and steel, and 76 percent of timber produced globally. In the average American's lifetime, he or she will consume 540 tons of construction materials, 18 tons of paper, 23 tons of wood, 16 tons of metals, and 32 tons of organic chemicals. Although we are recycling a higher percentage of our waste than in the past, we create more waste per capita each year. In 1960, Americans averaged 2.68 pounds per person per day, but this jumped to 4.4 pounds per person per day by 1997. Today, it is very easy to find one-time use items created for convenience, which only increases the amount of waste produced.

The chart on page 31 shows the waste composition for the United States. Much of what ends up in our landfill could be recycled (glass, metals, paper) in a process that requires less energy and far less resources than using new materials. All of the organics (food, wood, yard debris, miscellaneous

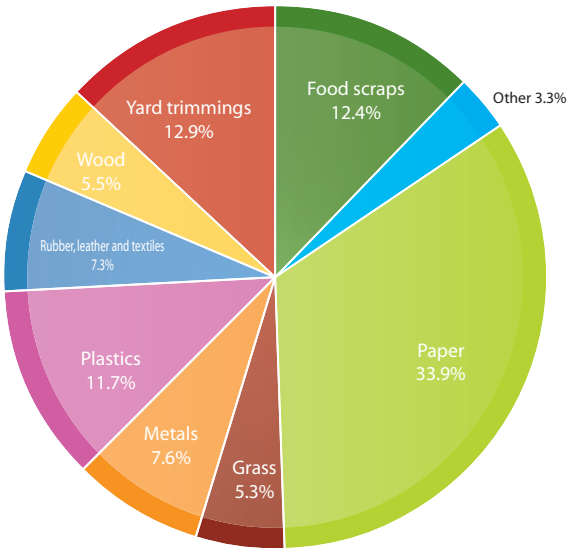
Table 7-1: Waste Composition, State of Oregon, 2000

Material	Percent of Waste Stream	Tons Disposed
Paper	22.1%	53,257
Food	16.22%	39,087
Inorganics (wallboard, concrete, fiberglass)	12.78%	30,797
Plastics	9.7%	23,375
Miscellaneous Organics	9.61%	23,159
Wood	8.81%	21,230
Metals	8.78%	21,158
Yard Debris	5.92%	14,267
Textiles	2.92%	5,518
Glass	2.29%	5,518
Household Hazardous Waste	.87%	2,097
Total	100%	240,982

Local Waste Facts

- Residential waste made up 41 percent of Oregon's waste stream in 2000, according to the Department of Environmental Quality's Oregon Solid Waste Composition Study.
- Most of Lane County's waste goes to Short Mountain Landfill, where about 75 to 80 percent of the methane is captured and used to create power for about 1,200 houses.
- In 2003, Lane County residents recycled 45 percent of waste.

Figure 5. Total MSW Generation (by Material), 2006
251 Million Tons (Before Recycling)



organics) could be composted, creating nutrient-rich soil and resulting in carbon dioxide emissions, rather than more potent methane emissions.

Reducing our waste not only decreases our greenhouse-gas emissions and other pollutants, but also conserves natural resources and landfill space, saves energy, and strengthens our local economy. Thanks to curbside recycling and yard waste composting, most of us are used to recycling household waste. But recycling requires the use of fossil fuels as raw material and for energy in processing—including transporting the waste—as does creating the original products we are recycling. In order to curb emissions associated with waste, we need to reduce the amount of waste we generate in the first place. The next step is reusing items we might normally throw away or recycle—like soft-drink bottles and yogurt containers. The final step, after reduction and reusing, is to recycle items we cannot reuse. Aside from reducing our greenhouse-gas emissions, these actions will save us money in the long run.

Reduce

Here are some ways we can reduce waste before it becomes waste, an idea known as source reduction:

Buy less.

When making a purchase, consider the following:

- Do I need to buy this?
- Can I buy this secondhand or remanufactured? Remanufactured products use 85 percent less energy in production [3]
- Is it available with postconsumer recycled materials? Purchasing these products save energy and raw materials, and ensures that the recycling industry will continue by sustaining a market for recycled items.
- Is it reusable?

Did You Know? The Aluminum Can

From Lean Thinking *by James P. Womack and Daniel T. Jones*

The aluminum can is more costly and complicated to manufacture (from virgin material) than the beverage. Typically, bauxite is mined in Australia and trucked to a chemical-reduction mill where a half-hour process purifies each ton of bauxite into a half ton of aluminum oxide. When enough of that is stockpiled, it is loaded on a giant ore carrier and sent to Sweden or Norway, where hydroelectric dams provide cheap electricity. After a monthlong journey across two oceans, it usually sits at the smelter for as long as two months. The smelter takes two hours to turn each half ton of aluminum oxide into a quarter ton of aluminum metal. These are cured for two weeks before being shipped to roller mills in Sweden or Germany. There, each ingot is heated to nearly 900 degrees Fahrenheit and rolled down to a thickness of an eighth of an inch. The resulting sheets are wrapped in ten-ton coils and transported to a warehouse, where they are rolled tenfold thinner, ready for fabrication. The aluminum is then sent to England, where sheets are punched and formed into cans, which are then washed, dried, painted with a base coat, and then painted again with specific product information. The cans are then palletized, fork lifted, and warehoused until needed. They are then shipped to the bottler, where they are washed and cleaned once more, then filled with soda. The filled cans are sealed with an aluminum "pop-top" lid at the rate of fifteen hundred cans per minute. Palletized again, the cans are shipped to a regional distribution warehouse, and shortly thereafter to a supermarket where a typical can is purchased within three days. Drinking the cola takes a few minutes, throwing the cans away takes a second. The United States still gets three-fifths of its aluminum from virgin ore, at twenty times the energy intensity of recycled aluminum, and throws away enough aluminum to replace its entire commercial aircraft fleet every three months.

