energy EXCHANGE

The National Energy Education Development Project September 2008

OCS Resources

The Outer Continental Shelf (OCS) provides 27 percent of current U.S. domestic oil production and 15 percent of domestic natural gas production. There have been restrictions by Congress, or a moratorium, since 1982 on where OCS drilling and exploration can occur. In 1990, President George H. W. Bush added his own restrictions. The moratorium was meant as a temporary action to asses the potential environmental impacts of additional OCS exploration and drilling. However, the restrictions have become longstanding. The areas under the moratorium could contain an additional 18 billion barrels of oil and 76 trillion cubic feet of natural gas, or possibly more.

In July, President Bush lifted the Executive Withdrawal on OCS oil and gas leases and urged Congress to do the same. Lifting the OCS moratorium allows the Minerals Management Service (MMS) of the U.S. Department of the Interior to provide additional lease agreements with companies that want to explore and drill in the OCS. MMS operates OCS lease agreements in five year increments, with the current plan to expire in 2012.

The goal for MMS and OCS resource use is to balance the energy needs of the nation with environmental concerns. When the current lease plan was initiated, oil prices were high, but still manageable and U.S. citizens were not as frustrated with gasoline prices as they are today. The economic impact of rising prices led the President to begin the process of opening up the resources of the OCS.

Expanded exploration and drilling in the OCS follows strict environmental regulations and will likely increase domestic jobs and oil production. However, critics argue that the amount of oil expected to be produced from the OCS moratorium areas is not enough to justify the potential environmental risks.

NEED curriculum with background information and activities about offshore drilling and energy resources include **Ocean Energy** (grades 5-8) and **Marine Energy** (grades 7-12). Additional information on the OCS, MMS, and environmental compliance can be found at www.mms.gov.

June 2008 Youth Awards

NEED's 28th Annual Youth Awards for Energy Achievement was a resounding success. Students and teachers from around the country came together to celebrate their energy education success for the past year. Congratulations to all the winners!

See page five for a list of winners and project ideas. For information about how to participate in the annual Youth Awards Program, visit www.need.org/youthawards.php.

Students from Chatham Middle School in Chatham, MA on the TourMobile with EIA's Energy Ant.

EIA *Energy in Brief* Series

An addition to the Energy Information Administration (EIA) website, *Energy in Brief*, uses plain language to make energy information more accessible to the public. Visit http://tonto.eia.doe.gov/energy_in_brief to read quick, understandable articles about current energy questions and topics such as, "How dependent are we on foreign oil?" and "How much renewable energy do we use?".

Inside This Issue

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The NEED Project is a 501(c)(3) nonprofit education association providing professional development, innovative materials correlated to the National Science Education Content Standards, ongoing support and recognition to educators nationwide.

A list of NEED sponsors is available at www.need.org and in the Annual Report.

Energy Exchange is published five times a year by NEED for educators and students, and is available at www.need.org.

NEED welcomes questions, comments, and suggestions. Please contact info@need.org.

Calendar of Events

September

10	TXU Energy Solar Academy Workshop – Mesquite ISD, TX
16	Oklahoma Energy Workshop sponsored by ConocoPhillips – Ponca City, OK
18	H_2 Educate Workshop – Columbia, SC
17	Oklahoma Energy Workshop sponsored by ConocoPhillips – Bartlesville, OK
17-18	Virginia Naturally Conference – Martinsville, VA
18	New Mexico Energy Workshop sponsored by ConocoPhillips – Farmington, NM
23	Montana Energy Workshop sponsored by ConocoPhillips – Billings, MT
24	Society of Petroleum Engineers/NEED Workshop – Denver, CO
25	TXU Energy Solar Academy Workshop – Cleburne ISD, TX
25	Alaska Energy Workshop sponsored by ConocoPhillips – Anchorage, AK
30	Washington Energy Workshop sponsored by ConocoPhillips – Ferndale, WA
30	Colorado Energy Resources Workshop sponsored by EnCana – Erie, CO

October-Energy Awareness Month

1	Colorado Energy Resources Workshop sponsored by EnCana – Denver, CO
1-2	Idaho Professional Development Energy Workshop – Idaho Falls, ID
2	Texas Energy Workshop sponsored by ConocoPhillips – Houston, TX
7	Texas Energy Workshop sponsored by ConocoPhillips – Sweeny, TX
7	Colorado Energy Resources Workshop sponsored by EnCana – Rifle, CO
11	H_2 Educate Workshop sponsored by the Sacramento Municipal Utility District – Sacramento, CA
21	Wilmington/Carson Energy Workshop sponsored by ConocoPhillips – Wilmington, CA
22	New Jersey Energy Workshop sponsored by ConocoPhillips – Linden, NJ
29	Colorado Energy Resources Workshop sponsored by EnCana – Parachute, CO
30 - Nov 1	NEED Sessions at NSTA Regional Convention – Charlotte, NC
30 - Nov 2	NEED Sessions and Exhibits at California Science Teachers Association Conference – San Jose, CA

November

6	Colorado Energy Resources Workshop sponsored by EnCana – Denver, CO
6-8	NEED Sessions & Exhibits at Conference for the Advancement of Science Teaching – Fort Worth, TX
13-15	NEED Sessions at VA Association of Science Teachers Conference – Hampton, VA
20-21	NEED Sessions & Exhibits at CO Science Teachers Association Conference – Denver, CO
20-22	NEED Sessions at NSTA Regional Convention – Portland, OR

December

4-6	NEED Sessions at NSTA Regional Convention – Cincinnati, OH

For additional workshops and upcoming events, visit www.need.org/calendar.php.
For more information, email info@need.org or call 800.875.5029.

