

Accelerating Demand for Fuel



BY JAHI CHIKWENDIU—THE WASHINGTON POST

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An Integrated Curriculum For The Washington Post Newspaper In Education Program

A Word About Accelerating Demand for Fuel

Motorists, truckers, growers of corn and sugarcane, dairy owners, oil producers, environmentalists and the high school student wanting the keys to the family car represent the many facets of the record increase in the cost of petroleum products.

The price paid for oil, domestic and imported, is not an isolated issue. It is an American and an international concern. It involves developing new recovery technology, seeking alternative fuels and paying for goods affected by fluctuating prices. "Finding and implementing solutions to the food, fuel and environment conflict is one of the greatest challenges facing humanity," stated David Tilman and Jason Hill in their Outlook piece that is included in this guide.

Our focus is this oil shock. These are lessons in the driving forces of a market economy, supply and demand — the world's demand for oil products has been increasing faster than supply. Lessons in scarcity, shift, speculation and steadily increasing prices. Lessons in alternatives and a tightening of family budgets. Lessons in production, policies and priorities.

The online guides provided by *The Washington Post* NIE program suggest activities to use with *Post* articles and the reproducibles that we have created for you. Many of the suggested activities work together to create interdisciplinary segments of a larger project. Select the ones that are appropriate for the age of your students, time available and curriculum fit.

A reminder to *Post* INSIDE program teachers: If you plan to use articles in this guide in the e-replica format more than three months after their publication date, remember to bookmark them to use this school year.

Lessons: Meeting the demand for more oil has many related consequences, influencing the supply and cost of other goods, impacting the environment and affecting international relations.

Level: Mid to high

Subjects: Economics, Business, Environmental Science

Related Activity: English, Journalism, Mathematics

NIE Online Guide

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Contributing to this guide: Economics educator Jennifer Rothenberger, Benjamin Banneker Academic High School, Washington, D.C., wrote the student activity, "Our Gas Is More Expensive — A Personal Look at Supply and Demand." Advanced Placement Economics educator Nancy Anwyll, retired, Thomas Jefferson High School for Science and Technology, Alexandria, Va., provided discussion questions and her expertise as materials were prepared.

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Accelerating Demand for Fuel

Making informed choices requires knowledge. As the price of gasoline and food rises, decisions about purchases, entertainment and transportation are influenced by the principles of supply and demand. Use the following activities with the articles in this guide and in your daily Washington Post to study these economic concepts.

Develop Vocabulary

“Do You Have Energy?” is provided in this guide. After completing the crossword puzzle, students could be asked to use five or more of the words in a paragraph about today’s energy dilemma.

Vocabulary in the sidebar “In the Know” provides key economic terms. Review the definitions with students before they read the articles in this guide and *The Post*.

Ask students to underline or record new words as they read the articles in this guide and *The Post*. From this list they are to select 10 words to create a personal vocabulary quiz with matching, multiple choice definitions, and fill-in-the-blank sentences.

Map It

As students read *Post* articles, have them locate countries and places on a world map. These will include Brazil, China, India, Iraq, Mexico, Nigeria, Venezuela and Oman.

Overview the New Oil Reality

Review the economic terms “supply” and “demand” before giving students “This Time, It’s Different” to read. This article provides an overview of the “new oil reality.” “Discussion: This Time, It’s Different” is provided to cover the content of the article. For question #2, economics students may be asked to illustrate the shift with a supply and demand graph.

Get Graphic

Use the informational graphics “Global Forces Converge to Drive Up Oil Prices,” “Why does Gas Cost \$4 or More a Gallon?” and those found with the reproduced articles in this guide. These illustrate, explain and augment information found in the articles.

These offer opportunity for students to practice reading and interpreting material found in graphs, charts and illustrations.

Determine Demand

“China’s Cars, Accelerating a Global Demand for Fuel” focuses on the increasing global demand for gasoline. The U.S. consumes one of every eight barrels of oil produced worldwide. China, a developing industrial nation, puts demand for petroleum in perspective.

Questions for discussion might include:

- Zhang Lisen provides an anecdotal lede and the close of the article. How does he represent modern China and its impact on the demand for oil?
- How is GM benefiting from the Chinese view that a car “shows off their status in society”? Visit the General Motors Web site (www.gmchina.com/English) for more information.
- What are reasons for the increase in worldwide demand for oil?

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In the Know

Assets: Things that have earning power or some other value to their owner

Capital: Money or assets put to economic use

Consumer prices: The prices paid by whoever finally consumes goods or services, as opposed to prices paid by firms at various stages of the production process.

Demand: One of two driving forces of a market economy. The amount of a good or service that people are both willing and able to buy

Demand curve: The relationship between the price of a good and the amount of it demanded

Factors of production: The ingredients of economic activity: land, labor, capital and enterprise

Factory prices: Prices charged by producers to wholesalers and retailers. These producer prices can be a leading indicator of consumer price inflation.

Law of supply and demand: Other things remaining the same, the quantity supplied will increase as the price increases.

Scarcity: Supplies of the factors of production are not unlimited. Needs and wants exceed the resources available to meet them.

Shift: Change in conditions that causes a movement to the left or right on a price-quantity diagram. A significant change in buyers’ income, prices of goods, consumers’ tastes can result in a shift in the demand curve. A significant change in costs of production, such as technology, labor and raw materials, can result in a shift in the supply curve. The results of shifts in either demand or supply will be higher or lower equilibrium prices.

Supply: The second driving force of the market economy. The amount of a good or service available at any particular price.

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- How have the government policies of developing countries contributed to a change in the conditions that influence the demand for oil in the world market?
- Do developing countries need to go through the same steps as older industrial, developed countries? Use the same forms of “old” energies? (China is “where the United States was in 1915.”)
- Create a chart using the information about the cost of a gallon of gas in the world.
- If the world supply of oil does not increase, and if most governments do not provide subsidies or control prices, explain why oil prices increase in developed countries that have long ago passed through an industrial revolution. Explain by illustrating with a supply and demand graph.
- How might a mixed, command economy such as China’s, influence its people to produce and consume goods and services? How would this compare to an open market economy?

Use a Case Study

“Calif. Field Goes from Rush to Reflection of Global Limits” focuses on the supply side. The Kern River field, near Bakersfield, “is the story of America’s oil supply.”

- What has influenced the U.S. going from the world’s biggest oil producer that could supply most of its oil needs to an importer of oil?
- Give three reasons why new discoveries may not help supply the demand for oil?
- Compare and contrast the positions of Matthew Simmons and Ali al-Naimi.

- How do forces beyond the borders of the U.S. influence the price of oil for American consumers?
- What impact do environmentalists have on American oil supply?

Read “Thirst for Oil Feeds Innovation in Oman.” This article also focuses on supply. Oman is a case study in the use of technology to sustain oil supply. Discussion may include the following questions:

- How and who benefited from oil in Oman in the past? In the present? Did/does Oman use the oil revenue wisely?
- At the current rate of 561,000 barrels of oil daily production (at \$100 a barrel income), how many days will it take to recover \$1 billion spent on enhanced recovery?
- How does technology influence the supply of oil? Does the price of oil per barrel influence how much technology an oil company spends on exploration and productivity?
- What types of economic diversity would you recommend for Oman?

Face Consumers

“Gas Prices Apply Brakes to Suburban Migration” takes a look at the American consumer and the American Dream. Discuss aspects of the American lifestyle that involve the use of an automobile.

- As the price of gas per gallon rose, what areas of middle class life were affected?
- In a market economy, should government pressure people to live near mass transit cores? In what way? Will people move to these areas without government policies?

Organizations & Programs

These were referred to in The Post Oil Shock series articles.

Conservation Reserve Program

www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=crp

Conservation International

www.conservation.org/

Food and Agriculture Organization of the U.N.

www.fao.org/

International Biofuels Commission

(formerly Interamerican Ethanol Commission)
www.helpfuelthefuture.org/web/

International Energy Agency

www.iea.org/

National Biodiesel Board

www.biodiesel.org/

National Petroleum Council

www.npc.org/

Organization of the Petroleum Exporting Companies

www.opec.org/home/

Saudi Aramco

www.saudiaramco.com

U.S. Agriculture Dept. Office of Energy

Policy and New Uses

www.usda.gov/oce/energy/index.htm

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- In what ways did the price of gas influence the use of mass transit in Europe?
- Should taxes on gasoline go more for development of mass transit than highways?
- Should local or national government pressure businesses to provide telecommuting or flex schedules for their employees?
- Of the different approaches presented in this article, which one would you most support in your community? Explain your answer.

Apply Supply and Demand Concepts

A student activity is provided in this guide. "Our Gas Is More Expensive — A Personal Look at Supply and Demand" gives students practice in graphing supply, demand and shifts in both. Its questions are also built around information provided in the articles in this guide.