Stop junk mail! Sign up at www.41pounds.org to start the process, or send a postcard or letter to

Mail Preference Service
Direct Marketing Association
PO Box 643
Carmel NY 15012-0643

Include your complete name, address, ZIP code, and a request to "activate the preference service."

- Is it durable and repairable? For example: Can the shoes be resoled? Can I replace appliance parts?
- Does it contain toxic substances? Many toxic materials are petroleum-based and result in emissions of greenhouse gases.
- Can I avoid the packaging? If not, can the package be composted or at least recycled?
- Sign up with the Direct Marketing Association to stop junk mail.
- Print on both sides of the paper and reuse paper.
- Rent or share items like tools, camping and outdoor recreation equipment, or books.
- Bring your own cup to the coffee shop and reusable cloth bags to the store.
- Host a clothing, book, or music exchange instead of going shopping.
- Many cleaning products are petroleum-based. Using nontoxic cleaners, varnishes, and paints not only reduces greenhouse-gas emissions, but also the flow of toxic waste from the household to the environment. See the end of this chapter for alternatives.

Reuse

Another important step in reducing waste is reusing. Gently used clothing, furniture, electronic equipment, appliances, and magazines can be donated to churches, charity organizations and community groups instead of thrown away. Instead of buying a new electronic item, consider purchasing a used or refurbished product and reduce emissions associated with manufacturing. Instead of recycling those prepared-food containers, use them to bring your lunch with you to work or school. These containers can also be used for storage in the refrigerator or freezer as well. Glass jars make excellent containers for storing small household items such as nails, screws, push pins, and sewing supplies. If you are planning on remodeling your home, be sure to donate wood, windows, cabinets, and fixtures to a place such as a recycling center that resells these used building materials.

Recycle

The final chapter in waste reduction is recycling. Recycling reduces methane emitted from waste decomposing in landfills as well as the amount of raw material used in creating new goods. In the case of paper products, recycled paper preserves forests that store carbon dioxide, both in the trees and in the soil beneath the trees. According to the Lane County Recyclers Handbook, "The energy saved by recycling one glass bottle would light a 100-watt light bulb for four hours. Every ton of paper recycled saves 4,100 kilowatt hours of energy, . . . 7,000 gallons of water, and reduces water pollutants by as much as 35 percent."

Composting and "grasscycling" are two other ways to reduce our methane emissions associated with landfills (see section six). By diverting organic wastes from landfills, we reduce the overall amount of methane emitted from landfills as the organic wastes decompose. The resulting rich compost provides nutrients to your yard and garden, reducing your need for fertilizers that are often fossil fuel–based.

Additional Resources

Metro: Fast facts about waste prevention. www.metro-region.org/article cfm?ArticleID=5507

U.S. Environmental Protection Agency, Municipal Solid Waste, Source Reduction, and Reuse. www.epa.gov/msw/sourcred.htm

Columbia University, Environmental Stewardship website. www.columbia.edu/cu/environment/docs-wycd/reuse-recycle/index.html

Minnesota Office of Environmental Assistance, Waste Prevention: Source Reduction Now. www.pca.state.mn.us/oea/publications/srn.pdf

Sample Assignment *(to be announced in class)*

This week, practice asking yourself the following questions before making a purchase:

- Why do I want this?
- How often will I use it?
- What are my alternatives?
- Can I get along without it?

Local Resources

City of Eugene Solid Waste and Recycling website. www.eugene-or.gov/pdd

Sanipac: Recycling and garbage collection in Eugene and Springfield. www.sanipac.com

Bring Recycling. www.bringrecycling.org

Next Step Recycling. www.nextsteprecycling.

RECYCLING FACTS

From the Lane County Recyclers Handbook

A child born in an American family will put a stress on the world's resources that is thirty times greater than a child born in a poor nation.[4]

People in the United States make up 5 percent of the world's population but use 25 percent of the world's resources and generate 30 percent of its garbage.[5]

The average American consumer uses nearly twenty tons of raw materials each year, twice that of the average Japanese or European.[6]

Paper

The United States consumes 734 pounds of paper products per capita versus 212 for West Germany and 127 for the European Economic Community as a whole.[7]

Making paper from recycled fiber generates 75 percent less air pollution.[8]

One person uses and discards two pine trees worth of paper products per year.[9]

Every time you recycle a forty-inch stack of newspapers, you save the equivalent of one southern pine tree.[10]

Recycling one-half the paper used throughout the world today would free 20 million acres of forest from paper production.[11]

The average office employee discards 1.5 pounds of recyclable paper each day, or about 360 pounds per year.[12]

Old corrugated containers account for nearly 50 percent of the total paper that is recycled.[13]

Recycling 437,000 tons of paper reduces air emissions equivalent to that produced by 200,238 cars driving on year. The total benefit from paper recycling in the United States is equivalent to taking 24 million cars off the road.[14]

Glass

The energy saved from recycling a glass bottle will light a 100-watt bulb for four hours.

Producing a new glass bottle from recycled glass uses 30 percent less energy than if raw materials were used.[15]

Recycling one ton of glass saves the equivalent of ten gallons of oil.

Plastics

The amount of plastic waste generated has been increasing by about 10 percent per year for the past twenty years.[16]

If just one-fourth of U.S. households used ten fewer plastic bags per month, 2.5 billion fewer bags would go to landfills each year.[17]

Aluminum

Aluminum made from recycled cans uses 95 percent less energy than if made from virgin (bauxite) ore.[18]

The average aluminum beverage can in the U.S. contains about 51 percent postconsumer recycled aluminum.[19]

100 percent of all beer and soft-drink cans are made of aluminum.[20]

It takes 95 percent less energy to make a can out of recycled aluminum than from raw materials.[21]

Steel and Tin Cans

The single largest domestic source of tin is recycling.