Energy Exchange in the Classroom

This issue of Energy Exchange focuses on transportation and fuel economy. Interested in teaching your students more about energy and transportation fuels? NEED materials have you covered.

Primary Stories and More (K-4) contains three stories exploring the topics of petroleum and gasoline: Under the Sea, Into Deep Water and A Car Ride for Carlos. **What Car Will You Drive?** (4-6) and **The Future is Today** (7-12) give students an overview of transportation fuels. There are also specific materials dedicated to **Biodiesel** (4-12) and **Ethanol** (4-12) which give students a more in depth look at these popular fuels. **Transportation Fuels Debate** (6-12) is a game that lets students debate the advantages and disadvantages of transportation fuels. Bring out your students' creativity using **Transportation Fuels Rock Performances** (4-12), where student rock bands write songs and sing about transportation fuels. One activity that allows your students to learn about transportation fuels and to teach others is **Transportation Fuels Expo** (4-12). In this activity, students work in groups to develop exhibits and make presentations about transportation fuels. A fun culminating activity is **Transportation Enigma** (7-12), a cooperative learning game where groups work to identify major fuel sources using hidden clues.

All of these materials are available to download at www.need.org.

NEED News

Welcome Back to School!

The new NEED materials are updated and available! Teachers asked for more online resources and we listened. The curriculum section of the website, www.need.org/curriculum.php, has most of NEED's Teacher Guides available by grade level, topic, or alphabetically. Let us know what you think about the expanded delivery of NEED materials via web by emailing info@need.org.

Students from Greensburg, KS make a solar oven at a one-day energy camp led by NEED staff.

Rebuilding a Greener Greensburg

On May 4, 2007, an F5 tornado hit the town of Greensburg, Kansas, destroying 95 percent of the town. In the wake of the storm, the city council passed a resolve to rebuild their town to the highest LEED standards—making it the greenest city in the United States.

To kick off the new school year, NEED staff visited the schools and presented a one-day energy camp filled with fun energy activities. Students learned about forms and sources of energy, sang energy rock songs, made solar ovens, and experimented with hydrogen and wind energy. Afterwards, students from the local energy team took the NEED staff on a tour of Greensburg, showcasing the town's historic sites as well as the new 547 Art Center—the first LEED Platinum building in the state.

To learn more about Greensburg, check out the show "Greensburg" on Discovery's Planet Green channel or visit http://planetgreen.discovery.com/tv/greensburg/.

Energy Awareness Month

Remember that October is Energy Awareness Month and the kick off of the **Change the World, Start with ENERGY STAR®** campaign. The **National Ocean Industries Association**, the **U.S. Department of the Interior**, and the **U.S. Department of Energy** worked with NEED to provide an updated Offshore Energy Resources activity book for students for Energy Awareness Month. The activity books come packaged in sets of 30. To request a set, email Samantha Forbes at sforbes@need.org. Watch NEED's Energy Awareness Month website, www.need.org/EnergyAwarenessMonth.php, for fun activities and ideas to celebrate Energy Awareness Month.

Employees and their children enjoy NEED's Energy Carnival at ConocoPhillips' *Take the Future to Work* day.

NEED Welcomes New Staff

Melanie Harper, of Odessa, Texas, recently joined the national NEED staff. Melanie is supporting both the programming and curriculum sides of NEED by leading teacher workshops and creating energy and earth science activities. NEED is excited to have her on board. Welcome, Melanie!

Take the Future to Work with ConocoPhillips

Last month, NEED, in continuation of its partnership with ConocoPhillips, participated in ConocoPhillips' *Take the Future to Work* day. Over 150 employee children attended the event with their parents where they listened to presentations and participated in activities related to energy. NEED presented the Energy Carnival where students tested their knowledge of the energy sources, transportation fuels, efficiency and much more.

NEED at the Society of Petroleum Engineers – Denver, Colorado

Working with the **Society of Petroleum Engineers**, Denver area teachers will have the opportunity to be trained on NEED materials, tour the SPE exhibit floor and learn more about the nation's energy picture.

EnCana and NEED Partner in Colorado

NEED is pleased to launch a program providing teacher workshops and curriculum materials to schools in Colorado with the sponsorship of **EnCana**. EnCana's support provides hands-on kits, teacher workshops and classroom support in several communities in Colorado.

Energy Exchange and Career Currents in 2008-2009

In an effort to keep costs low, and reduce the use of energy resources for printing and mail, NEED will begin delivering its Career Currents and Energy Exchange newsletters electronically. Recipients of the newsletters may elect to receive an email announcing that the newsletters have been posted online. To view the newsletters each month, and to access back issues, visit www.need.org/newsletters.php. To make sure you can receive email from NEED, set your spam blocker to accept email from need.org.

