Doing Our Share: Greenhouse Gas Reductions Manual for Schools

New Jersey Sustainable Schools Network

By

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Introduction

Five good reasons to involve your students and your school in this *Doing Our Share School Campaign to Reduce Greenhouse Gases*:

- *Global warming is a real problem that impacts New Jersey.*
- *Reducing greenhouse gases (GHGs) is a significant solution to this problem.*
- *The State of New Jersey's commitment to reduce GHGs demonstrates to students that they can be part of the solution, not just be overwhelmed by the problem.*
- *There are <u>many</u> resources available to help students accomplish observable results.*
- *This campaign can help teachers achieve at least 17 of the State's Core Curriculum Content Standards.*

The international scientific community continues to issue warnings that our average global temperatures are warming due to the greenhouse effect. The primary cause in global climate change over the past century is the human-caused input of greenhouse gases (GHGs), such as carbon dioxide, methane, and nitrous oxide, to the atmosphere.

This information *can* seem like a ton of more gloom and doom for our students to hear, but it does not have to be. Many people across the globe are working for solutions to this problem – and our students can be part of the solution as well. Partly because of the bumpy road that the negotiations on the Kyoto Protocol have taken in recent years, the New Jersey Department of Environmental Protection has decided to act on the solutions side of this particular equation. The NJDEP has established the quantitative target of a 3.5% reduction in New Jersey's GHG emissions below our 1990 baseline by the year 20005. Given increased outputs of GHGs since 1990, this goal represents an actual reduction of 15%.

Schools can join governmental agencies, businesses and college campuses in helping to achieve this goal and thus do something positive about reversing global warming – by "*doing our share*." At the same time, many of the energy-saving strategies that will reduce CO_2 emissions will also save schools significant amounts of money. This saved money can then be applied to ongoing educational and energy-saving actions in a win-win outcome for the schools that undertake these actions.

This manual contains resources to involve students in the *Doing Our Share Campaign* and to help schools do three things:

1. Calculate their greenhouse gas emissions and determine target emissions for the year 2005 that will be 3.5% below their 1990 levels.
2. Identify resources that will help the school achieve these reduced emissions.
3. Identify resources that can be used to teach about global warming, the greenhouse effect, and energy efficiency.

NJ Department of Education's Core Curriculum Content Standards addressed:

Science: 5.1, 5.2, 5.4, 5.5, 5.9, 5.10 and 5.12

Social Studies: 6.7, 6.8 and 6.9

Language Arts: 3.2, 3.3, 3.4 and 3.5,

Workplace Readiness: 2, 3 and 4.

Since the proverbial journey of a thousand miles begins with a single step, the reader is encouraged to view the suggested actions and resources in this manual with an eye toward identifying the next best

step to take – not how to accomplish the entire goal all at once. You may want to select one or two of the lessons, or one or two strategies to investigate more thoroughly. You will want to explore which potential areas for action will give you the most significant GHG reductions and which actions are most achievable. Which areas you choose for reducing your school's GHG emissions will depend on such factors as

- who is already involved in this effort
- how difficult or easy the action will be to accomplish
- any costs involved
- whether the payback periods are reasonable relative to the costs
- any financial incentives that may be available for particular activities
- the opportunities posed by your school district's renovation and building schedules.

I. A School's Greenhouse Gas Emissions Calculator

Doing Our Share to Reverse Global Warming

Two versions of this calculator can be found in Addendum 1 for use with students.

The information required to complete the calculator will probably have to be obtained from your district's business administrator. If the district no longer has the 1990 data, use the year closest to 1990 as your base year. The total energy used will probably be comparable unless your school has undergone any significant changes, such as a change in heating fuel or lighting upgrades or new construction.

The CO_2 equivalent for electricity is based on the PMJ – Pennsylvania, Maryland, New Jersey – grid, which is where the State's electricity comes from. If we consumed only electricity produced in New Jersey, the figure would be lower, but the State's utilities purchase out-of-state electricity from this grid. The figure for 1990 is slightly higher than current year's CO_2 outputs thanks to some improvements in electricity production over the past decade.