Consider Energy Policies

Read and discuss the Business section article, "Losing Forests to Fuel Cars," and a guest opinion essay, "Corn Can't Solve Our Problems." Give students "Outlook: Towards a National Energy Policy," questions for discussion. Two class projects are also included: drafting an energy policy and preparing posters, PSAs and podcasts.

Terms found in the articles may be covered before reading the articles.

In a sidebar, "Organizations and Programs," in this guide, URLs of organizations mentioned in *The Post* series articles are provided. These may be especially helpful if students are asked to do some research before drafting an energy policy.

Energy policies might be drafted by groups. After groups present their policies, compare and contrast them or hold a debate. Will the class be able to reach an agreement on certain points? What compromises are they able to reach on other points?

Conduct a Survey

In the summer of 2008, families were taking "staycations," more workers were riding Metro, milk and corn prices increased and many complained about the cost of gas. Take a survey and conduct interviews to find out how the price of fuel, food and other factors are influencing student, family and school budgets. Include questions that reveal the extent of the "ripple effect" of fuel prices on the individual.

Cover the wording of survey questions, both open-ended and multiple-choice response.

Localize the Issue

Demonstrate how the rising cost of fuel impacts many other areas and financial decisions. School systems that provide bus service to and from school are taking a hard look at their budgets. Systems are reporting that the increase in the cost of fuel has required a 36% to 200% increase from the previous school year's budget.

Do the Math. What would this mean for a district that had \$500,000 budgeted for fuel, then faced a 40% increase?

Brainstorm the other areas that may have to be reduced to balance the budget. What would students do about the following:

- Away games, number of games played in each season, admission fee

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What to Survey?

Conduct a survey to find out what is happening, what people are thinking and what changes have taken place.

Interviews with school officials may include:

- How has the cost of fuel influenced school bus service and routes?
- Has the school budget for heating and cooling of buildings been influenced?
- In what ways has the rising cost of food and milk influenced the school lunch program?

Surveys of younger students may include:

- Trips and vacations: *None, fewer, same; staycation vs. vacation*
- Carpooling: *To sports practices and events? To school?*
- Allowance: *More, same, reduced? Buy more, same, less with allowance?*

Surveys of high school students may include:

- If you drive, do you pay for your own gas?
 - yes often seldom no
 - non-school, personal use only
- Did your parents' expectations of your buying your own gas change when a gallon of gas cost more than \$3/gallon?
 - yes no
- Since the increase of the price of gas to more than \$3/gallon, the following is true
 - I take the school bus to school
 - I walk to school
 - I carpool to school:
 - daily | more often | occasionally
 - (CIRCLE WHAT IS TRUE)
- My family plans its trips to stores and errands more
- How has the price of gas influenced your driving habits?
- In what ways has the rising cost of food, apparel, entertainment and energy, influenced the purchases your family makes? You make?

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- Cafeteria food — items offered, cost of meals
- Distance from schools — who walks, who receives a bus ride
- “Enrichment” programs — guest speakers, art, music, physical education
- Field trips — number and cost
- Temperature settings for heating and cooling
- Number of teachers
- New textbook orders

How may the situation be exacerbated by fewer parents driving students to school and older students no longer driving to school?

Will orders for replacement school buses be cancelled?

How does the housing crisis with foreclosures in the same neighborhoods add to the dilemma? Explain to students how local property taxes benefit your school.

What other factors are in play at your school?

Read a Cartoon

Provide a copy of Tom Toles August 24, 2008, cartoon. Explain that Toles is *The Washington Post* editorial cartoonist. He is on the op-ed page because he provides visual commentary. In addition to the questions provided with the cartoon, discussion may include:

- Toles’ style is minimalist. How does he create the illusion of being at a gas station? An art teacher might also note his depiction of humans, the different tires and perspective (size of sign, pump, car).
- What are the benefits and dangers of paying on credit? Credit cards encourage people to spend more than they have in their bank accounts. Some debit

card companies deduct more than the price that is used until the bank and/or gas company verify amounts in the consumer’s checking account; these 3 to 5 days may lead to an overdraft.

If this cartoon is viewed after reading the articles, the discussion will include more perspectives on the role of producers and consumers, impact on the environment and interrelated elements of an economy.

- If the price of gas has dropped, it is possible that more ethanol from corn or sugar cane is being used. These biofuels produce greenhouse gases. What options are available to create cleaner energy, lower impact on food and feed, and reduce environmental impact?

Find Enrichment

1. Research the main types of competition in a free market economy. Shared monopolies are discouraged in a free market economy, but oil companies exist and thrive in most developed western countries without interference. Other oil producing countries have created a cartel (OPEC). Some countries have state-owned oil companies. Would more competition in the oil industry help the supply and demand of oil?
2. Research the consumer theory of Thorsten Veblen and show how it applies to consumer demand in China.
3. Does the high price of oil influence the supply and demand of labor? Will geological or mechanical engineers that work for oil companies receive higher salaries and wages than truck drivers, gas station attendants or corporate

On the Web: Economics & Energy

www.ncee.net

National Council on Economic Education

Lesson plans and other resources

<http://ecedweb.unomaha.edu/home.cfm>

Economic Education Web

University of Nebraska teaching resources

<http://ecedweb.unomaha.edu/lessons/popcorn.htm>

Popcorn Economics

Lesson on scarcity and allocation. How natural resources are scarce even in a country as wealthy as the United States.

www.econedlink.org/lessons/index.cfm?lesson=EM394&page=teacher

Fill'er up, Please

A lesson on supply and demand

<http://www.energy.gov/>

U.S. Department of Energy

Curriculum guides, activities for educators; fun facts and more for students

www.teachingtools.com/CrudeEnergy/OilEnvironment.htm

Oil and the Environment

Teaching guide, video and classroom activities; ConocoPhillips sponsors the site.

www.thinkfinity.org/EducatorHome.aspx

Thinkfinity

Clearing house for lesson plans, interactive games, activities and more

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office janitors? Will unskilled labor lose jobs or gain jobs as the prices of oil increases? Can a poor or

5. Read the platforms of the two major political parties. Do they address energy policies? Provide solutions to the current fuel imbalance (demand vs. supply)

and its impact on consumers? Businesses? The environment? Compare and contrast the policies.

6. The oil industry has been a substantial contributor to national political campaigns. (Oil and gas companies do not have a large labor force to provide volunteers and they are geographically

confined, mainly in states that are not considered as essential to election strategy.) How might the following positions influence campaign contributions from oil industry executives?

- A call for an end to the federal ban on offshore drilling for oil
- Opposition to drilling in Alaska's Arctic National Wildlife Refuge
- Statement that drilling will not produce new, usable gas for years
- Support of increased taxes in order to fund global warming initiatives ■

The Future: Finding More

Search Areas Are Limited . . .

For political reasons, many of the world's best oil prospects are either off-limits or access to them is restricted. They include much of Iraq, parts of Russia and areas off U.S. shores.



REPORTING BY BRENNAN MALONEY; GRAPHICS BY LAURA STANTON — THE WASHINGTON POST

middle class person afford to get a college degree to be an engineer for the oil industry?

4. Consider elastic and inelastic demands. How many substitutes for gas consumption do citizens have? Provide a list or have students brainstorm a list (carpools, more bike lanes, mass transit, flex time, telecommuting, Zipcar and bike rental). Have students research each option for its viability in your community, cost, benefit and downside.

... And Getting to Production Can Be Costly and Time-Consuming

A major new oil platform can cost billions and take more than a decade to complete. For example, Canada's Hibernia platform:

- Cost: **\$5 billion**
- From discovery to production: **19 years**
- Produces only **0.2%** of world oil demand

Drilling Online

www.washingtonpost.com/wp-srv/business/oilshock/index.html

Oil Shock: Drilling for Answers on High Prices

The 5-part *Post* series, special report: "Gas-Saving Tips," links to related interviews, articles, graphics and photos

www.washingtonpost.com/wp-dyn/content/gallery/2008/07/27/GA2008072701006.html?sid=ST2008072701990

China's Demand for Oil

Articles, photographs: China's increasing demand for oil is a key contributor to the dramatic rise in global oil prices.

www.washpost.com/nie

Manual, Business Section

Lessons for use in Business and Economics classes. Select "Economic Essentials: Circular Flow" for three activities and a Circular Flow diagram.