ENERGY STAR®

Recycle My Old Fridge with ENERGY STAR®

Students from Scituate, RI showcase their artistic side by participating in the ENERGY STAR® Art Fridge Project.

The U.S. Department of Energy and ENERGY STAR® have officially kicked off their Recycle My Old Fridge Campaign. Refrigerators more than 16 years old are using twice as much energy as needed to cool food, costing families an average of $100 every year just by being plugged in. Recycling your fridge also results in huge energy savings. The nationwide effort encourages people to recycle their old energy-wasting refrigerators and replace them, if necessary, with newer, ENERGY STAR® qualified models. Visit www.recyclemyoldfridge.com for more information about the program, to find recycling centers, and to calculate how much your old fridge is costing you. The site also features a NEED curriculum guide to help teachers bring the campaign into their classrooms.

ENERGY STAR® was at NEED's Career Fair at Youth Awards this summer, and their website includes over thirty videos by NEED students. NEED students also participated in the Art Fridge Project. Their fridge door will be on display at the National Building Museum in Washington, D.C. from August 25 to September 2, 2008 alongside some of the greatest artists from across the country.

Celebrate National ENERGY STAR® Change a Light Day on Wednesday, October 1, 2008

NEED's participation in the 2007-2008 ENERGY STAR® Change a Light, Change the World Campaign has been a great success. NEED, along with our state affiliates, collected 24,729 Pledges and replaced 54,876 bulbs, with the potential to save 15,475,032 kWh of energy, $1,439,178 in energy costs, and preventing 22,444,284 pounds of greenhouse gas emissions. Congratulations to the most active state affiliate, **Kentucky NEED**, with 21,980 Pledges. Congratulations also to the school group that collected the most, **St. Isidore NEED Group**, with 1,326 Pledges. Thank you to everyone who took the Pledge and to the NEED students who spread the word in their communities.

This year, the campaign takes on a new name and expanded focus encouraging all Americans to take small, individual steps that make a big difference in the fight against global warming. In addition to Pledging to change at least one light in your home to an ENERGY STAR® qualified one, the Pledge provides the opportunity to "Do Even More." For example, setting a programmable thermostat or purchasing ENERGY STAR® qualified appliances.

Participating in the **Change the World, Start with ENERGY STAR®** campaign is a great energy club or classroom activity. If you plan to collect at least 100 Pledges, sign up your school as a second tier Pledge Driver under "National Energy Education Development Project (NEED)." You will be able to track the number of Pledges you collect and receive recognition for meeting your goal while NEED receives credit for your efforts. Starting on **October 1, 2008** you can register as a Pledge Driver for this year's campaign and begin collecting Pledges. Go to www.energystar.gov to register.

A free NEED Teacher's Guide with suggestions for implementing the Change the World campaign is available to download at www.need.org. Take the Pledge today and help us reach our goal of at least 1,000 Pledges in 2008-2009. Then choose an ENERGY STAR® qualified compact fluorescent light bulb and replace the most often used bulb in your home, office, or school. It's a small step towards making a big difference. Visit www.need.org to take the Pledge.

NEED in Action

2008 Youth Awards for Energy Achievement

NEED's Youth Awards Program encourages student leadership. Do you plan to participate in energy related service projects or education outreach this year? Get your students in gear now for Youth Awards 2009. To jump start your students' excitement, here are some ideas from the 2008 award winners.

The busy students from **Huntingdon Primary School** in Tennessee participated in six energy tours, hosted fourteen energy speakers, recycled to raise money to purchase an energy efficient water heater and CFL bulbs for a Habitat for Humanity house, and took part in the ENERGY STAR® Change a Light, Change the World campaign. Students from **A.K. Suter Elementary School** in Florida took a fieldtrip to a landfill, started a recycling program, educated their community about CFL bulbs, and lobbied a local congressman for energy reform. At **St. Isidore School** in Nebraska, students presented energy plays, designed energy lesson plans, wrote energy radio announcements and newspaper articles, and participated in culminating Energy Fairs for Kindergarten, fifth and eighth graders. Students at **Fayette Academy** in Tennessee distributed CFL bulbs they purchased through fundraising, grants and donations, instituted their school's first energy policy, networked with local and state legislators, and established an elementary mentoring program.

Distinguished Service Awards
Viola Henry—Thaxton Elementary, Virginia
Irene Brown—BP America, Inc.

Student Leader of the Year
Ryan Flynn—Rhode Island

Youth Energy Leadership Awards
Brooke Cowden—Alice Lloyd College
Ricardo Edwards—Columbia College Chicago
Ryan Flynn—University of Rhode Island

State of the Year
Ohio—Ohio Energy Project

Special Category—District of the Year
Kenton County School District—Kentucky
Project Adviser: Chris Baker

Primary School of the Year
Huntingdon Primary School—Tennessee
Project Adviser: Connie Bond

Elementary School of the Year
A.K. Suter Elementary School—Florida
Project Adviser: Deborah Pate

Junior School of the Year
St. Isidore School—Nebraska
Project Adviser: Mary Lou Green

Senior School of the Year
Fayette Academy—Tennessee
Project Adviser: Donna Burrus

Wind Energy Explorations

Keep NEED informed of how students and teachers across the country are involved with energy education in their school and community. Please send updates and photos to info@need.org. Thanks to Ann Fleischer, fourth grade teacher, for sharing her students' accomplishments.