The amount of tin ore left in the world will last only thirty-one years if use grows at projected rates.[22]

One ton of steel cans contain 3.8 pounds of tin.[23]

The average American uses 130 steel cans per year.[24]

Tires

Every year Americans throw away 260 million tires. If stacked, they would reach a height of about 32,000 miles.[25]

If all car owners kept their tires properly inflated, we could save up to 2 billion gallons of gas each year.[26]

Batteries

A typical car battery contains twenty pounds of lead and one gallon of corrosive sulfuric acid.

Packaging

Americans throw away twice as much packaging as they did in 1960.[27]

Thirty percent of municipal solid waste is made up of packaging.[28]

Junk Mail

The amount of junk mail received by the average household doubled between 1977 and 1987.[29]

Americans receive almost 2 million tons of junk mail every year.[30]

About 44 percent of junk mail is never opened or read.[31]

SECTION EIGHT: FOOD

Key Learning Points

Sources of food-related emissions along the food chain

- Complexities of transportation emissions
- Emissions related to omnivorous versus vegetarian or vegan diet
- Emissions related to conventional versus organic agriculture
- Strategies for reducing food emissions

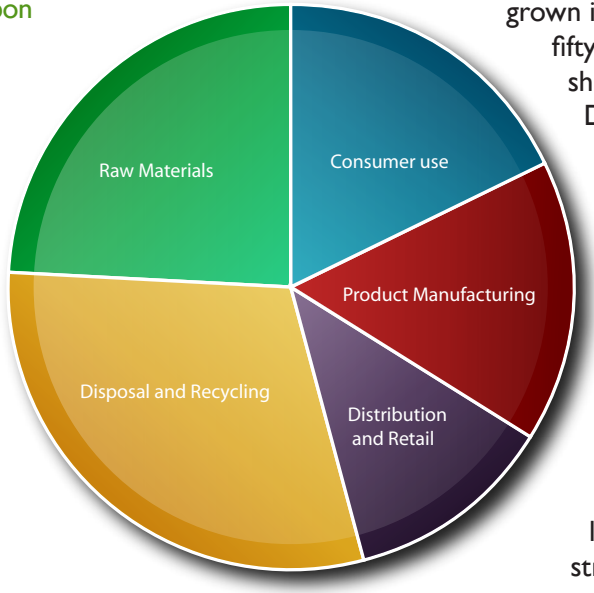
While we often associate greenhouse-gas emissions with the transportation and energy sectors, agriculture accounts for a whopping 7.4 percent of emissions in the United States, excluding food-related transportation and manufacturing.[1] Modern agriculture relies on large expenditures of fossil fuels at all levels of food production and distribution, from plowing and fertilizing fields to transporting crops to storage, from processing and packaging products to the final trip to the consumer's home (where further energy is used to store and prepare food). At every stage of this process, food is wasted and thrown away.

For example, a can of cola purchased at the market embodies the emissions for extraction of raw materials for the can and the cola, soda and can manufacturing, and distribution. This all happens before the can makes it to your refrigerator (the appliance that uses more energy than any other in your home). After you have finished the cola, the empty can leads to further emissions as it is transported to the landfill or to a recycling center, where it either releases methane as it decomposes or uses more energy to be made into a new product. It's clear that changing our eating habits has the potential to reduce our greenhouse-gas (GHG) impact, and there are several ways we can lighten our load.

8-1 Can of Cola Carbon Footprint

This diagram from the Carbon Trust illustrates the carbon footprint of a can of cola, from cradle to grave, and its intensive fossil-fuel requirements.

Source: Carbon Footprints in the Supply Chain: The Next Step for Business (2006).



Transporting Food

One way we can reduce our GHG impact is to learn about the production and distribution of food in our area. Armed with this knowledge, we can make more prudent food choices at the market. In most cases, buying local, in-season produce at the market will reduce our GHG emissions. But occasionally, we must make decisions based on incomplete information, as much of what we would like to know doesn't show up on labels or signs.

Eating local food grown in season is a good rule of thumb to follow. When possible, consider both mode of transportation and distance when attempting to reduce GHG emissions associated with distribution of consumer goods, since we cannot assume that food grown and produced closer to home has fewer GHG emissions associated with its journey than food produced further away. The difference in the efficiency of various modes of transportation of our food (air, truck, rail, and barge in descending order of fuel efficiency) means that closer doesn't always equal fewer emissions.

The difference between transport by air and by barge, for example, can be staggering. For example, a pineapple from Hawaii is grown 800 miles closer to Oregon than one grown in Costa Rica, but transported by air it embodies fifty times more GHG emissions than a pineapple shipped from Costa Rica.[2] According to the U.S. Department of Transportation, one gallon of fuel can transport one ton of food fifty-nine miles by truck, 202 miles by rail, 514 miles by barge, but only seven miles by air.[3] Although most food is transported by other means (barge to truck, for example), transporting food by air is on the rise. According to a report released in the United Kingdom, food transport by air increased more than any other mode of transportation between 1992 and 2004.[4] Foods commonly transported by air include asparagus, avocadoes, cherry tomatoes, citrus, lettuce, specialized and processed meats and fruits, strawberries, and seafood.[5]

Eating with the seasons increases your chances of finding food produced locally, in-season. Food grown locally, but out of season, can require additional energy for production in heated greenhouses. For example, the energy used for growing hothouse tomatoes in winter in England has been shown to require more energy (for heating or lighting) than importing tomatoes from Spain shipped by truck.[6] So, if we shift our produce consumption to in-season, local produce, we can drastically cut our food-related GHG emissions.