If your school has undertaken any energy upgrades, e.g., changes to more efficient electrical fixtures, ballasts and bulbs, your school probably has a head start on its GHG reductions. These should be figured into your final results.

The CO_2 equivalent for number 2 heating oil is lower than for number 6 heating oil. A change from number 6 to number 2 heating oil will in itself produce some GHG savings.

> **Please** contribute to the statewide *Doing Our Share Campaign* by sending a copy of your results to Global Learning, Inc., 1018 Stuyvesant Avenue, Union, NJ 07083, or by email to globallearning@att.net. We will tabulate and submit all results to NJDEP for their statewide calculations under the GHG Action Plan. Thank you!

For the year _____ (the latest year for which information is available)

1. **Electricity**
   Enter the number of kilowatt hours used _____ x 1.268 lbs. CO_2/kilowatt hour = _____ lbs. CO_2
2. **Heating**
   Gals. of #2 heating oil used _____ x 22.38 lbs. CO_2/gal. = _____ lbs. CO_2

Gals. of #6 heating oil used _____ x 26.0 lbs. CO_2/gal. = _____ lbs. CO_2
Therms of natural gas used _____ x 11.7 lbs. CO_2/therm = _____ lbs. CO_2
or Standard cubic feet of natural gas used _____ x .174lbs. CO_2/scf = _____ lbs. CO_2

3. **Transportation**
Gals. of gasoline used _____ x 19.64 lbs. CO_2/gal. = _____ lbs. CO_2
Gals. of diesel fuel used _____ x 22.38 lbs. CO_2/gal. = _____ lbs. CO_2
Therms of natural gas used _____ x 11.7 lbs. CO_2/therm = _____ lbs. CO_2
or Standard cubic feet of natural gas used _____ x .174lbs. CO_2/scf = _____ lbs. CO_2
4. **Total** lbs. of CO_2/ released into the atmosphere = _____ lbs. CO_2

For the year 1990 (the base year) or 199___

5. **Electricity**
Kilowatt hours used _____ x 1.33 lbs. CO_2/kilowatt hour = _____ lbs. CO_2
6. **Heating**
Gals. of #2 heating oil used _____ x 22.38 lbs. CO_2/gal. = _____ lbs. CO_2
Gals. of #6 heating oil used _____ x 26.0 lbs. CO_2/gal. = _____ lbs. CO_2
Therms of natural gas used _____ x 11.7 lbs. CO_2/therm = _____ lbs. CO_2
or Standard cubic feet of natural gas used _____ x .174lbs. CO_2/scf = _____ lbs. CO_2
7. **Transportation**
Gals. of gasoline used _____ x 19.64 lbs. CO_2/gal. = _____ lbs. CO_2
Gals. of diesel fuel used _____ x 22.38 lbs. CO_2/gal. = _____ lbs. CO_2
Therms of natural gas used _____ x 11.7 lbs. CO_2/therm = _____ lbs. CO_2
or Standard cubic feet of natural gas used _____ x .174lbs. CO_2/scf = _____ lbs. CO_2
8. **Total** lbs. of CO_2/ released into the atmosphere = _____ lbs. CO_2

The *Doing Our Share* Calculations

The goal is to reduce greenhouse gas emissions by 3.5% of the school's 1990 total by 2005.

9. **Multiply** the total on line 8 _____ x .035 = _____ lbs. CO_2

10. **Subtract:** line 8 total _____ minus line 9 total _____ = _____ lbs. CO_2

This is the school's target amount of greenhouse gas emissions for 2005.

How does it compare with line 4?

What steps can your school take to reach the goal on line 10 by 2005?

Class Activity: *Deciding what to do: what's our best next step?*

The teacher may want to decide ahead of time which area the class will tackle based on the realities of limited time and resources for this project. Or the teacher may want to include the class in deciding what to undertake. This activity is designed to help a class decide what steps to take to achieve the GHG reductions goal, once they have completed the GHG Calculator.