Just before summer break, students at **Tom Matsumoto School** in San Jose, California used a NEED Wind Kit, provided by Pacific Gas and Electric Company, to explore the energy in wind. Students worked in six-person teams trying to find out how to best use energy from wind power. Investigators fashioned make-shift wind gauges out of paper cups, straws, and pencils and used the Beaufort Scale to measure wind speed. Parents cut PVC pipe and bought enough joints so that five model wind turbines could be fashioned by students. The NEED kit included enough hubs, dowels, small generators with lead attachments, and duct tape for the students to put together their energy producing devices.

Tilting a turbine blade to determine the best pitch.

The fourth graders had to determine the following: how many blades to use, what the pitch should be, and what the distribution should be. Halfway through the process, light weight wooden blades were introduced, sending each team back to the drawing board to evaluate combination choices.

To establish wind speed consistency, a household fan was used to test the turbines. NEED's kit included voltage meters for each team, which they used to see how much electricity their turbines were producing.

Many new skills were learned as students worked together to try to produce enough electricity to power a flashlight bulb. In the end, it was determined that linking all the turbines together would have easily powered the light, but time and logistical constraints kept them from testing their hypothesis. Students were asked to ponder the outcome for the summer.

Energy Essentials

Pricing a Gallon of Gasoline

Gasoline is the main product from crude oil refining and is one of the major transportation fuels consumed in the United States. In 2007, the U.S. used 142 billion gallons of gasoline, an average of about 390 million gallons per day. This equals 17 percent of total U.S. energy consumption, 44 percent of all the petroleum consumed, and 61 percent of energy consumed solely for transportation. Most of the gasoline is used in cars and light trucks, but it is also used for boats and farm, construction and landscaping equipment. Specialized tanker trucks that deliver gasoline to the 167,500 retail stations receive their load from terminals connected to oil refineries through a vast array of pipelines.

What contributes to the price of gasoline?

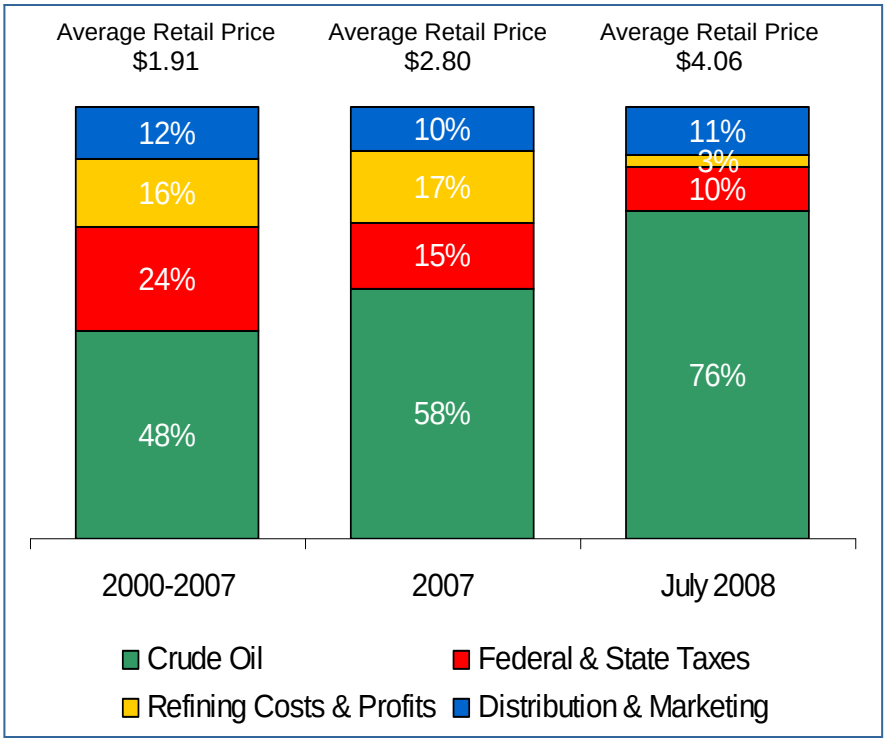
Crude Oil Prices: In July 2008, crude oil costs accounted for 76 percent of the price of a gallon of gasoline. This is significantly higher than the average for the past several years.

Taxes: Federal, state, county and local taxes all contribute to gasoline prices. Federal and state taxes comprised 10 percent of the price of gasoline in July 2008, which is much lower than previous years. Some states have additional taxes. Additional county and city taxes can have a large impact on local prices of gasoline.

Refining and Profits: The cost to refine crude oil and provide a profit to the company amounted to only three percent of the price of a gallon of gas in July 2008. This is a much smaller percentage to the past.

Distribution and Marketing: In July 2008, distribution, marketing, and retail station costs and profits equaled 11 percent of the price of a gallon of gasoline, a similar average for the past several years.

Contributing Costs for a Gallon of Gasoline



Source: Energy Information Administration

Why do gasoline prices fluctuate?