<http://www.bts.gov/>

Bureau of Transportation Statistics

Transportation data (highway, air, sea); current topics and study releases

<http://www.eia.doe.gov/oaif/forecasting.html>

Energy Information Administration

Official energy statistics for U.S. government; data includes prices and supply and demand for oil, natural gas, renewables

www.nature.org/magazine/summer2007/features/art20830.html

The Last Stand

A case study from Canada: The Nature Conservancy feature focuses on the Mackenzie Gas Pipeline project; written by Scott Weidensaul author of *Living on the Wind*, a Pulitzer Prize finalist.

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WORKSHEET ANSWERS "Our Gas Is More Expensive — A Personal Look at Supply and Demand."

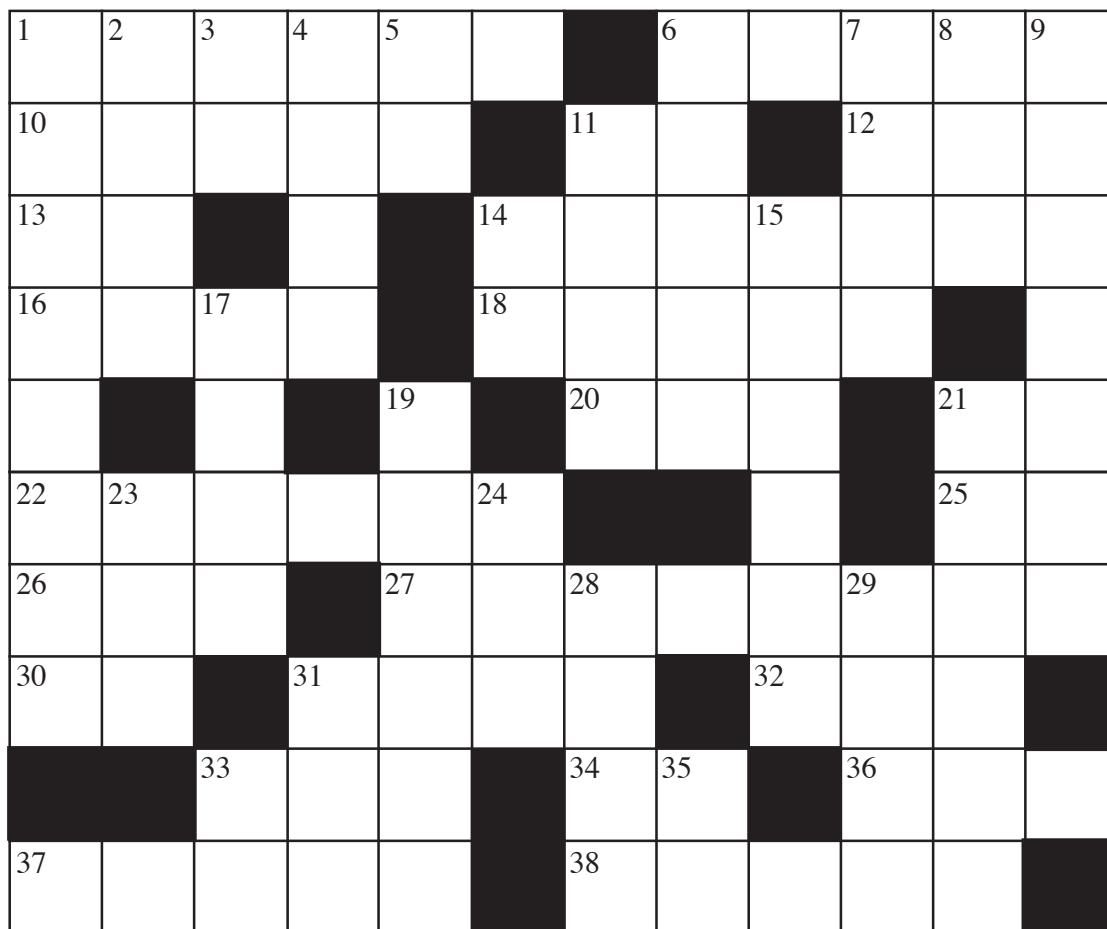
1. Draw the diagram
2. Draw the diagram
3. Draw the diagram
4. Equilibrium is at \$4 and four tanks of gas will be sold. We should sell and buy at this price because supply and demand are equal. As a result, there will be no surplus or shortage.
5. A. A fall in the price of oil brings an increase in the quantity demanded of oil, which is a movement down the demand curve.
B. An automobile is a compliment to gas. If the price of an automobile falls then more automobiles will be purchased, meaning more gas will be purchased. This is movement up along the demand curve.
C. Theoretically, consumers will stop purchasing as much gas. As a result, a shift will occur to the left.
D. The government is providing an incentive to purchase gas, which will mean more gas sold. The demand has changed and a shift will move to the right.
E. If income increases, more gas will be sold because gas is a normal good. There will be a shift to the right.
6. A. If the price of oil rises, then there will be more supplied. As a result, there will be a movement up along the supply curve.
B. It takes labor to make oil. If labor increases then price will increase; causing a change in supply. As a result, there will be a shift to the left.
C. If there is not oil to be found, the supply must slow; therefore, causing a change in supply. There will be a shift to the left.
D. New technology changes the supply, making a shift to the right.
E. More oil equals a change in supply and a shift to the right.
7. If the price of corn falls, corn ethanol will be more appealing. It is likely that gas will be needed less since corn ethanol is a substitute for gas. The supply curve will shift to the right. The demand curve will shift to the left.
8. China will continue to increase the amount demanded. Since the demand is not meeting the supply, a shortage will occur. Both the United States and China have pushed their economies to rely on oil, making it difficult to cut back on oil, even when there is a shortage.
9. There is a change in supply and as a result there will be a shift to the left in the supply curve. This is happening because oil is not readily available as it once was.
10. Demand has changed, because of countries such as the United States and China. There continues to be a movement up along the demand curve, but there has been/is also a noticeable shift in demand for oil due to demand increase from China, India and developing countries as well as an increase in demand in the U.S. and developed countries.
11. Many answers will be given here.

Answers Crossword Puzzle: "Do You Have Energy?"

Name _____

Date _____

Do You Have Energy?



ACROSS

1. Agreement to pay later; praise
6. A sudden increase or rush forward
10. Fertile or green spot in a desert
11. Fe, fi, ___, fum
12. Biofuel for an early form of transportation
13. *Abbr.* North Carolina
14. *Adj.* Optimistic that the stock market will rise
16. Small faction united by common beliefs or interests
18. Horizontal, even plane; steady
20. Allow
21. An article
22. Place, institution or technological arrangement by which goods and services are bought and sold
25. Antonym of yes
26. Indefinitely long period of time
27. Flammable, poisonous liquid used as a fuel, antifreeze or solvent
30. *Abbr.* Radial Keratotomy
31. Solemn promise to fulfill a pledge
32. Hawaiian garland of flowers
33. Large container
34. Indefinite, singular pronoun
36. Industrious, social insect who likes picnics
37. Broad expanse of land, with crops or open area
38. Intelligent

DOWN

1. One who utilizes economic goods
2. Competition to reach a goal
3. Dir. from Chicago to Miami
4. Force, effort, power
5. Present tense state of being verb
6. Find an answer
7. Displease or disturb; make a liquid muddy by stirring up sediment
8. Not solid or liquid; a fuel
9. Alternative fuel fermented from corn and grains
11. Something consumed to produce energy
14. *Abbr.* Black
15. Fatal, devastating
17. Main ingredient in tortillas and ethanol
19. The quantity of a good or service that customers are willing and able to buy at all possible prices during a period of time
21. To put oil on to consecrate
23. Approval
24. Vietnamese lunar New Year
28. Pronoun referring to the person or thing present or just mentioned
29. Opposite of far
31. Liquid, combustible substance; petroleum
33. Exist
35. *Abbr.* Trademark

Name _____

Date _____

Discussion: This Time, It's Different

Read “*This Time, It’s Different: Global Pressures Have Converged to Forge a New Oil Reality*,” the first in *The Washington Post* series called *Oil Shock*. Answer the following questions on your own paper.

1. *Washington Post* reporter Steven Mufson provides two examples that he says were “emblematic of the larger forces of supply and demand that have sent world oil prices bursting through one record level after another.”
 - What are the two examples?
 - How is each representative of supply and demand?
2. Who and what are to blame for the high cost of energy? Have conditions changed enough so that the country and the world now have a shift in supply and demand for oil?
3. Mufson states “the latest run-up [of prices] has been accelerating over several years as ample supplies of crude oil have proven elusive and the thirst for petroleum products has grown.”
 - What are the definitions of “run-up,” “accelerating,” “ample” and “elusive”?
 - State three examples that support this evaluation.
4. According to Mufson, the effects of rising prices include 1) cutting other household spending, 2) adding inflation, aggravating the U.S. trade deficit, 3) taking a toll on businesses already struggling with the economic slowdown caused by the housing and financial crises, and 4) speeding the search for alternative energy sources.
 - Select one of the four areas. Give three examples of its effect in the U.S. or the world.
5. Politics has had an influence in the price of oil. Explain the oil embargo of 1973 and the curtailment of output in 1979.
6. What prevented prices from rising (run-ups) and sustaining high cost in the past?
7. Who has benefited from the rise of prices of oil and oil-based products?
8. What American expectations and attitudes need to change in order to confront the decreasing supply of oil?
9. To whom does Canada, the Middle East and the former Soviet Union supply most of its oil?
10. Using the data provided in the informational graphics (“Global Forces Coverage to Drive Up Oil Prices” and “Why does Gas Cost \$4 or More a Gallon?”) pose a question about China, Venezuela, Iraq or Mexico. Answer the question you have written.