The trip from the supermarket to our home can contribute among the largest expenditures of energy in the food's travels. The reason is that a truck carrying tomatoes will be packed to the brim, using one engine to carry pounds and pounds of tomatoes. We might carry just two bags of groceries home in our otherwise empty vehicle. Most of the fossil fuels burned in that journey home are being used to move the hulking body of the vehicle, rather than to move our groceries. One way to avoid unnecessary transportation emissions is to grow a portion of your own food, and then bike, walk, or use public transportation for your other shopping.

Go Organic

Modern conventional agriculture relies heavily on fossil fuel, and therefore greenhouse-gas emissions, in almost every aspect of production:

The fuels burned in machinery

The fertilizers, pesticides, herbicides, and fungicides used in farming are made from fossil fuels, they release nitrous oxide (a greenhouse gas) into the soil, and they require energy for production and transportation

The embodied emissions—the emissions produced in the manufacture and maintenance of a product, to its point of use—in machinery used for plowing, harvesting, and irrigation

One way to reduce the emissions associated with food production is by purchasing organic food. According to a study from Great Britain, organically grown produce shipped by barge from more than 1,000 kilometers away from their country had fewer associated GHG emissions than their conventionally grown local produce.[7] Organic farming methods typically require less fossil fuel use because they do not rely on chemical fertilizers; organic farms are also limited in the amount and types of pesticides that can be used. A twenty-two-year study from the Rodale Institute demonstrated that conventional farming methods require 3.7 barrels of oil per hectare of crop production, while organic farming methods needed only 2.5 barrels of oil to produce the same crop yield. Organic farmers rely less on machinery and more on labor-intensive practices to weed and harvest fields.[9] In addition, soil farmed organically has been found to store greater amounts of carbon dioxide than soil farmed by conventional methods. The same Rodale Institute study concluded that fields farmed organically stored at least twice, and up to three times, as much carbon than fields farmed using conventional methods.[8]

Eat Whole Foods

Processing and packaging foods is an energy-intensive practice—and we're surrounded by a multitude of these products. If we shop for whole foods, like fresh vegetables and grains, instead of packaged and processed foods, which are often high in calories and low in nutrition, we can reduce the energy demand required to transport and produce food commodities. Of the total amount of energy used in the United States, about 16 percent is consumed by the food production system. Of that 16 percent, nearly a third is used for processing, 10 percent for transportation, and 17.5 percent for agriculture.[9] If we reflect back on the can of cola, we can clearly see the energy required in its production. We can also support our local farmers by purchasing produce and canning at home; the farmer benefits by selling more of his crop, and we benefit by reducing our reliance on processed foods from the grocers.

Diet

Adopting a fully or largely vegetarian or vegan lifestyle can reduce our emissions dramatically. If that's too difficult, even cutting one meat meal a week makes a difference. A University of Chicago study compared the average American diet, which includes red meat, to the emissions produced by a Chevrolet Suburban; the lacto-ovo vegetarian diet was much closer to the emissions of a Toyota Prius, a low-carbon emissions car.[10] Several factors lead to their conclusions.

Cows raised for dairy and meat belch methane (which has twenty-one times more warming potential than carbon dioxide) as their four guts digest the fibrous grass that makes up their diet. Cows raised on corn (of which there are many these days) belch even more methane than grass-fed cows. According to the Worldwatch Institute, this methane makes up 16 percent of the overall methane emissions produced per year. Data from the U.S. Department of Energy supports that statistic: 94 percent of total methane emissions from agriculture are directly related to livestock.[11] Feedlots (a type of confined-animal feeding operation) also rely on antibiotics and grain production to increase meat yields, further increasing demands for fossil fuels. Much of the large-scale meat production occurs in areas that have been recently deforested in order to produce more expensive commodities. The cost to the atmosphere of meat production also embodies the loss of forests that fix, or sequester, CO_2—many of them in tropical areas where plants are able to photosynthesize year-round. In conclusion, it takes many pounds of grain or corn to produce one pound of beef. This means more cleared land and more fossil fuels to grow the grain or corn that feeds most cows.

Although many focus on the impact of red meat on the global climate, deep-sea fishing also requires large amounts

of fossil fuel in catching, storing, and transporting fish from sea to market. In fact, the University of Chicago study found that a diet rich in fish nearly equaled the emissions associated with a red-meat diet.[12] In addition, because many of the world's fisheries have collapsed due to over-fishing, fishing methods have become increasingly invasive and destructive on marine ecosystems.

When buying products like coffee, tea, chocolate, and tropical fruit, purchasing goods certified as "fair trade" ensures that the people producing the food are receiving the benefits of its sale in the global market. For instance, fair trade coffee farmers receive US$1.26 per pound of coffee, while the international rate for coffee is US$1 a pound. When middlemen are put in the picture, the coffee bean farmer may actually receive as little as fifty cents per pound of coffee.

Fair trade certification includes environmental requirements, ensuring less environmental destruction and deforestation than conventional fertilizer-intensive or slash-and-burn methods. By cultivating fair trade products, farmers can earn more and, in turn, return more of their profits to their community and invest in sustainable farming.[13]

Take-Home Points

Reduce food emissions by:

- Buying only what you need; wasted food is pointless emissions
- Buying local foods in season and learning about food distribution in your area
- Supporting organic agriculture
- Moving toward a vegetarian or vegan lifestyle
- Avoiding processed and packaged goods
- Cutting shopping emissions by biking, walking, using public transport, or combining errands
- Cooking efficiently

Additional Resources

Leopold Center for Sustainable Agriculture. www.leopold.iastate.edu

Earth Save International (Plant-Based Diets). earthsave.org

Local Harvest Community Supported Agriculture. www.localharvest.org/csa

The Omnivore's Dilemma: A Natural History of Four Meals by Michael Pollan. An excellent book resource that examines many facets of food-related issues.