Crude Oil Supply and Prices: Crude oil prices are determined by worldwide supply and demand. Current high demand relative to supply worldwide has contributed significantly to the increase in gasoline prices. Additional factors that shape the price of crude oil are political events and conflicts in major oil producing areas and the declining value of the U.S. dollar.

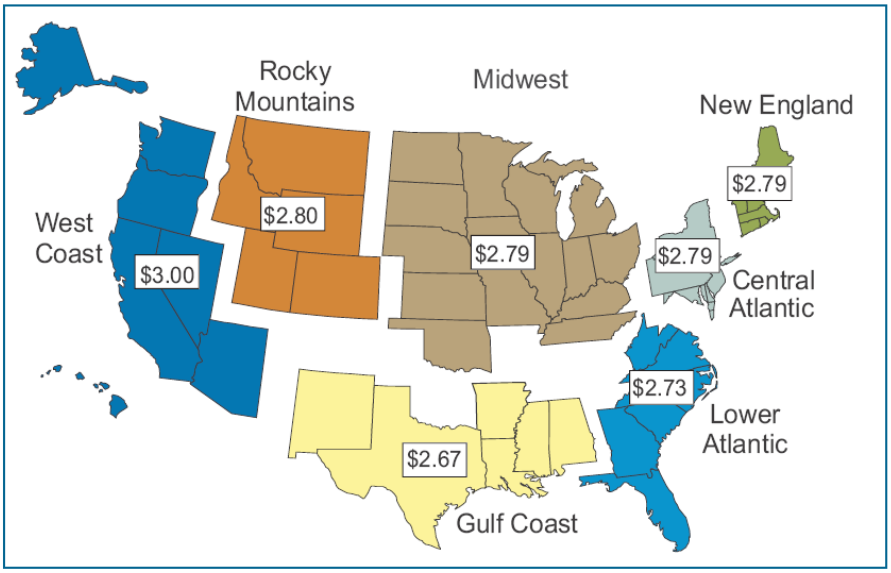
Gasoline Supply and Demand: Like most retail commodities, gasoline prices tend to increase when the demand is high but the supply is low, and they decrease when the demand is low but the supply is high. Gasoline supply is determined by crude oil supplies, refining capabilities and gasoline stocks. Stocks are the additional gasoline inventories that can lessen the difference between major short-term supply and demand imbalances. Stocks can have a strong influence on gasoline prices. For example, if a problem at a pipeline or refinery causes gasoline stocks to decrease, the cost for the available supply of gasoline typically increases as wholesalers anticipate future supply deficits.

Seasonal Demand: In the U.S., gasoline prices gradually increase starting in spring to their peak in late summer. The demand for gasoline in the summer is usually five percent higher than the rest of the year. Good weather and vacations account for the demand increase. Even if there is no change in crude oil prices, U.S. consumers can expect a 10 to 20 cent increase in gasoline prices from the start of the year to summer.

Why are gasoline prices regionally different?

Distance from Supply: The farther away a retail station is from the source of the supply, the higher the price of gasoline. Locations that are far from ports, refineries, pipelines or terminals have higher prices. Since two-thirds of the crude oil processed in the U.S. was imported in 2007, and most of that was brought by ocean tankers, the U.S. Gulf Coast is the source of about 40 percent of the gasoline produced nationally. Additionally, the Gulf Coast region is the beginning of most major gasoline pipelines. Typically states in the Gulf Coast region of the U.S. have the lowest gasoline prices.

2007 Regional Retail Prices for Regular Grade Gasoline



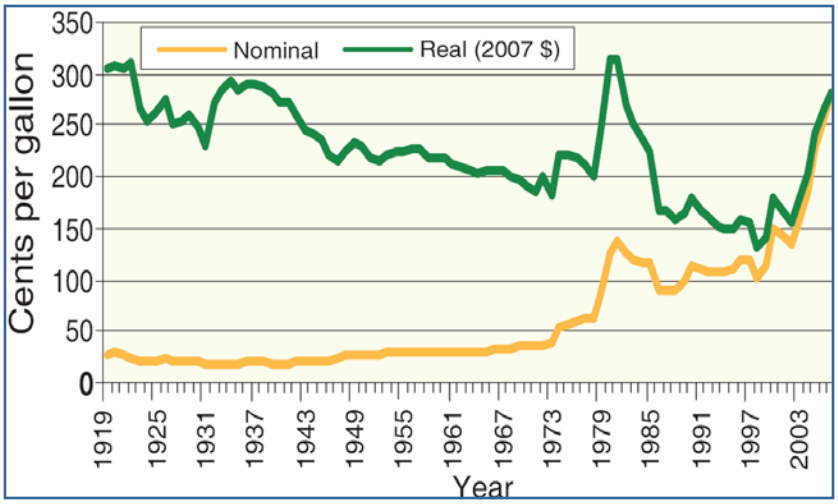
Source: Energy Information Administration, *EIA-878, Motor Gasoline PriceSurvey.*

Supply Disruptions: Disruptions in gasoline production even for short periods of time can influence regional prices. Disruptions include planned maintenance and unexpected repairs for refineries and pipelines, and unplanned shutdowns (such as those that occurred with Hurricanes Katrina and Rita).