OIL SHOCK

Percentage of the world's oil produced by the top 10 producing countries:
41.5%



Barrels of oil produced daily (Includes oil from tar sands and natural gas liquids)

1. SAUDI ARABIA
10.4 MILLION BARRELS

2. RUSSIA
10.0 MILLION

3. UNITED STATES
6.9 MILLION
(5.1 million crude oil,
1.8 million natural
gas liquids)

4. IRAN
4.4 MILLION

5. CHINA
3.7 MILLION

6. MEXICO
3.5 MILLION

7. CANADA
3.3 MILLION

8. UNITED ARAB EMIRATES
2.9 MILLION

9. KUWAIT
2.6 MILLION

10. VENEZUELA
2.6 MILLION

The world's 10 oil producers account for about 86 million barrels per day.

In the time it takes most people to read this sentence, the world will have used up (forever) about 9,520 barrels of oil. At 40,000 gallons per second, it's going fast.

The United States plays a central role in the global energy system as the largest consumer, the largest importer and the third-largest producer of oil in the world. With use of this finite resource rising at breakneck speed, will the world have enough to meet its needs, and will it be able to afford it?

The world consumes about 85.5 million barrels per day.

Percentage of the world's oil consumed by the United States in 2007:
24.4%



Barrels of oil consumed each day (Includes consumption of ethanol and other biofuels)

1. UNITED STATES
20.7 MILLION BARRELS

2. CHINA
7.9 MILLION

3. JAPAN
5.1 MILLION

4. INDIA
2.7 MILLION

5. RUSSIA
2.7 MILLION

6. GERMANY
2.4 MILLION

7. SOUTH KOREA
2.4 MILLION

8. CANADA
2.3 MILLION

9. BRAZIL
2.2 MILLION

10. SAUDI ARABIA
2.2 MILLION

TOP OIL PRODUCERS

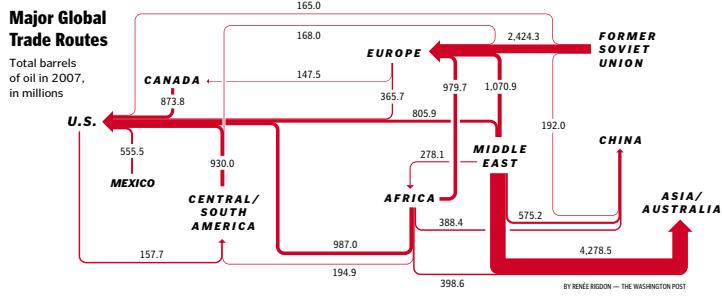
Where does the oil come from? Just three countries — Saudi Arabia, Russia and the United States — pump about 31 percent of the world's oil. More than 9 million barrels per day of crude oil (plus another 1 million barrels per day of liquids derived from natural gas) are being extracted from the reserves underneath Saudi Arabia, the world's single largest oil producer.

Graphics reported by Brenna Maloney.
graphics by Todd Lindeman — The Washington Post

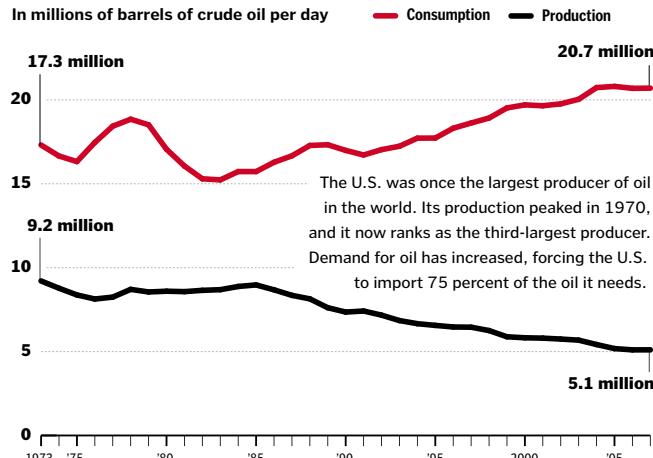
TOP OIL CONSUMERS

Every day, the U.S. consumes more than 20 million barrels — almost one-fourth of all the oil used in the world and more than two times as much as the second-biggest consumer, China. Consumption in most developed countries, including Britain, France, Germany and Italy, hovers around 2 million barrels a day — barely a tenth of that used by the U.S.

Global Forces Converge To Drive Up Oil Prices



U.S. Oil Production vs. Consumption



U.S. Oil Imports

The U.S. imported more than 4.91 billion barrels of oil in 2007. Canada is our chief supplier of foreign oil.

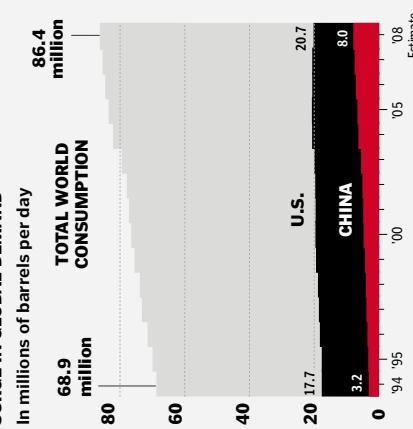
Thousands barrels per day (May 2008)

Canada	1,840
Saudi Arabia	1,579
Mexico	1,116
Venezuela	1,030
Nigeria	851
Iraq	583
Angola	464
Algeria	440
Brazil	318
Kuwait	263

Why Does Gas Cost \$4 or More a Gallon?

There is no single answer to this question. A number of factors contribute to the price of oil:

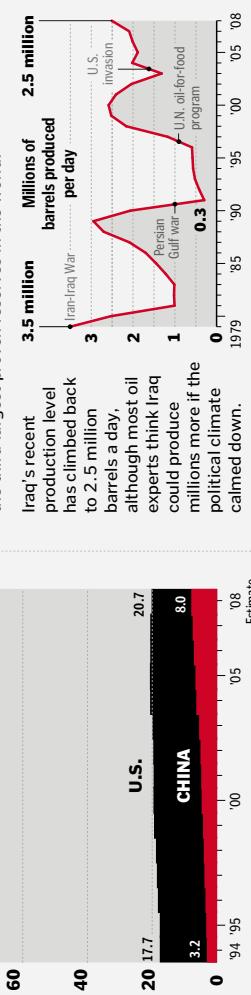
SURGE IN GLOBAL DEMAND



PRODUCTION OBSTACLES

Natural disasters, political unrest, deteriorating equipment, accidents or any combination of these could interrupt the supply of oil. A few examples:

- Since 1980, Iraq's oil output has been disrupted by three wars and years of international sanctions. Only 17 of the 80 known fields have been developed, and the country has the third-largest proven reserves in the world.



THE MARKETS

In the past several years, there has been an influx of investments from pensions and hedge funds and firms not in the oil business. This has increased the use of oil as a financial instrument, not just as a raw material. The effect on price remains a matter of great debate. Most economists say this has no impact on prices. But many oil experts and financial analysts, while acknowledging the tight oil balance worldwide, say the influx of money has created a bubble effect similar to that of tech stocks or housing that raised prices further than they would have otherwise.

MONTHLY ENDING LIGHT, SWEET CRUDE OIL PRICES PER BARREL SINCE AUGUST 1990



A WEAKENING DOLLAR

The falling U.S. dollar has contributed to the rise in the price of oil. Many investors buy commodities such as oil as a hedge against inflation when the dollar falls. Also, a weaker dollar makes oil less expensive to investors dealing in other currencies.

LOW DISCOVERY RATES

Much of global oil comes from mature fields that are now approaching their peaks or are already in decline. Worldwide, output from existing fields is falling by as much as 8 percent per year, which means oil companies must develop 7 million barrels more a day to keep current output steady — plus many more millions to meet growth in demand of about 1.8 percent per year.