Achieving the goal of a 3.5% reduction of the school's 1990 CO_2 emissions by 2005 will require a series of steps over the next few years. What this class decides to do can be one of those steps and a

significant contribution to achieving the goal. The class' action might range from publicizing the overall issue to various decision makers in the school and school district to focusing on one or more specific issues to actually make a change.

Questions to discuss with the class:

1. Where do you think we can make the biggest dent in our school's GHG emissions? List on a sheet of newsprint and include the reasons behind the choices.

2. What information do we need to work on these areas? Where can we get that information? What will be easiest to get? Hardest to get?

3. How much time can we give to this effort? Or state how much you can allocate given your class schedule.

4. Develop a class strategy either by brainstorming broadly with the class: "What might we do next?" Or by distributing a copy of "How Schools Can Cut GHG Emissions" from the Contents page. Discuss the suggested topics, clarify questions about them, ask if there are other topics that could be added to this list, and begin to narrow the focus.

II How Schools Can Cut GHG Emissions

The process we are proposing that schools undertake to cut their GHG emissions involves five steps:

5) monitor/evaluate results.
4) take actions and
3) propose actions
2) evaluate alternatives
1) audit current use

This section contains references to a wide variety of resources that students can use or adapt to implement their action plans. The following programs and organizations provide comprehensive energy efficiency resources in more than one area. Additional resources and groups are then included according to more specific categories as outlined on the contents page.

EnergySmart Schools, US Department of Energy – Contains listings of Building Resources, Bus Resources, Teaching Resources, Kids Links, Success Stories, and Related Web Sites. This site provides a broad array of background information on energy for use with students. www.eren.doe.gov/energysmartschools/about.html

The **New Jersey Board of Public Utilities' State Energy Program** is proposing to fund five programs for energy awareness and conservation in 2000-2001 for a limited number of schools. For applications, contact Alma Rivera, (973) 648-7405, NJBPU, Division of Energy, 2 Gateway Center, Newark, NJ 07102, email rivera@orion.bpu.state.nj.us:

- **Savings Through Energy Management**, recommended for grades 7-12. The goal of **STEM** is to train students and teachers in preparing an energy audit which will identify low cost or no cost energy conservation improvements in their school. Thirty hours of training over five weeks.

- **Watt Watchers Program**, recommended for grades 5-6. The Watt Watchers program is similar to STEM, but focuses only on electricity. Two days.
- **Energy UUUU**, recommended for grades 3-4. Standing for "We understand it's up to us to use energy wisely," Energy UUUU is a one-day program that teaches a group of up to 30 students the importance of energy in their lives.
- **Energy UUUU2** is a one-day program that teaches children the science principles associated with renewable energy sources that can be used to reduce fossil fuels and nuclear energy.
- **Posse's Energy Posse Program**, recommended for grades K-2. This one-day program uses a puppet, Sheriff Poss, to teach students how energy is used and wasted in their school building.

The NJBPU has established the **Clean Energy for New Jersey** Program, which works through the State's utility companies (www.njcleanenergy.com). Significant financial incentives for energy efficiency and renewable energy for schools are outlined in the Commercial and Industrial Program.

Green Schools Program of the Alliance to Save Energy combines energy efficiency management & building retrofit intervention with student involvement. Contact: Merilee Harrigan mharrigan@ase.org or Karen Anderson kanderson@ase.org (202) 530-2215

New Jersey Department of Environmental Protection, Office of Innovative Technology and Market Development is responsible for implementing the NJDEP's Greenhouse Gas Action Plan, which is available at http://www.state.nj.us/dep/dsr/gcc/gcc-download.htm. For more information, contact Mike Winka at MWINKA@dep.state.nj.us, or Athena Serafides at ASARAFID@dep.state.nj.us, 609-633-1161.