Retail Competition and Operating Costs: Gasoline prices are often higher in retail locations that have fewer stations nearby. Traffic patterns, rent, and gasoline supply sources differ from station to station, which also contributes to differences in costs.

Environmental Programs: Some areas of the country have environmental programs designed to reduce carbon monoxide, smog and other air toxins. These programs require the use of "reformulated" gasoline which has special additives. Additional programs put restrictions on gasoline storage and transportation. These programs often add to the cost of producing, storing and distributing gasoline.

Average Annual Regular Grade Gasoline Prices—Nominal and Real



Source: Energy Information Administration, *Short Term Energy Outlook, January 2007*

How do current prices for gasoline compare historically?

Knowing what components drive the costs of a gallon of gasoline and why prices fluctuate does little to help the sinking feeling consumers currently have at the pump. But how do prices compare historically? Looking at prices adjusted to reflect inflation, or "real" prices, the highest historical prices per gallon in the U.S. were in the early 1920s and early 1980s. 2007 prices fell below those prices, but current prices are almost one dollar higher than those historic highs.

For more information, visit www.eia.doe.gov/bookshelf/brochures/gasolinepricesprimer.

Energy Connections

Predicting and Estimating

Materials: 1 clean, empty gallon milk jug, 1 cup measuring cup, water, 1 cup cotton balls or 1 cup marbles

In America, gasoline is dispensed by the gallon, a unit of volume. What does a gallon of gas look like? Show students an empty, clean, gallon size milk jug. Explain it is a one gallon container; equal to the amount of one gallon of gas.

1. Have students predict how many cups of water it will take to fill up the jug. Use a 1 cup measuring cup to fill the jug. Count the number of cups of water needed to fill the jug (16 cups).
2. Have students predict how many cotton balls or marbles it will take to fill up the jug.
3. Challenge the students to figure out a way to estimate the answer (count the number of cotton balls or marbles in 1 cup and multiply by 16). Have students make an estimation of the amount in the gallon. How does the estimation compare to the predictions?

Drawing and Analyzing a Bar Graph

1. Ask students, "How did you get to school today?" List all the modes of transportation on a piece of chart paper. Tally the number of students who used each mode of transportation. Instruct students to use the data to create a bar graph.
2. Discuss where the energy to drive a car or bus comes from (fossil fuels). Discuss where the energy to walk or ride a bike comes from (the food we eat). Go through the class list and discuss the fuels each mode of transportation uses. On their bar graphs, have students color the modes of transportation that use fossil fuels blue, and those that don't green.
3. Instruct students to use their bar graphs to determine how many students used fossil fuels to get to school and how many did not. Compare answers. Encourage students to brainstorm reasons why the data looks this way. (Why do so many students walk to school, or why does almost everyone ride a bus? Questions will vary depending on your community.)

Current Events

When completing current events projects with your students, include the article about lifting the moratorium on OCS exploration and drilling (front page). Have students research the resources on the OCS, the environmental policies and impacts surrounding drilling there, and take up opposing sides in a debate about opening up the OCS.

Primary Transportation Activity: School Bus Hunt

Concepts

- Objects have many observable properties, including size, shape, and color. (NSECS K-4: Physical Science 1a)
- Objects are made of one or more materials, such as paper, wood, and metal. Objects can be described by the properties of the materials from which they are made. (NSECS K-4: Physical Science 1b)

Preparation

Request permission and schedule a school bus driver to park a bus in your school's parking lot. Ask the bus driver to give a tour of the school bus.

Introduction

1. Ask: Who rode on a school bus today? Let a few students share experiences riding on a school bus.
2. Tell students they will be touring a school bus and meeting a bus driver. They will learn about what a bus is made of and what fuel it uses to transport students.

Activity

1. Tour the bus inside and out; be sure the tour allows students to see the engine.
2. Instruct students to look around the bus and point to something round. Have the bus driver help students name the round objects they find. Discuss what makes each round object different. For example, a tire is "big and black" and a screw is "small and silver." Help students determine what material each object is made of, such as the tire is made of rubber, and the screw is made of metal.
3. Choose another property and have students hunt again. Discuss the properties and materials of the found objects as in step 2. Suggestions include: Find something green. Find something square. Find something hard. Find something large. Continue hunting as time permits.
4. Seat the students inside the bus and discuss the purpose of a school bus (transport students safely to and from school). Ask students about other ways to get to school (car, walk, bike).
5. Discuss with students the fuels that are needed to get to school, include fuel for vehicles and buses (typically gasoline and diesel) and fuel for bodies (food).

Extensions

1. Ask the bus driver to prepare a short (2-5 minute) presentation about the responsibilities of a bus driver. Allow time for students to ask questions.
2. Sing "The Wheels on the Bus" but change verses to represent the objects and properties students observed. For example, the tires on the bus are big and black.