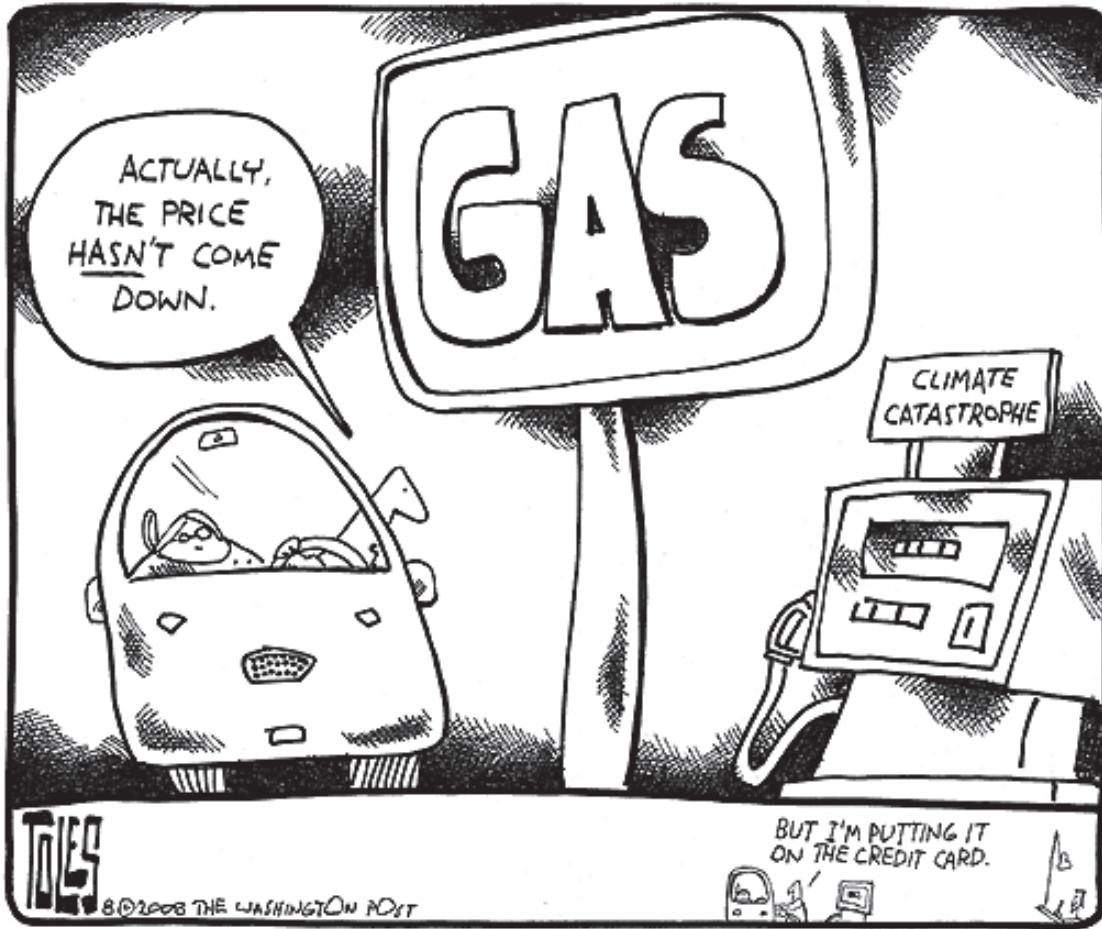
Oil can't be pumped from the ground until it is found, yet the volume discovered each year has steadily declined since the early 1960s. Tupi oil field, discovered off the Brazilian coast last November, is the largest find in 7 years, with an estimated 8 billion barrels. It is only 1/15th the size of Saudi Arabia's legendary field, Ghawar, which held about 120 billion when detected in 1948.

OIL SHOCK

An Integrated Curriculum For The Washington Post Newspaper In Education Program

Tom Toles | August 24, 2008

Tom Toles is the editorial cartoonist of The Washington Post. Read the August 24, 2008, visual commentary and respond to the following questions.



- What are the essential details that establish the setting of this editorial cartoon?
- Why do you think Toles did not include the price per gallon in the frame?
- Toles posts “climate catastrophe” on the pump. Is this another kind of price consumers have to pay? Explain your answer.
- Where Toles’ alter ego resides in the lower right, a second frame is created. On what is Toles commenting through the two statements of the driver?

Write a paragraph in which Toles’ point of view is summarized.

Name _____

Date _____

Outlook: Towards a National Energy Policy

Read “*Losing Forests to Fuel Cars*,” a Business section article, and the guest opinion piece “*Corn Can’t Solve Our Problems*.” Both selections were written in 2007. They provide background and perspective on fuel sources, government and private energy decisions, and the options available to solve the energy supply and demand dilemma.

After reading the articles, answer the following questions on your own paper:

1. What “old” energy is required to produce the cleaner, “new” energy of ethanol? What is gained and what is lost in the process?
2. How does the high price of gasoline influence corn farmers?
Why does the price of corn influence the cost of tortillas, chicken and milk?
In what ways do consumers benefit or suffer from the use of ethanol in gasoline?
3. The decision to use corn to produce ethanol has many interlinked ramifications — for the environment, economy and energy consumption. Give examples of problems that occur from a reliance on corn ethanol in each of these three areas.
4. Did President Bush help the American consumer by encouraging Brazil to sell sugar cane ethanol to America? Will the American farmer benefit from Brazil’s competition with American ethanol? Explain your answers.
5. Compare and contrast the impact of ethanol produced from corn, sugar cane and prairie-grasses on greenhouse gases.
6. In what ways might greenhouse gases in Brazil have an impact on the U.S.?
7. In a paragraph, summarize the national biofuels policy that Tilman and Hill would advocate.
8. What should be the role of government in these energy decisions? For example, should government pay for research on new fuel sources? Subsidize ethanol producers or oil suppliers to lower the market (equilibrium) price? Place tariffs on imported ethanol? Tax gas sales?

As a class, draft an energy policy in which fossil fuels, biofuels and alternative energy sources are addressed.

In one sentence, Tilman and Hill give two simple ways to save energy: “Car tune-ups and proper tire air pressure would save more energy [than that gained by ethanol use].” Prepare posters, PSAs and a podcast to promote these two energy savers within your school community.

Terms Used in the Articles

<i>Advocacy</i>	<i>Ecosystem</i>	<i>Moratorium</i>
<i>Agribusiness</i>	<i>Encroachment</i>	<i>Nuance</i>
<i>Biodiversity</i>	<i>Ethanol</i>	<i>Prudent</i>
<i>Bioengineer</i>	<i>Euphoria</i>	<i>Renewable fuel</i>
<i>Biofuel</i>	<i>Extol</i>	<i>Subsidy</i>
<i>Deforestation</i>	<i>Fossil fuel</i>	<i>Sustainable</i>
<i>Degraded</i>	<i>Greenhouse gas</i>	<i>Tariff</i>

Name _____

Date _____

Our Gas Is More Expensive — A Personal Look at Supply and Demand

1. Each week Amanda, Mo, Eric and Jenny fill their automobile tanks with gas. Using the information, below, label and draw the total demand curve.

Price Per Gallon	Amanda	Mo	Eric	Jenny	Total Demand
\$8	0	0	0	0	0
\$6	1	0	0	0	1
\$4	2	1	1	1	5
\$2	3	1	2	1	7

2. Each week Amaco, BP, Exxon, and Texaco are willing and able to sell gas as shown, below. Using the information, label and draw the total supply curve.

Price Per Gallon	Amaco	BP	Exxon	Texaco	Total Demand
\$8	2	2	1	1	6
\$6	2	1	1	1	5
\$4	1	1	1	1	4
\$2	0	1	1	0	2

3. Now indicate the total supply curve and the total demand curve on one graph.
4. At what price is the equilibrium? Why should the market buy and sell at this price?
5. The Demand Market for oil fluctuates due to many factors. Political factors, for example, such as the OPEC embargo against the United States in 1973. These changes are called a change in quantity demanded. According to the Law of Demand, when the price of a good increases the quantity demanded of that good decreases. The opposite is also true, if the price of a good decreases the quantity demanded of the good increases. Using this knowledge explain the following effects on demand and illustrate either a movement or a shift.
- The price of oil falls.
 - The price of automobiles fall
 - Consumers become aware that most oil fields are becoming dry.
 - A government provides a tax break on the use of gas and pay for amenities for those who purchase cars.
 - Income increases.