Greening the Garden State: A Report on Sustainable Business Actions in New Jersey is on the Building a Greener NJ website, www.bgnj.org**.** This report to the NJ Commerce & Economic Growth Commission describes sustainable businesses working in the energy sector, recycled products, agriculture, integrated pest management, and the chemical industry. Full contact information is provided. Available from the NJ Office of Sustainable Business, PO Box 820, Trenton, NJ 08625-0820 (609) 777-0885. www.state.nj.us/commerce/sustain.htm

Energy Service Companies (ESCOs) can consult with your school or district to find the most cost-effective choices for reducing energy use. Their fees can be negotiated so that they are paid from the financial savings that they produce. **It is important for individual schools also to negotiate with district personnel so that *some* or *all* of the district's financial savings are redirected to the school's ongoing energy conservation and GHG reductions efforts**. This source of continuing funding will help motivate school personnel and students to maintain an interest in energy saving activities. **A sample memorandum of understanding can be found in Addendum 2**. A list of ESCOs can be found in *Greening the Garden State: A Report on Sustainable Business Actions in New Jersey* www.bgnj.org, or be obtained from the NJ Office of Sustainable Business, PO Box 820, Trenton, NJ 08625-0820 (609) 777-0885.

A. Electricity

1. Lighting

a. Reduce waste/conservation

WATTEAM is the name of student energy patrols that monitor energy waste in the public schools of Texas. If students find lights on in empty rooms they leave "tickets;" they may leave thank you notes where their recorded data shows consistent energy efficiency. Full information on the program and sample forms can be downloaded from www.watteam.org. The Energy Education Network is the headquarters for the WATTEAM and is located in the Children's Museum in New Braunfels, TX. 1-888-WATTEAM (toll-free) or email at watteam@watteam.org.

The **Energy Patrol** is a similar program that originated at DeVargas School in the Cupertino Unified School District near San Jose, California. The program has reduced the school's energy costs by roughly 1/3 or $1,000 a month. That money can be used for other school programs. Full information and sample forms can be downloaded from: www.energy.ca.gov/education/patrol/index.html

School Library Energy Audit for grades 8-12 is available for free from the US Department of Energy at www.eren.doe.gov/buildings/k-12activities/index.htm. This unit contains all the information and worksheets needed for students to understand and conduct an energy audit for any room in a school, as well as to evaluate alternative energy-efficient lighting strategies.

b. Increase efficiency & reduce pollution

See Section One "Powered by Innovation," ***Greening the Garden State: A Report on Sustainable Business Actions in New Jersey***. Available at www.bgnj.org or from the NJ Office of Sustainable Business, PO Box 820, Trenton, NJ 08625-0820 (609) 777-0885.

i. High efficiency lighting/equipment

Manufacturers have made major strides in increasing the outputs and life spans of lighting equipment, including high performance and low mercury fluorescent lamps, electronic ballasts and compact fluorescent replacements for highly inefficient incandescent bulbs.

ii. Controls

2. Other uses: computers, office equipment, motors, A/C

i. High efficiency equipment/Energy Star

ENERGY STAR was introduced by the US Environmental Protection Agency in 1992 as a voluntary labeling program designed to identify and promote energy-efficient products, in order to reduce carbon dioxide emissions. EPA partnered with the US Department of Energy in 1996 to promote the ENERGY STAR label, with each agency taking responsibility for particular product categories. ENERGY STAR has expanded to cover new homes, most of the buildings sector—including schools, residential heating and cooling equipment, major appliances, office equipment, lighting, consumer electronics, and more product areas, which are listed at www.energystar.gov.

ii. Controls

3. Increase use of renewables

Renewable electricity resources are generated from the sun, water, wind, biomass (the burning of agricultural or other wastes), and geothermal (heat from the earth).

The Center For Resource Solutions established the **Green-*e* Renewable Electricity Certification Program** in order to encourage consumer confidence in buying "green" electricity. Inspired by the success of the recycling logo, the Green-*e* logo is a way for customers to easily identify "green" electricity products. The project is the nation's first voluntary certification and verification program for "green" electricity products. When you see the Green-*e* logo on an electricity product, you can be sure that at least 50% of the electricity supply for the product comes from Renewable Electricity Resources. Center For Resource Solutions, PO Box 29512 San Francisco, CA 94129, Tel: 415-561-2100, Fax: 415-561-2105 http://www.green-e.org/

The Power Scorecard is a tool for consumers that grades the types of generation resources used to produce electricity according to their effects on the environment. Although its original version includes only California and Pennsylvania, some of the suppliers are available to New Jersey consumers. Additional states will be added to the site as well.