Elementary Transportation Activity: Bus Stop

Concepts

- Objects have many observable properties, including size, weight, shape, and color. (NSECS K-4: Physical Science 1a)
- Objects are made of one or more materials, such as paper, wood, and metal. Objects can be described by the properties of the materials from which they are made. (NSECS K-4: Physical Science 1b)

Materials

Chart paper
School bus and bus driver
Science notebooks or piece of paper per student

Preparation

Request permission and schedule a school bus driver to park a bus in your school's parking lot. Ask the bus driver to prepare a short (2-5 minute) presentation about the responsibilities of a bus driver, followed by a tour of the school bus.

Introduction

1. Ask: Who rode on a school bus today? Let a few students share experiences riding on a school bus.
2. Discuss the purpose of a school bus (to safely and efficiently transport students to and from school).
3. Tell students they will be touring a school bus and meeting a bus driver. They will observe the bus to discover what a bus is made of and learn what fuel the bus uses.
4. If students have questions for the bus driver, write them on chart paper.

Activity

1. Instruct students to fold a piece of paper lengthwise into thirds. Label the left column OBJECTS. Label the middle column PROPERTIES. Label the right column MATERIALS.
2. Seat students inside the school bus. Listen to the bus driver's presentation on the responsibilities of a bus driver.
3. Tour the bus inside and out. Look at the engine compartment, wheels, body, etc.
4. Under the OBJECTS column, students will make a list of objects they observe on the bus (seats, steering wheel, tires, etc.) Give students five minutes to work.
5. Gather students back inside the bus. Discuss their observations. Did anyone observe something green? Something silver? Something square? Something round? Something small? Something large? Explain that these attributes are observable properties. Give students five minutes to fill in the PROPERTIES column for each item.
6. Choose an object, such as a tire and ask students what it is made of. Discuss how they can find answers if they aren't sure (ask the bus driver, look up bus manufacturing online, perform a test). Explain that all objects are made of one or more materials, such as paper, wood or metal. Did anyone observe an object made of paper on the bus? Wood? Metal? What other materials did they notice (rubber, copper, plastic, glass, etc.)? Give students five minutes to fill in the MATERIALS column for each item.
7. Discuss with students others ways to travel to and from school (car, walk, bike). Ask students what is needed to fuel each mode of transportation (gasoline, food). Ask the bus driver to talk about what fuel is used for the bus (typically diesel).
8. As a class, make comparisons between the various modes of transportation in terms of fuel and materials used to make them. Discuss which ways of travelling to and from school are most similar and most different.
9. Let students ask the bus driver any questions they have about being a bus driver, the fuel used, and the objects, properties and materials that make up a school bus.

Assessment

Explain that objects can be described by the properties of the materials from which they are made. Instruct students to choose three objects on their list and mark them with a star. On the back of their paper, students will write descriptive sentences for each starred object, describing properties of the materials. For example, tire: A tire is round. It is made of rubber. Rubber is black. It smells funny, too.

Extensions

1. Make a bar graph of each type of material found on the bus (plastic, wood, metal, rubber, etc.).
2. Discuss with students the types of materials on the bus that are made using petroleum products.

Intermediate Transportation Activity: Calculating Fuel Economy

Concepts

- Vehicles vary in their fuel economy.
- The fuel economy of a vehicle impacts travel costs.

Preparation

Visit the websites used in the activity to familiarize yourself with the contents.

Determine if the research portion will be completed for homework or in the computer lab. If using the lab, request computer lab time. Make sure students are able to access the sites from the computer lab.

Vehicle Classes Used by the EPA

Class	Passenger & Cargo Volume	
Two-seater cars		
Sedans		
	minicompact	under 85 cu. ft.
	subcompact	85-99 cu. ft.
	compact	100-109 cu. ft.
	midsize	110-119 cu. ft.
	large	120 or more cu. ft.
Station Wagons		
	small	under 130 cu. ft.
	midsize	130-159 cu. ft.
	large	160 or more cu. ft.

Class	GVWR
Pickup Trucks	
small	under 6000
standard	6000-8000
Vans	under 8500
passenger	
cargo	
Minivans	under 8500
Sport Utility Vehicles	under 8500

(Gross Vehicle Weight Rating = vehicle weight plus carrying capacity)

Introduction

1. Discuss as a class the meaning of fuel economy. A fuel economy rating for a vehicle is the estimated miles per gallon it will travel in city and highway driving. Fuel economy is estimated by the U.S. Environmental Protection Agency (EPA) using laboratory tests to simulate various driving conditions.
2. Discuss the terms class, make, and model as they refer to vehicles. Class is the type of vehicle, for example, pickup truck or sedan. Make is the brand of vehicle, for example, Ford or Toyota. Model is the specific version of a vehicle, for example, F150 or Camry.
3. As a class, determine what classes of cars to divide the vehicles into or use the EPA classifications.
4. For homework, have students determine the class, make, model and year of a vehicle at their home or of someone they know.

Activity

1. Have students look up and record the fuel economy for their vehicle using www.fueleconomy.gov.
2. As a class, determine how far a field trip to NEED Headquarters would be from your school.
3. Have each student calculate how many gallons of gas it would take them to drive their vehicle to NEED Headquarters.
4. Have students look up the average national price of gasoline at www.fuelgaugereport.com.
5. Have each student calculate and record the cost for fuel for a trip to NEED Headquarters.
6. Gather the class data and disseminate to the class or have each student share out loud the class, fuel economy and cost for fuel for the trip for their vehicle.
7. Using different colors for each class represented, have students generate a scatter plot of the comparison for fuel economy and fuel costs.