Name _____

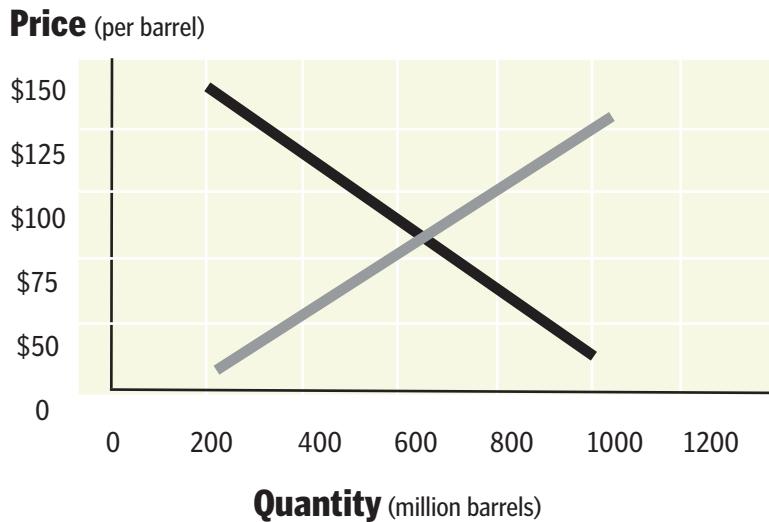
Date _____

Our Gas Is More Expensive—A Personal Look at Supply and Demand | Continued

6. The Supply Market for oil fluctuates from many factors, such as new technology. These changes result in what is called a change in supply. According to the law of supply, when the price of a good increases the quantity supplied increases. The opposite is also true, when the price of a good decreases, the quantity supplied of a good decreases. Using this knowledge explain the following effects on supply and illustrate either a movement or a shift.

- A. The price of oil rises
- B. The price of oil decreases
- C. Many oil drills become dry and can no longer produce the oil needed to sustain the demand.
- D. New technology provides oil that was once too thick to abstract through the use of steam.
- E. Governments allow oil companies to drill in once forbidden areas, such as the Alaskan wilderness preserves.

7. The figure below shows the supply and demand for gas. Suppose that consumers think that ethanol can substitute for gas. In the figure, below, show what happens to the price and quantity if the price of corn falls.



8. If China continues to drive the economy to rely on oil, what will happen? How are the United States and China's policy on oil similar?

9. Explain the change in supply that is happening to the world's supply of oil and illustrate with a supply curve.

10. Explain the change in demand that is happening to the world's demand of oil and illustrate with a demand curve.

11. What is the solution to the world's supply and demand of oil based on your knowledge of economics? As an environmentalist? As an average American needing to drive to work every day? As the CEO of an oil company? As the President of the United States?

An Integrated Curriculum For The Washington Post Newspaper In Education Program

OIL SHOCK

This Time, It's Different

By STEVEN MUFSON
Washington Post Staff Writer

• Originally Published July 27, 2008

The two events, half a world apart, went largely unheralded.

Early this month, Valero Energy in Texas got the unwelcome news that Mexico would be cutting supplies to one of the company's Gulf Coast refineries by up to 15 percent. Mexico's state-owned oil enterprise is one of Valero's main sources of crude, but oil output from Mexican fields, including the giant Cantarell field, is drying up. Mexican sales of crude oil to the United States have plunged to their lowest level in more than a dozen years.

The same week, India's Tata Motors announced it was expanding its plans to begin producing a new \$2,500 "people's car" called the Nano in the fall. The company hopes that by making automobiles affordable for people in India and elsewhere, it could eventually sell 1 million of them a year.

Although neither development made headlines, together they were emblematic of the larger forces of supply

and demand that have sent world oil prices bursting through one record level after another. And while the cost of crude has surged before, this oil shock is different. There is little prospect that drivers will ever again see gas prices retreat to the levels they enjoyed for much of the last generation.

Unlike the two short, sharp oil jolts of the 1970s, the latest run-up has been accelerating over several years as ample supplies of crude oil have proven elusive and the thirst for petroleum products has grown. The average price of a barrel of oil produced by the Organization of the Petroleum Exporting Countries doubled from 2001 to 2005, doubled again by March this year and jumped as much as 40 percent more after that.

For American motorists, a full tank of gas costs nearly twice what it did at the start of last year, racing past the \$4-a-gallon mark, and has begun cutting into other household spending.

"What can you do? You need gas," said Barry Modeste, a construction worker who stopped his van at a Shell station in Takoma Park one recent morning to add \$15 worth. It was enough, he

said, to get him to a cheaper station in Rockville. "If you don't have gas, you can't get to work. And if you can't get to work, you don't get paid. And if you don't get paid, you can't buy food. We're at their mercy."

Last month, 51 percent of the respondents in a Washington Post poll said rising gas prices were causing a serious financial hardship for them or others in their household. It was the first time a majority had said that since the poll began posing that question eight years ago.

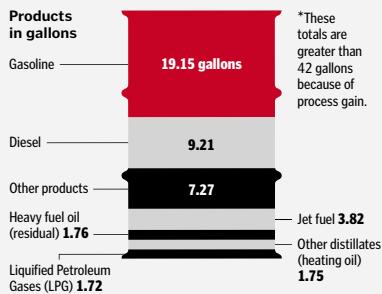
The rising prices are also adding to inflation, aggravating the U.S. trade deficit — oil now accounts for about half of it — and taking a toll on businesses already struggling with the economic slowdown caused by the housing and financial crises.

"I'm a very small businessman. If I get any smaller, I'll be out of business," said independent trucker Lee Klass, who was driving through the Texas Panhandle this month with a 33,000-pound load of plastic containers bound for Colorado.

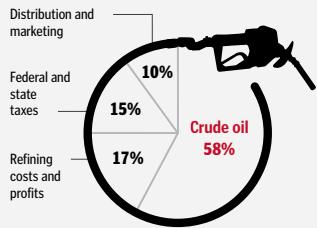
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What's in a Barrel?

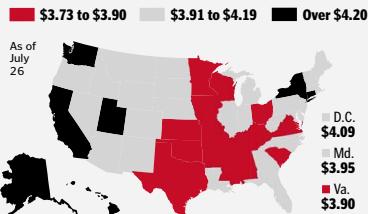
A 42-gallon barrel of crude oil yields 44 to 45 gallons of petroleum products.*

**What's in a Price?**

To the average person, it may seem as though there's little rhyme or reason in how gas prices are determined. What goes into the price of a gallon of gas?

**Price Range**

Transportation costs, state taxes and the location of gas stations can account for regional price differences. Alaska currently leads the nation at \$4.68 per gallon of regular unleaded gas. Gas is cheapest in Oklahoma at \$3.73 per gallon.

**Sticker Shock**

It costs less to fill up in the U.S. than in most other countries. The cost to fill a 17-gallon tank in select countries, in U.S. dollars:

UNITED KINGDOM	\$152.32
UNITED STATES	\$68.10
SAUDI ARABIA	\$7.99
VENEZUELA	\$2.04

SOURCES: Associates for International Research; Bloomberg; British Petroleum; Energy Information Administration; International Energy Outlook, 2008; International Energy Agency; Energy Information Agency; National Petroleum Council

An Integrated Curriculum For The Washington Post Newspaper In Education Program



BY ROBERT F. BUKATY — ASSOCIATED PRESS

Traffic ties up Beijing's central business district. Global demand for oil has grown with China's dizzying economic expansion.

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Klass had just paid \$636 for fuel, enough for the trip but no more. Filling the tank would cost nearly twice that much.

Abroad, riots shook India after the government trimmed fuel subsidies. Truckers in Britain, France, Spain and South Korea have clogged the roads to protest rising fuel prices. In the Philippines, soaring prices for oil and petroleum-based fertilizer have derailed the economy and ignited calls for a cut in the tax on oil imports. With her popularity at a record low, President Gloria Macapagal Arroyo is expected to confront the issue in a nationally televised speech scheduled for tomorrow.

Even after oil prices have tumbled more than \$24 in the past two weeks, largely as the result of easing tensions

in the Middle East and slowing U.S. economic activity, crude is still trading near historic highs.

In a series of articles starting today, *The Washington Post* examines the economic forces that have unhinged oil prices from their longtime cyclical patterns, propelling fuel costs to once unimaginable levels that are now both fraying the lifestyles of our recent past and speeding the search for an energy source of the future.

* * *

Earlier oil shocks have had obvious causes. In October 1973, OPEC raised prices and declared an oil embargo against the United States and other countries that had supported Israel in its war earlier that month against its Arab

neighbors. The embargo ended in March 1974, but pricing power had shifted from the oil companies to the producing countries. In 1979, prices soared again after the Iranian Revolution curtailed output and consumers and oil companies went on a spree of panic buying.

Now, however, there is no one culprit and no single international crisis to blame. Instead, world demand has been increasing faster than supply, steadily squeezing oil markets.