Sample Assignment *(to be announced in class)*

Make one or more shifts in your eating and purchasing patterns to reduce greenhouse-gas emissions. Cut out one meat-, fish-, or dairy-based meal a week. Buy one or more food staple produced organically, rather than with conventional methods.

Local Resources

Oregon Roadside Guide to Eco-Healthy Eating, Oregon Environmental Council. www.oeconline.org/livinggreen/onthego/roadsideguide/view?searchterm=oOregon%20Roadside%20Guide%20to%20Eco-Healthy %20Eating

Willamette Farm and Food Coalition. www.lanefood.org

SECTION NINE: CONSULTATIONS AND OUTREACH

Key Learning Points

- Major emission sources: transportation, food and material goods consumption, space heating
- Communication strategies for motivating climate-change action
- Consultation protocol

Consultation Basics

The household consultation should increase the resident's awareness of the "big ticket" greenhouse-gas emitters in their life: typically these include transportation, home energy use, and consumption of food and other resources. However, some residents may have a high level of awareness and may already have done a great deal to reduce their emissions and energy use. The consultant must communicate in a way that meets the needs of the resident and focuses on their needs and interests.

Communication

Effective communication is a two-way street that invites the resident to ask questions and learn from the consultant. You must be respectful, nonjudgmental, and open-minded as you step into a home consultation. Be supportive and always praise and acknowledge the efforts they are already making. As a guest in their home, you are there to educate and recommend, but never to lecture or pressure people into making changes they aren't ready or willing to make. If met with resistance, back off!

Provoking shame or guilt is likely to lead to defensiveness, while evoking fear often will result in a complete shutdown on the part of the recipient. Providing realistic information about the problem and feasible solutions is most likely to achieve behavior change.

Some good questions to ask about home-energy use might include the following:

- What do you perceive as the biggest energy users in your household?
- What would you like to get out of this session?
- Who uses energy and how? (e.g., kids, showers and laundry)
- Are you a renter or an owner? How long have you lived here? Has the dwelling been weatherized?

While you are in their home, be an astute observer:

- Don't be afraid to do a "walk through" of the home, checking water temperature at the faucet farthest from the water heater. Give them the chance to do the measuring.
- See if there are water leaks in the bathroom sink and tub or the kitchen. Are they hot or cold leaks?
- Is furniture blocking vents or heaters?
- Are thermostats old and inaccurate? (showing "comfort zone" or "high, med, low" instead of degrees)
- Do appliances look dated and in poor repair or newer and well-sized for their needs?
- Are there outbuildings that house power tools, extra refrigerators, and freezers? Is there a hot tub or security lighting?

While finding answers to the questions above, use the resident as a resource and, above all, do not forget that you are entering another person's home—a space in which they may feel vulnerable or defensive with a consultant's eye sweeping the place.

On page 38, an Australian home consulting manual for their Cool Communities program provides further details on communication.

Tools

All consultants will use a checklist and a series of consulting worksheets to perform the consultation. The checklist begins with the highest greenhouse-gas emitters (transportation, home heating and cooling, water heating) and moves to what are typically lower emitters for a household. The consultant should focus on the portion of the checklist (transportation, home energy use, food consumption and waste, or yard emissions) and those worksheets that the resident is most interested in.

The worksheets are designed to guide the consultant through the process. These provide questions to ask, recommendations, and resources. Use these as a guide, but, where appropriate, feel free to ask additional questions and include other sound recommendations and resources. The worksheets can be left with the resident at the end of the consultation.

Other useful things to bring with you on your consultation include the following:

- Plate Pal thermometer for measuring air temperature
- Meat thermometer to measure water temperature
- Refrigerator and freezer thermometer
- Screwdriver
- Rag
- Flashlight
- "Freebies" for the resident, if available

When talking to someone at their home, the consultant should:

- Always use plain English language and explain any jargon which needs to be used.
- Draw out as much information from the householder as possible about how they use and conserve energy. Please note that people may be a bit embarrassed about how much energy they use and therefore may underestimate their consumption.
- Make every effort to make the householder comfortable with having you in their house. This means being relaxed no matter what the surroundings are like and not making disparaging remarks about the house or the householder.
- Ask the householder if they would like to accompany you. Use this as an opportunity to engage the householder in energy-efficiency practices, explain what the issues are, and answer any questions they might have.
- Remember that all people are different and what is likely to make one person feel uncomfortable or annoyed may leave another unabashed. Comments about your views of the world or religion have the potential to go down like a lead balloon. Sticking to the issue at hand is generally advisable.
- Beware of people who are angry and looking for someone to blame. If they perceive their energy bills are too high, this could be anyone from a member of their household to their energy supplier or the government. Provide them with the facts and your observations, but don't get too involved.

When talking to a group, the consultant should:

- Always use plain English language. When jargon has to be used it should be explained. This can be quite empowering for the members of the group.
- Draw out as much information from the group members as possible about how they use and conserve energy. This helps other group members to understand that there are different ways of doing things, different bill levels, and different options for solving problems.
- Use the group dynamics positively, being aware that groups can operate negatively. For instance, there is potential for a high-energy user to be stigmatized if they are in a group of energy conservers. The group's knowledge and energy should be harnessed to support that person.
- For instance, when trying to convey the need to put external blinds on west facing windows, a poor communicator might say:
- "Since these windows face west, they need blinds."

A good communicator might say:

"Do you find this room heats up in summer? That is because west-facing rooms get the hot afternoon sun. What are you doing currently to reduce the heat? If you put external blinds on the windows, that will keep the sun off and stop the room from heating up."