Created by a group of six well-known environmental organizations (Environmental Defense, The Izaak Walton League, Natural Resources Defense Council, Pace University Energy Project , The Union of Concerned Scientists), the Power Scorecard gives clear, accurate, and reliable information to help you understand the real environmental differences among electricity products. The Power Scorecard grades the environmental quality of electricity products in two ways: **1. Overall Environmental Impact Rating:** [**AIR IMPACTS** 1. global climate change; 2. acid rain; 3. smog (ozone) and fine particulates; 4. toxic mercury emissions; **WATER IMPACTS** 5. consumption of water resources; 6. pollution of water bodies; **LAND IMPACTS** 7. on-site land impacts (permanent plant footprint); 8. off-site land impacts (solid waste disposal and fuel processing)] and **2. New Renewable Content Rating.** By using new, low-impact, renewable resources, a power supplier displaces older, often higher-polluting facilities - one of the very best ways to make a difference. http://www.powerscorecard.org. Pace University School of Law's Center for Environmental Legal Studies, White Plains, New York.

Community Energy is launching a wind farm near Scranton, PA in 2001 to produce electricity that will be available to New Jersey consumers. According to their literature, each 1.3 megawatt wind turbine keeps nearly 1,300 tons of coal in the ground each year or the equivalent to not driving 5.1 million miles or planting almost 1,100 acres of trees. Contact John Halley, 215-778-1133, johnhalley@earthlink.net.

B. Heating

1. Reduce waste/conservation

One simple step for energy conservation is to see if the thermostats for the heating system and the hot water system can be set lower and still meet the school's needs.

The Alliance to Save Energy free lessons below in section II.A.contain lessons on insulation and windows.

The U.S. Department of Energy provides a wide variety of fact sheets on insulation, energy efficient windows, water heating etc. at www.eren.doe.gov/consumerinfo/factsheet.html and at www.ornl.gov/roofs+walls/insulation/ins_01.html.

National Fenestration Rating Council (NFRC) at www.nfrc.org is a non-profit, public/private organization created by the window, door and skylight industry. NFRC provides consistent ratings on window, door and skylight products. The NFRC label rates: U-factor, or how well a window keeps heat inside a building, solar heat gain, or a window's ability to block warming caused by sunlight, visible light transmittance, or how much light gets through a product, and air leakage, or heat loss and gain by infiltration through cracks in the window assembly.

2. Increase efficiency & reduce pollution

See Section One "Powered by Innovation," ***Greening the Garden State: A Report on Sustainable Business Actions in New Jersey***. Available at www.bgnj.org or from the NJ Office of Sustainable Business, PO Box 820, Trenton, NJ 08625-0820 (609) 777-0885.

a. High efficiency equipment
b. Energy management systems
c. Boiler controls

3. **Increase use of renewables**

The Geothermal Project at Richard Stockton College provides support and information on geothermal systems to school boards and school administrators. http://vulcan.geo-phys.stockton.edu/ Contact Alice M. Gitchell (609) 652 4677 alice.gitchell@stockton.edu

Schools Going Solar: A Guide to Schools Enjoying the Power of Solar Energy is available free at http://www.ttcorp.com/upvg/schools/. Contents include: an Introduction, Solar Energy in U.S. Schools, Solar ABCs -- Photovoltaics, Passive Solar, Solar Thermal -- What You Need to Know About Going Solar, Creating Better Schools, Healthier Environments, Performance Contracting -- A Promising Means to Finance Solar Schools, as well as a listing of specific solar schools around the country.

4. Improved maintenance
Are school employees operating and maintaining all equipment according to the manufacturers' recommendation?

C. Transportation

1. Reduce waste/conservation

a. **Walk/bike to school**

Kids Walk-to-School is a program of the National Center for Chronic Disease Prevention and Health Promotion to encourage children to walk to and from school in groups accompanied by adults. www.cdc.gov/nccdphp/dnpa/kidswalk/.