Assessment

Have students look for trends in the data. Do certain classes of vehicles have lower fuel economies than others? Instruct students to write a few paragraphs analyzing the class data and describing the overall trend for vehicle fuel economy.

Extensions

1. Have students discover the fuel economy for their dream car at www.fueleconomy.gov. Ask students to also explore the energy impact score, carbon footprint, and air pollution score. Have students discuss whether the information changes their opinion about which vehicle they would like to own.
2. Have students compare the EPA estimated fuel economy of their vehicle with the actual fuel economy for their family.
3. Have students estimate fuel economy and fuel costs for vehicles of similar makes and models to those in class. Then have students look up the vehicle fuel economy at www.fueleconomy.gov to compare their estimate.

Secondary Transportation Activity: Analyzing Fuel Economy

Concepts

- Different types of vehicles have varied fuel economy.
- Average fuel economy is determined by many factors, including weight of vehicle, size of engine, percentage of city and highway driving, quality of roads driven, driving speed, and driving habits.

Preparation

Request permission from parents to use personal information about vehicles, driving distances, fuel prices, etc. Ask parents to participate fully in the project, including logging data for miles, speed, etc., and helping students locate owner's manuals, especially if their student does not yet drive.

Introduction

1. Ask the students if their families have been talking about gasoline prices. Discuss the thoughts they or their parents have shared. Include information from "Pricing a Gallon of Gasoline" (pages 6-7) as appropriate.
2. Discuss fuel economy and what it means. In terms of vehicle driving, fuel economy is the average distance a vehicle can travel using a gallon of gasoline, expressed in miles per gallon (mpg). Fuel economy for a single vehicle may vary with speed, driving habits, weather conditions, and percentage of highway and city miles traveled.

Activity

1. Have students determine what they would like to know about fuel economy. Some suggestions include: Does fuel economy change when driving at different speeds? Does fuel economy change when driving during different seasons? Why is fuel economy different for different vehicles? Does my family vehicle have the fuel economy listed in the owner's manual? Ensure suitable questions as needed.
2. Explain to students that they will use data from the whole class to help answer the questions they have developed. As a class, generate a list of information each student should gather about their vehicles to ensure all students' questions will be answered.
3. Assign data acquisition as homework. Some information may take longer than overnight to obtain (such as, how many highway miles and city miles were driven this week?).
4. Have students use class data to answer their questions about fuel economy. Students should justify the answer to their question, including charts and graphs as appropriate.

Assessment

Have students calculate the cost of driving their vehicle to and from school for a week. How much does this cost for the entire school year? Compare class data. Who has the cheapest and most expensive commute to school? Which vehicles represent those inexpensive and expensive commutes? Discuss the data. Do any trends develop? What conclusions do students draw?

Extensions

1. Have students research ways to improve fuel economy and reduce consumption and create a tri-fold brochure with at least five suggestions to share with their families.
2. Compare costs for driving in the United States versus other countries.

Resources

- Compare vehicles for fuel efficiency, greenhouse gas emissions, air pollution ratings, and even safety information at www.fueleconomy.gov.
- Enter the type of vehicle being driven, city of origin and destination to get an estimate of trip fuel cost at www.fuelcostcalculator.com.
- The Alternative Fuels and Advanced Vehicle Data Center has information about various alternative fuels, station refueling locations, and alternative fuel vehicles at www.eere.energy.gov/afdc.
- Find the national average for fuel prices at www.fuelgaugereport.com.

Short Circuits

CFL Recycling at Home Depot

The U.S. Environmental Protection Agency (EPA) encourages all consumers to recycle compact fluorescent light (CFL) bulbs so that the mercury in the bulbs can be recovered and used again rather than released into the environment. In June, Home Depot announced an in-store collection program for used CFL bulbs. This program will be offered in almost 2,000 stores nationwide. At each store, customers can hand in unbroken, burned-out CFL bulbs to the Returns Desk. The bulbs will be recycled and responsibly disposed of by an environmental management company.

For more information, visit www.homedepot.com/ecooptions or www.epa.gov/epaoswer/hazwaste/id/univwast/lamps/index.htm.

Dedicated propane bus.
Photo credit: Blue Bird Corp.

Spending Less on Transportation Equals More for Education

To combat increasing fuel costs, school districts across the country are converting their school buses to run on propane. Not only is propane currently $2.50 per gallon cheaper than diesel, but school districts receive a 50 cent per gallon rebate through Federal tax credit. The savings could amount to hundreds of thousands of dollars annually.

School bus manufacturer Blue Bird Corp. recently delivered 16 dedicated propane buses to a district outside San Antonio, Texas. The new classic yellow buses are the first in the nation to come off the production line propane-ready. The propane buses cost about $83,000 each—or $11,000 more than diesel models.

Are your school's buses running economically and efficiently? If not, put together a presentation for your school board encouraging them to improve your school buses to run more efficiently and economically.

For more information, visit www.usepropane.com or www.propanecouncil.org.

NEED
Putting Energy into Education