When trying to convey the need to install draft blockers, a poor communicator might say:

"Installation of draft blockers will improve your thermal efficiency by X percent."

A good communicator might use an incense stick around doorways and windows and say:

"See how the smoke is being blown into the room? I bet you can feel the drafts in here in winter. When you add up all the spaces where air is moving in this room it would be about the same as having a hole the size of a basketball in the wall."

You may also want to think about ways to get the whole family involved in energy-conservation consciousness. For instance, you could discuss plotting kilowatt usage and getting other household members involved in this activity. Encourage the participation of everyone and make it a family challenge to reduce energy usage lower this month than the same time last year (refer them to their utilities bills). Ask them to jot down strategies and tasks on their Action Plan while you're presenting suggestions.

As you talk to people about these issues, we hope you will come up with your own list of effective communication strategies.

Additional Resources on Home Consultations

Cool Communities Home Greenhouse Audit Manual: www.greenhouse.gov.au/local/publications/pubs/audit.pdf

Sample Assignment *(to be announced in class)*

Conduct a practice consultation with another participant in the Climate Master class.

How to conduct a consultation

1) Introduce yourself and the Climate Master program—a project to help households reduce their greenhouse-gas emissions. Thank them for their participation and tell them that you're in training through the Climate Master class and are learning how to do this.

2) Double check their area of greatest interest for the consultation.

3) Administer the survey and get utility release forms signed, if necessary. These are all voluntary, but will help us evaluate the program.

4) Proceed through the consulting worksheets for areas of greatest interest. Give the resident a "master checklist" and worksheets so they can follow along with you and jot down strategies and tasks for their Action Plan.

5) At some point during the consultation, discuss priority areas for emission reduction:

a. Transportation: reducing flights and car trips
b. Home heating, cooling, and water heating
c. Consumption and embodied emissions

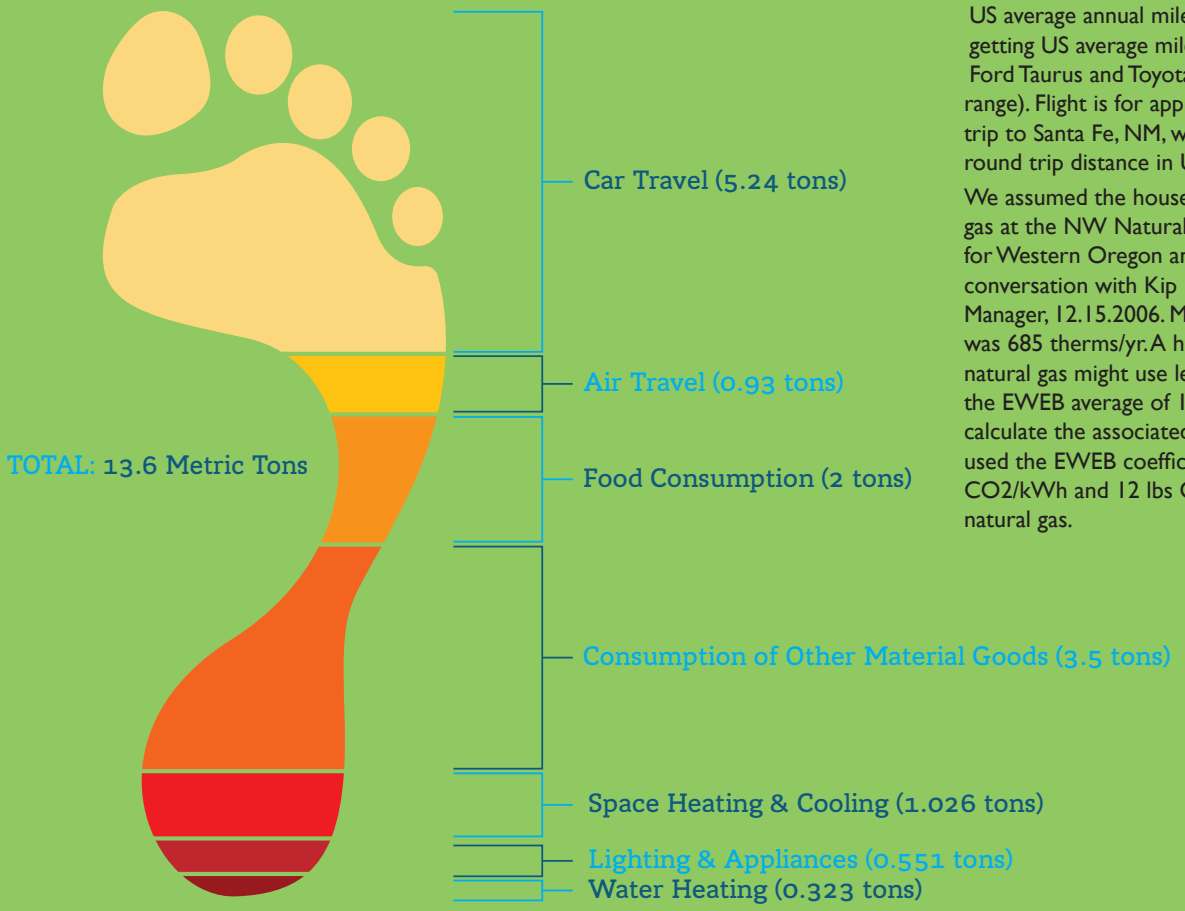
6) Secure a commitment for one or more changes.

7) Leave any resources that the resident is interested in.

8) Mail the commitment and survey to your organization to be recorded in the database.