This in turn has signaled to investors that prices are inevitably heading higher. Financial players, such as Wall Street banks and hedge funds, have bet just that, investing tens of billions of dollars in oil futures. Critics on Capitol Hill and elsewhere say this speculation has turbo-

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An Integrated Curriculum For The Washington Post Newspaper In Education Program

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charged the market, helping lift prices even more.

The tightening of the oil market reflects decisions made a decade ago, when conditions looked radically different. Regular unleaded gas was less than a dollar a gallon. Oil was little more than \$10 a barrel. And the *Economist* magazine, predicting prices could soon be half that, ran a cover story with the headline: "Drowning in Oil."

Those low prices sent the wrong signals to consumers and oil companies alike.

Demand for oil jumped as U.S. sales of gas-guzzling cars soared and China's breakneck economic expansion picked up pace.

Daniel Yergin, a historian of the oil business and head of Cambridge Energy Research Associates, said that over the five years from 1998 to 2002, world oil demand grew 1.1 percent annually, raising daily consumption by 4.2 million barrels. But in the following five years from 2003 to 2007, world oil demand grew 2.1 percent annually, boosting consumption by about 8.2 million barrels per day.

The low prices of the late 1990s also dampened the impetus for finding new supplies. Oil companies delayed exploration for new fields. Capital spending dropped 15 percent at the biggest oil companies in late 1998 and plunged as much as 70 percent at the smaller ones. Too few drilling rigs were built. And refineries weren't expanded or upgraded, making it hard for them to use the lower-quality crude oils that have become a larger portion of supplies or to produce the right balance of products as gasoline use is stagnating and diesel fuel use growing.

Investment slackened just as finding new supplies was becoming more

BARRELS PER DAY | in millions in 2007

TOP EXPORTERS		TOP IMPORTERS	
1. Saudi Arabia	7.9	1. U.S.	12.2
2. Russia	7.0	2. Japan	4.8
3. U.A.E.	2.5	3. China	3.7
4. Norway	2.3	4. Germany	2.3
5. Iran	2.3	5. S. Korea	2.2

SOURCE: Energy Information Administration

difficult and costly. Most of the world's big, easy-to-tap fields have already been discovered and largely drained.

Some analysts argue that peak oil production has already been reached. Others say the peak remains a ways off but perhaps not very far. Though capital spending by big oil companies has again picked up pace in the past couple of years, spurred by higher prices, exploration is still falling short.

"It's not that we're going to run out of oil or hydrocarbons, but it's not going to become available as fast as uninhibited, unrestricted demand," said Sadad Husseini, a consultant and former petroleum geologist at Saudi Aramco.

Just two decades ago, the world could pump 15 percent more oil than it needed. Today, that spare production capacity has practically vanished — it's now about 2 percent beyond the world's total daily consumption of 85.5 million barrels. That makes the market very sensitive to rumors about anything that might endanger existing production.

Earlier, oil-rich nations opened their spigots to prevent run-ups in prices. In the early 1980s, oil from the British and Norwegian North Sea started to flow in large volumes and helped push down

prices even as war raged between Iran and Iraq, disrupting Mideast supplies. During the Persian Gulf War after Iraq invaded Kuwait in 1990, Saudi Arabia

increased production to head off a spike in oil prices.

But now, the cushion is all but gone. And Saudi Arabia, which is home to what little spare capacity remains, has become reluctant to temper price increases by boosting production. Quite the reverse, the kingdom and its fellow OPEC members have trimmed production on those few occasions when prices showed signs of slipping, most recently in late 2006.

That has left the global oil market particularly vulnerable to threats as varied as hurricanes in the oil-rich Gulf of Mexico, the potential for war with Iran and pipeline attacks by small groups of insurgents in remote parts of the Niger Delta.

* * *

At the beginning of the pipeline, high oil prices have been a gusher of good news.

Any company that owns oil in the ground or a share of what's pumped out of it is swimming in profit. Exxon Mobil, the biggest of the independent oil giants, last year broke records for U.S. corporate profits, chalking up \$40.6 billion. This year, it is on track to earn even more.

Thanks to the rapid and sustained rise in prices, oil-producing countries are also accumulating vast reservoirs of money in one of the most massive transfers of wealth in history. Every day, oil consumers pay \$6 billion to \$7.5 billion more for crude oil than they paid six years ago. At the current rate, they will pump more than \$1.5 trillion a year into the coffers of OPEC, Russia and other oil exporting countries.

Some Middle Eastern countries are already on a shopping spree: indoor ski facilities on the edge of the desert, water-

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An Integrated Curriculum For The Washington Post Newspaper In Education Program



BY GUIDDAUD CHRISTOPHE — ABACA PRESS VIA NEWSCOM

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borne hotel complexes, new industrial cities.

The new balance of petro-power was evident at a meeting of oil producers and consumers in late June in Jeddah, Saudi Arabia. The body language and setting said it all.

Grim-faced, British Prime Minister Gordon Brown followed a half-step behind a smiling Saudi King Abdullah as they entered a palatial conference room with marble walls and glittering chandeliers.

Dignitaries in flowing robes and business suits from 35 nations, seven international agencies and 25 companies were seated in a horseshoe arrangement. The king, flanked by Brown and China's vice president, was perched on a dais in the center and politely listened to entreaties from U.S. Energy Secretary Samuel Bodman and others for higher oil output. In the end, Abdullah bestowed only modest assurances while admonishing consuming countries for "selfish interests, increased consumption." This exercise in oil diplomacy did nothing to stop the relentless rise of petroleum prices. If anything, the summit showed

the inability of consuming nations to change today's prices and the relative indifference of producing countries, who blame high prices on Western "speculators."

But Bodman insisted that high prices were a question of supply and demand, and he urged the Saudis to boost output. "I believe that most of us agree on one thing: Prices are too high at present," he said. "And unless we act, the situation will remain unsustainable."

What makes it unsustainable is that cheap oil has been a building block of the American economy and society, from big cars and big planes to interstate highways and commuters living in remote exurbs.

For the better part of a century, U.S. policy contributed to this pattern of development. Taxes on gasoline were set aside for highways, which opened up more vistas for new communities. This in turn promoted even more driving, more gasoline consumption and more tax revenue for highways. Today U.S. automobiles use more than 9 million barrels of gasoline a day, more than any other country.

Today: Current Stockpile

Oil reserves are the estimated quantities of crude oil claimed to be recoverable under existing economic and operating conditions. Many oil-producing countries do not reveal how they calculate their estimates. Some countries probably overstate how much oil they have in reserve.

	Largest proved reserves	
	Share of world total	Billions of barrels
Saudi Arabia	21.3%	264
Iran	11.2	138
Iraq	9.3	115
Kuwait	8.2	102
UAE	7.9	98
Venezuela	7.0	87
Russia	6.4	79
Libya	3.3	42
Kazakhstan	3.2	40
Nigeria	2.9	36

The high price of oil has sparked recent efforts by technology experts, venture capitalists, alternative energy firms and even some oil companies to come up with ways to wean the world economy off its addiction.

Developing countries like China and India, however, are in no hurry to embrace this new vision. They want to join the ranks of economic powerhouses and question why they should be forced to temper their aspirations, why their oil use should be more constrained than those who came before.

A century after Henry Ford's Model T revolutionized American life, Tata's Nano could do the same for India. Unveiling his company's concept for the car early this year, Chairman Ratan Tata placed the Nano in a narrative of technological endeavors that led from bicycle to jet. He called it "a journey that embodies the human spirit of change . . . the drive to stretch the envelope . . . the quest to lead and the quest to conquer."

But in an era of scarce oil, the Nano could take the world down a rough and costly road. ■

Staff writer Simone Baribeau contributed to this report

An Integrated Curriculum For The Washington Post Newspaper In Education Program

OIL SHOCK

China's Cars, Accelerating A Global Demand for Fuel

By ARIANA EUNJUNG CHA
Washington Post Foreign Service

• Originally Published July 28, 2008

SONGJIANG, China — Nodding his head to the disco music blaring out of his car's nine speakers, Zhang Linsen swings the shiny, black Hummer H2 out

of his company's gates and on to the spacious four-lane road.

Running a hand over his closely shaved head, Zhang scans the expanse of high-end suburban offices and villas that a decade ago was just another patch of farmland outside of Shanghai. To his left is a royal blue sedan with a couple

and a baby, in front of him a lone young woman being chauffeured in a van.

"In China, size matters," says Zhang, the 44-year-old founder of a media and graphic design company. "People want to have a car that shows off their status in society. No one wants to buy small."