Way To Go is a program in British Columbia, Canada for elementary schools to enable more children to walk, bike, carpool or take public transportation to school with their families, friends & neighbors. Contact: Way To Go, (604) 732-1511, toll free: (877)-325-3636, waytogo@bc.sympatico.ca, http:/www.waytogo.icbc.bc.ca/descript.html

b. Car pooling

2. Increase vehicle efficiency & reduce pollution

a. Improved maintenance

b. **New equipment**

In 2000, the South Coast Air Quality Management District, the agency responsible for air quality in Orange County and the urban portions of Los Angeles, San Bernardino and Riverside counties in California, established an Adopt-a-School Bus program to encourage businesses to help school districts pay for alternative fuel buses or diesel soot traps for existing buses. www.aqmd.gov

3. Increase use of renewables/alternative fuels

Advanced Technology Vehicle Taskforce, NJ Clean Cities Program gives assistance in finding funding for alternative fuel vehicles for municipalities. Contact: Ellen Bourbon, Alternative Fuels Project Manager, PO Box 350, Trenton, NJ 08625 (609) 984-3058 Bourbone@BPU.state.nj.us

New Jersey Genesis Project involves high schools, colleges and industry in building an alternative fuel car for entry in the Tour de Sol, an annual race for alternative energy cars. Contact: Kirsten Minich, Millenium Fuel Cell Corp., Minich@milleniumcell.com

California's Safe School Bus Clean Fuel Efficiency Demonstration Program provides alternative fuel buses to CA schools and has pioneered new technologies with existing school bus makers. Contact: Al Deterville, Transportation Technologies & Fuels Office, California Energy Commission, (916) 654-4685 ADetervi@energy.ca.gov
www.energy.ca.gov/afvs/schoolbus/index.html

The US Department of Energy's Clean Cities Program is a voluntary, locally based government/industry partnership to mobilize local stakeholders in the effort to expand the use of alternatives to gasoline and diesel fuel, accelerate the deployment of alternative fuel vehicles, and build a local AFV refueling infrastructure. www.ccities.doe.gov

The Natural Gas Vehicle Coalition is a national organization working to develop a growing, sustainable and profitable natural gas vehicle market. Their *2000-2001 Natural Gas Vehicle Purchasing Guide* contains passenger vehicles to school buses. www.ngvc.org

D. Waste Reduction

See Section Two "Re-made in New Jersey," ***Greening the Garden State: A Report on Sustainable Business Actions in New Jersey***. Available at www.bgnj.org or from the NJ Office of Sustainable Business, PO Box 820, Trenton, NJ 08625-0820 (609) 777-0885.

1. Recycling

Recycle newspapers. Paper made from recycled paper uses about one-third less energy than paper made from raw materials. Recycle glass bottles and jars. Glass made from recycled glass also uses about one-third less energy than glass made from raw materials. Recycle steel and aluminum cans and aluminum foil. Aluminum cans made from recycled aluminum use 90% less energy than aluminum made from raw materials. Buy products made of recycled material. Look for the recycle mark--three arrows that make a circle--on the package. (*Learning About Saving Energy*, Energy Efficiency & Renewable Energy Network, US Department of Energy -- www.eren.doe.gov/erec/factsheets/savenrgy.html)

2. Pollution prevention

Environmentally Preferable Purchasing is the procurement of products and services that have a lesser or reduced effect on human health and the environment when compared to competing products and services that serve the same purpose. The National Association of County's (NACo) Environmentally Preferable Purchasing Project assists counties to locate and select products that encourage the following: Reduced exposure to hazardous materials; Waste reduction; Energy efficiency; Conservation of resources; Cost effectiveness . NACo can also provide, upon request, information packets on eight product categories: automobile and fleet maintenance/alternative fueled vehicles; cleaners; pesticides and herbicides; office supplies; painting; printing; construction and demolition; green buildings/energy efficiency. www.naco.org/programs/environ/purchase.cfm

E. Offsets – Plantings

Whether or not planting more trees will help reverse global warming is a hotly debated issue in the global scientific community. U.S. governmental support for this strategy is one of the things that led to disagreements in the Kyoto negotiating process. The following resources, however, support plantings.