After the consultation, CLI will contact the resident to see if they have followed through on their commitments. If not, we will find out why and see if there are any additional resources or assistance we can provide. If they have carried out their commitments, we will see if they are willing to make any other commitments. With additional commitments, we will follow up a second time to see how they did on the second round of commitments.

Approximate Total Personal CO2e Emissions for a Typical Eugene Resident



Assumptions:

US average annual miles traveled in vehicle getting US average mileage (Honda Accord, Ford Taurus and Toyota Camry are in this range). Flight is for approximate return trip to Santa Fe, NM, which is the average round trip distance in US.

We assumed the household uses natural gas at the NW Natural residential average for Western Oregon and SW WA, from conversation with Kip Much, NW Natural Manager, 12.15.2006. Much stated use was 685 therms/yr. A household using natural gas might use less electricity than the EWEB average of 12,000 kWh/yr. To calculate the associated CO2 emissions, we used the EWEB coefficient of .01 pounds CO2/kWh and 12 lbs CO2/therm for natural gas.

In the United States, annual greenhouse-gas emissions are about twenty tons of carbon dioxide equivalent (CO2e) per person. The Oregon per capita average is closer to seventeen tons CO2e per year.[1] The Eugene per capita greenhouse-gas emissions, as calculated by the City of Eugene, amount to 8.6 metric tons of CO2e.[2] However, the Oregon and Eugene numbers do not reflect the emissions associated with freeway travel, air travel, and those emissions associated with the production of food and other goods brought in from other communities and consumed here. Therefore, at CLI we have created the profile of a "typical" Eugene household, which includes a broader scope of personal emissions than does a standard community-level greenhouse-gas inventory.

A resident in this typical Eugene household is responsible for the emission of 13.8 tons of carbon dioxide equivalent. This person heats with natural gas and drives a Honda Accord for 12,000 miles a year. He or she takes one round trip flight to Santa Fe, New Mexico, each year to soak up some extra sunshine.

The majority of our typical resident's 13.8 tons of greenhouse-gas emissions derive from transportation. The emissions embodied in food and other consumables are difficult to accurately calculate, but we conservatively estimate that they could amount to 5.5 tons per person per year. Most of the emissions from home energy use for this resident, living in a two-person household, derive from the natural gas they use, rather than the electricity. Of their home emissions, the majority are from space heating, then lighting and appliances, followed by water heating.

There are still many emissions sources not included in our calculations, such as those embodied in existing buildings we live in, in petroleum-based pesticides and fertilizers we use in our yards that emit nitrous oxide, and the emissions from waste decomposing in landfills (excluded because about 80 percent of methane is captured for creating electricity at Short Mountain Landfill).

SECTION TEN: OFFSETS

Key Learning Points

- Definition of "offsets"
- Common offset projects: reforestation, renewable energy, efficiency—pros and cons
- No single regulatory body or standards

Carbon offsets are carbon credits purchased to offset the production of greenhouse-gas (GHG) emissions from energy use and other activities. Carbon offsets are intended to reduce the impact of your carbon footprint. After reducing emissions in all areas possible (or not), some people choose to offset their GHG emissions by reducing an equal amount of carbon somewhere else in the world. This is achieved by purchasing an amount of carbon credits equal to the amount produced—taking into account the differing warming potentials of the various greenhouse gases. All carbon credits represent the reduction of GHG in metric tons of carbon dioxide (CO_2), the most common GHG. Methane has a warming potential twenty-three times that of CO_2, and therefore a ton of methane gas has the warming potential of twenty-three tons of CO_2.

Common carbon offset projects

Most carbon offset retailers support a variety of mechanisms for reducing carbon. Reforestation, investing in renewable energy, and increasing energy efficiency are some of the most common practices utilized to offset emission production.

Reforestation

Carbon sequestration through replanting forests is one of the most common methods used by carbon-offset organizations. Carbon is captured and removed from the atmosphere and stored by the planted trees. Reforestation often occurs in areas decimated by large-scale deforestation. Projects are often initiated in areas of high biodiversity in order to ensure the perpetuity of ecologically sensitive regions.

Renewable Energy Credits

Renewable energy credits (REC), also know as green tags or green power, represent the environmental benefits of the creation of electricity derived from renewable energy sources. One REC is equivalent to the benefits associated with one megawatt of renewable power. Some carbon-offset retailers "purchase and retire" the credits in order to lower the total amount of carbon available to be traded. By investing in renewable energy technologies, companies may help increase demand for renewable energy and spur new development.

Energy Efficiency

In the Chicago Climate Exchange's voluntary carbon-trading market, carbon credits are created when businesses increase their energy efficiency by consuming less energy. The exchange functions as a "cap-and-trade" program, where companies tabulate their emissions from a 1998–2001 baseline. These companies are required to reduce their emissions over time. If companies have achieved increased efficiency, they can sell their credits. If their usage has increased, they must purchase credits from within the market. (If we had a national cap-and-trade policy, it would function in this manner.) Energy efficiency can be achieved through the development of new technologies or changes in processes and practices that were energy inefficient. Carbon credits may be purchased from the exchange by carbon-offset retailers.

Controversy in carbon offsets

Reforestation is controversial as an effective tool in reducing the amount of carbon dioxide in the atmosphere. Reforestation projects lack permanence, as the trees may potentially be felled or catch fire, and the CO_2 would be released. Many opponents of tree planting as a primary mechanism in carbon trading markets argue that it fails to address our dependence on fossil fuels and that the actual project size and completion can be difficult to validate. Promoters of reforestation maintain that these projects mitigate the ramifications of deforestation and may help provide indigenous peoples with a sustainable economic and environmental incentive to perpetuate forests. Reforestation projects can be certified by the Climate, Community, and Biodiversity Alliance, which ensures that the project protects and restores endemic species and biodiversity.