Trees absorb CO_2, the primary gas causing Global Climate Change. Trees retain the carbon (C) from the CO_2 molecule and release oxygen (O_2) into the atmosphere. The carbon makes up half the dry weight of a tree. One ton of carbon equals 3.67 tons of atmospheric carbon dioxide. Trees store carbon as they grow, so that their years of maximum carbon intake occur during their years of rapid growth. For most species in North America, this is between 10 and 60 years. AMERICAN FORESTS holds that three trees must be planted to ensure that at least one is likely to reach 40 years of age. This conservative number is the basis for our per-acre and per-tree

carbon sequestration figures. As they grow, trees compete for root space, sunlight, and water. Not all make it to 40 years, but those that do, represent the full carbon potential of that ground area. Shade trees, planted in the right places, can reduce air conditioning bills during summer, reducing one's climate "footprint." In cities, trees cool the "Urban Heat Island" effect and reduce electrical usage. (Source: AMERICAN FORESTS)

AMERICAN FORESTS provides a "Climate Change Calculator" geared toward individual and family activities at http://www.americanforests.org/clmt_chg/index.html. This site, which also contains the "Assumptions and Sources" used by the authors, can be adapted for school use.

The State and Territorial Air Pollution Program Administrators and the Association of Local Air Pollution Control Officials have an on-line slide show, ***Carbon Sequestration***, at www.4clearair.org/comments/GHGPowerPoint/CARBON/tsld002.htm. These 9 slides could be used with a class.

The U.S. Department of Energy has an interesting discussion, ***Global Climate Change…Science and Solutions: Sequestering Carbon***, at www.fe.doe.gov/issues/climatechange/globalclimate_sequester.html.

National Arbor Day is celebrated each year on the last Friday in April. **The National Arbor Day Foundation**, the world's largest tree-planting environmental organization, provides more than 8 million trees for planting throughout America each year. www.arborday.org.

II. Teaching About GHG Emissions, Global Warming, and Climate Change

A. Free Lessons, K-12

The Alliance to Save Energy Green Schools Project provides the following free lesson plans at www.ase.org/educators/lessons/index.htm:

Elementary School Lesson Plans

Energy Introduction to Lesson Plans

Energy Sources

Energy Activities

Yesterday and Today

How Much Energy Do You Use?

Wasting Energy at Home?

The Pay Me Game

Conserving Energy at School

Be "Sun"-Sible About Heating Water

Meter Reading

Middle School Lesson Plans

Acid Rain

Cost Effective Buying

Converting Fuels to Obtain Energy

A Home Energy Audit

The Formation of Fossil Fuels

The Electric Hookup

Insulation: Keeping Heat In or Out

Window Treatments for Energy Savings

The Appliance Explosion

Energy Transformations

High School Lesson Plans

Air Pollution: The Issue of Global Warming

Air Pollution: Lesson Plans

Energy: The Issue of Renewable Energy

Energy Efficient Homes

Generate Your Own Hydropower

Measuring the Number of Calories in Sunlight

To Conserve or Not to Conserve

Global Warming: Early Warning Signs. The Union of Concerned Scientists has posted a science-based world map depicting the local and regional consequences of global climate change, along with four activities: 1) climate change in my city, 2) oral history project: climate change then and now, 3) climate change and disease, and 4) climate change and ecosystems at www.climatehotmap.org/curriculum/index.html.

The Institute for Global Environmental Strategies has a collection of lessons on **The Potential Consequences of Climate Variability and Change** available for free and listed below at http://www.strategies.org/Climate.html.