There is long-standing debate about whether renewable energy credits (REC) should be used as an equivalent to carbon "additionality" offsets (i.e., the offset revenues having clearly made another energy-saving project possible that would not have happened otherwise). The amount of carbon dioxide displaced by a REC is generally determined by calculating the amount of CO_2 emitted by local fossil-fuel-burning power plants per kilowatt hour. The main debate on RECs is whether they can satisfy the greenhouse-gas offset requirements. Critics argue that many renewable energy projects would have come to fruition regardless of

prospective REC sales because of the high price of fossil-fuel energy, various tax breaks, existing desire for more diversified energy, and availability of renewable energy sources. Advocates argue that RECs are an important offset tool because they change the energy mix by displacing the use of fossil-fuel energy and can be more reliable than some other offset projects, such as reforestation.

Retail voluntary carbon market: upstanding supply and demand

No federal greenhouse-gas (GHG) emission regulations exist in the United States at this time. However, voluntary carbon markets are playing an increasingly significant role in both citizen and business efforts to show leadership in addressing global warming. Going "carbon neutral" refers to the idea of reducing one's GHG emissions and ultimately neutralizing one's carbon footprint through purchasing offsets. Unlike the compliance-based market, the voluntary market does not rely on mandated reductions to generate demand. Voluntary credits do not have to be registered with any central body, thus the market remains fragmented and unregulated. In the voluntary market, both for-profit and nonprofit organizations sell a range of offset types certified to an array of standards. Due to this fragmentation, prices in the voluntary market vary widely from $1 to $35 per ton of CO_2. Prices are affected by two main factors: 1) the cost of the offset (technical reduction cost plus administrative fees) and 2) the market price, which varies with supply and demand. Today the voluntary carbon market is driven by several factors including rising consumer concern about climate change, institutional investors who view a firm's carbon footprint as a business risk, and by governments addressing their constituents' desire for action on climate change.

Accounting for and verifying reductions in the carbon market

Project Creation

Project creators vary widely from nonprofits interested in combating climate change to public agencies interested in seeding the market for private companies who seek to profit in the carbon market. Project types include reducing emissions at the source or reducing GHG levels in the atmosphere (sequestration).

Examples of Project Types

- Methane capture from landfills, livestock, coal mines (sequestration)
- Soil or geological sequestration
- Direct fossil-fuel reduction
- Indirect fossil-fuel reduction (RECs)
- Reforestation or avoided deforestation

2. Product Verification

In the absence of quality standards, there are a wide variety of accounting methods in the voluntary market. A number of third-party certifiers are being developed, such as the Gold Standard (requires offsets to meet the Kyoto Protocol Clean Development Mechanism), the Greenhouse Gas Protocol for Project Accounting (developed by the World Resource Institute and the World Business Council for Sustainable Development), ISO 14064, Voluntary Carbon Standard, and Climate Neutral Network (developing the "Climate Cool" logo).

The major considerations with offset quality are as follows:

"Additionality"—The offset revenues clearly make a project possible that would not have happened otherwise.

Baseline determination—A credible approach must be used to calculate the emissions that would have occurred in the absence of the project.

Benefit quantification—A credible quantification of the GHG-emission reductions resulting from a project.

Permanence—The project must be able to guarantee GHG mitigation that is not subject to potential reversal in the future.

Double counting—A project must avoid being claimed and sold multiple times.

Offset timing—Ex-ante and ex-post accounting, where

credits are sometimes sold before or after they are produced. In the former, there is a risk of nondelivery; in the latter, a risk of not being able to prove "additionality."

Co-Benefits—While the primary purpose of a project is to reduce greenhouse gases, sometimes projects have additional benefits such as contributions to local communities or habitat protection.

Redundancy—The project must not already be required by some other law or regulation.

Carbon leakage—The implementation of the project should not create an increase in emissions outside the project.

3. Product Distribution

Once a project has been developed and verified, middlemen often step in as buyers (with the purpose of reselling credits) or facilitators of transactions on a fee-for-service basis. Today there are about thirty-five retail providers of offsets available on the Internet that vend both emissions-reduction projects and sequestration-project credits. While there are, at present, only a small number of providers, as the voluntary carbon market matures more investors and brokers will join the market, often maintaining a portfolio of projects. Currently the Chicago Climate Exchange is the only voluntary carbon-trading exchange, and trading is restricted to CCX-registered members. Some registries have been created recently for corporate buyers and sellers of carbon credits, including the Bank of New York, My-Climate, Green-e, and the U.S. Department of Energy Voluntary Reporting Greenhouse Gases Program.

4. Product Consumption

Consumers in the voluntary carbon market come in all shapes and sizes, from individual households to large corporations and municipal governments. There are dozens of online carbon calculators that have been developed to estimate how many credits must be purchased to offset particular activities.

Some examples of common offset purchases include the following:

- Institutions purchase carbon credits to offset their internal emissions generated by their activities, facilities, and employees.
- Companies may purchase carbon credits to offset the life cycle of their services or products in order to develop "carbon neutral" branding.
- Organizers of high-profile events may choose to make the events carbon neutral through the purchase of offsets.

To see a rating of various offset programs, visit Clean Air, Cool Planet at www.cleanair-coolplanet.org and click on the link to Consumers' Guide to Retail Carbon Offset Providers. The report ranks the Climate Trust and Native Energy as among the top three offset providers.

PRESENTER EVALUATION

Topic: _____ Presenter Name: _____

What did you like most about this presentation?

What would you change about this presentation?

Should this speaker present to future CM classes?

Presenter Evaluation

Topic: _____ Presenter Name: _____

What did you like most about this presentation?

What would you change about this presentation?

Should this speaker present to future CM classes?

END NOTES

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