OVERVIEW
Too Many Blankets (Grades 1-4) Simple experiments using fish tanks demonstrate the greenhouse effect.
Global Balance (Grades 5-12) A water reservoir model is used to demonstrate balance in a system.
AGRICULTURE
El Niño (Grades 5-8)
The Great American Desert? (Grades 9-12)
COASTAL AREAS
What Could a Hurricane Do to My Home? (Grades 5-8)
What Is El Niño? (Grades 5-8, 9-12)
Coral Reefs in Hot Water (Grades 9-12)
FORESTS
A Sticky Situation (Grades 5-8)
Planet Watch 2000 (Grades 9-12)
HUMAN HEALTH
Beyond the Bite: Mosquitoes and Malaria (Grades 5-8, 9-12)
Climate and Disease: A Critical Connection (Grades 9-12)
WATER
Here, There, Everywhere (Grades 7-8, 9-12)

Two more related lessons from IGES are *CO_2 and You*, available at www.strategies.org/lesson2.html, and *Earth's Energy Budget or Can You Spare a Sun?* at www.strategies.org/LESSON8.html.

B. Other Resources

Energy Education Resources: Kindergarten through 12th Grade. National Energy Information Center, EI-30, Energy Information Administration. Room 1E-238, Forrestal Bldg., 1000 Independence Avenue, S.W., WASHINGTON DC 20585. (202) 586-8800. Email: infoctr@eia.doe.gov. 1999. Free printed report updated annually that contains a list of organizations that provide free or low-cost energy-related materials and also available at www.eia.doe.gov/bookshelf/eer/kiddietoc.html.

Energy Efficiency and Renewable Energy Clearinghouse (EREC), 1617 Cole Blvd., Golden CO 80401. (303) 275-4826 (800) 363-3732
Email: sustainable.development@hq.doe.gov,
provides factsheets at www.eren.doe.gov/factsheets/factsheets.html
and technical and reference briefs at www.eren.doe.gov/consumerinfo/briefs.html

EnergyNet, Educational Dividends, Illinois. EnergyNet is an innovative network science project, in which students evaluate their school's heating and lighting systems and then share their data over the Internet. Students thus form scientific research communities in which they learn about the production, cost, and management of the energy upon which both their school and their society depend. – *Energy Detectives Project* for grades 3-5 and *Energy Auditing Project* for grades 6-12 at www.energynet.net

EnergySmart Schools, US Department of Energy – Contains listings of Teaching Resources at www.eren.doe.gov/energysmartschools/teach_stuff.html.

EZ Sim: the Billing Simulation Tool, by Stellar Processes, an energy engineering consulting firm. This spreedsheet software is used in the Green Schools Program. It uses current billing

information and provides "what if" hypothesis testing for conservation measures. Cost $199. www.ezsim.com.

Global Warming: Opposing Viewpoints. Tamara L. Roleff, ed. San Diego, CA: Greenhaven Press, Inc. n.d. This book of essays is appropriate for secondary students if you want to explore the pros and cons of the debate on this subject.

Global Warming: Understanding the Forecast – This web site is based on an exhibition from the Smithsonian's National Museum of Natural History. www.enviroweb.org/edf

The GLOBE Program – Global Learning and Observations to Benefit the Environment is a worldwide network of students, teachers, and scientists to study and understand the global environment. http://www.globe.gov

Greenhouse Gases, Global Climate Change, and Energy is a general discussion with graphics at the U.S. Department of Energy, www.eia.doe.gov/oiaf/1605/ggccebro/chapter1.html.

Recognizing the problem of potential global climate change the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) established **the Intergovernmental Panel on Climate Change (IPCC)** www.ipcc.ch in 1988. The role of the IPCC is to assess the scientific, technical and socio-economic information relevant for the understanding of the risk of human-induced climate change. It does not carry out new research nor does it monitor climate related data. It bases its assessment mainly on published and peer reviewed scientific technical literature. The IPCC has three working groups and a Task Force:

Working Group I assesses the scientific aspects of the climate system and climate change.
Working Group II addresses the vulnerability of socio-economic and natural systems to climate change, negative and positive consequences of climate change, and options for adapting to it.
Working Group III assesses options for limiting greenhouse gas emissions and otherwise mitigating climate change.
The Task Force on National Greenhouse Gas Inventories oversees the National Greenhouse Gas Inventories Programme.

NASA Global Change Materials Directory Learning Center – the place to find all sorts of data and information about global environmental change. http://gcmd.gsfc.nasa.gov