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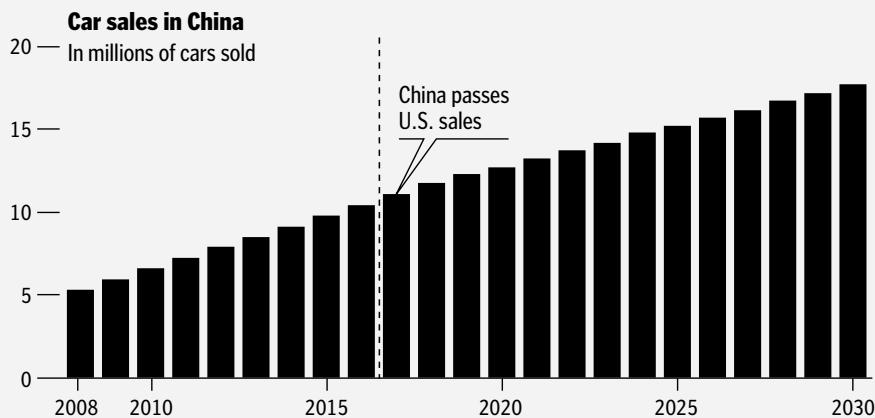
Fritz Hoffman—National Geographic Image Collection

Chinese newlyweds are driven past pumps in the frontier oil town of Daing, Manchuria. Many car owners want to appear rich enough to have a chauffeur, so even big cars in China can be longer than their American counterparts to create enough room for the owners to sit in the back.

An Integrated Curriculum For The Washington Post Newspaper In Education Program

Chinese Auto Sales

Auto sales in China are expected to exceed those in the United States in about 2015, when there will be more than 17 million vehicles in the Chinese market.



SOURCES: International Energy Agency

THE WASHINGTON POST

CONTINUED FROM PAGE 21

Zhang grasps the wheels of his Hummer, called "hanma" or "fierce horse" in Chinese, and hits the accelerator.

Car ownership in China is exploding, and it's not only cars but also sport-utility vehicles, pickup trucks and other gas-guzzling rides. Elsewhere in the world, the popularity of these vehicles has tumbled as the cost of oil has soared. But in China, the number of SUVs sold rose 43 percent in May compared with the previous year, and full-size sedans were up 15 percent. Indeed, China's demand for gas is much of the reason for the dramatic run-up in global oil prices.

China alone accounts for about 40 percent of the world's recent increase in demand for oil, burning through twice as much now as it did a decade ago. Fifteen years ago, there were almost no private cars in the country. By the end

of last year, the number had reached 15.2 million.

There are now more Buicks — the venerable, boat-like American luxury car of years past — sold in China than in the United States. Demand for Hummers has been so strong that starting this year, Chinese consumers can buy a similar military-style vehicle called the Predator at more than 25 new dealerships.

Yet strong demand for oil isn't limited to China and its automobiles. Ever since an investment group led by a New York lawyer and a New Haven, Conn., banker came up with the notion of using Pennsylvania oil for lighting in the 1880s, petroleum has been an essential component of the industrial age. It fuels ships, planes and cars, and goes into road asphalt, home heating fuel, lubricants, plastics and petrochemicals.

The United States is the world's single largest consumer of oil, burning through more than 20 million barrels per day last year. This year, U.S. usage

is on track to decline the most in 25 years, the result of high fuel prices and a sluggish economy. Still, about one of every eight barrels of oil produced worldwide ultimately ends up in the fuel tank of an American car or truck.

Demand in many developing countries, in the meantime, is accelerating because of the spread of middle-class lifestyles and populist policies that subsidize fuel to keep it cheap.

India's government, for example, will spend \$24.5 billion this year on oil subsidies. And that's after subsidies were scaled back in June, triggering riots over the cost of diesel, which fuels most of the country's vehicles, and other oil products. "The hike in fuel prices last month has done little to damp soaring diesel demand," said Seema Desai, an analyst at the Eurasia Group. Indians are paying about \$3.60 a gallon for diesel, far below market rates, and demand is still growing at an annual rate of more than 20 percent.

Oil-producing countries are even more generous to their residents. In Venezuela, gasoline costs 12 cents a gallon. In Iran, it costs 41 cents. In Saudi Arabia, it costs 47 cents; in Russia, \$3.90.

All this growth is more than offsetting the conservation measures taken in the United States, Europe and other industrialized nations. This year, the combined consumption of China, India, Russia and the Middle East will increase 4.4 percent and for the first time exceed that of the United States, according to the International Energy Agency.

For energy planners in the industrialized world, this is a cruel irony, coming after a concerted effort by consumers and lawmakers to steer consumption downward. If China continues to increase its use of oil at the average pace of 6 to 7 percent a year, as it has since 1990, it will consume as much as the United States in more than 20 years.

CONTINUED ON PAGE 23

An Integrated Curriculum For The Washington Post Newspaper In Education Program



BY FRITZ HOFFMAN—NATIONAL GEOGRAPHIC IMAGE COLLECTION

Welders assemble cars at a General Motors plant in Shanghai. There are now more Buicks sold in China than in the United States.

CONTINUED FROM PAGE 22

But China bristles at criticism of its growing oil use, noting that per capita it will remain a small fraction of U.S. consumption for decades to come. Moreover, industrialized nations all relied on heavy petroleum use as they developed. Why should we be penalized, the Chinese ask, for coming late to the game?

* * *

While a number of factors contribute to China's surging demand, including rapid industrial development and hoarding by the government to ensure adequate

supplies for this summer's Olympic Games in Beijing, it is autos that are having the biggest impact.

Yet despite this dizzying increase in passenger cars, less than 4 percent of the country's 1.3 billion people have already bought one. That's where the United States was in 1915.

"The entire energy market of the world is being affected by this country already. Can you imagine when we get to 50 people out of every 1,000 in China owning cars?" asked Friedhelm Engler, design director for General Motors and Shanghai Automotive Industry's joint-venture engineering and design lab in China.

For the previous generation, owning a car was the province of a privileged

few — those in government, heads of state-owned companies and others in positions of power.

But starting in 2000, China began to aggressively promote consumption to balance its export-driven, white-hot economy. Zeng Peiyan, who was then director of the national planning committee, created a list of things average citizens should be encouraged to buy. At the top of that list was cars.

Beijing has simplified procedures for buying cars, cut sales taxes and improved the availability of bank loans. It encouraged local governments to build more parking areas. It banned bicycles on some larger streets. And it laid thousands of miles of gleaming,

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BY FRITZ HOFFMAN—NATIONAL GEOGRAPHIC IMAGE COLLECTION

Traffic moves along in Shanghai. In 2000, China began to promote car ownership and has since cut sales taxes, encouraged construction of parking spaces, banned bicycles on some streets and laid thousands of miles of highways.

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multi-lane superhighways around the country.

In the meantime, gas has been kept artificially cheap. Even after subsidies were partly lifted last month, a gallon of gas in China costs only \$3.40, well below market prices.

Some Chinese cities actually promote bigger, fancier cars to help foster the image of a more “wenming,” or civilized, modern society.

The northern port city of Dalian; the Hunan provincial capital, Changsha; Shenzhen, across the border from Hong Kong; and many other cities ban cars with engines smaller than 1 liter from entering their downtowns on the grounds

that those cars are old and dirty. Some other municipalities ban smaller cars from expressways, claiming the cars are so small they may endanger their owners when going at high speed. Other local governments single out owners of small cars for special charges — “traffic capacity expansion” or “road and bridge maintenance” fees — that can run \$150 to \$1,500.

In 2006, when China released its most recent “five-year plan,” a national road map of priorities, a newly environmentally conscious central government began to encourage local governments to remove any disincentives for consumers to buy and for manufacturers to produce small cars. But legislation that would require local governments to revise their old

practices is still pending, and change has been slow.

* * *

The impact of China’s official car policies is perhaps most evident in the manufacturing center of Dongguan, a maze of motorways and parking lots close to the country’s southern border in the heart of the Pearl River Delta. For every 1,000 residents in Dongguan, 520 have cars — the highest rate in the nation and nearly 15 times the average.

Spread out over 952 square miles of industrial parks and housing complexes, Dongguan may be the closest thing to a Washington-style suburb in China. With no local subway system, a shortage of taxis and buses with limited routes,

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Dongguan's 7 million inhabitants often have no way of getting around without a car. To help residents purchase cars, the government has offered numerous financial incentives. In 2007, the city worked with local banks to allow consumers to put zero down and get a car loan. Civil servants receive generous subsidies for using their own cars for official business, which prompted a rush on automobile purchases by local government workers. Dongguan also ordered operators of parking garages to cap their monthly charges at half the market price in neighboring cities.

All this has been good news for Feng Jiangming, 28, who owns a small business that sells nails, screws, ball bearings and other hardware to stores. Earlier this month in Dongguan, Feng was at the Zhicheng car dealership shopping for a new car to supplement the one he has had for five years.

In 1998 at the age of 17, Feng arrived here from Hunan Province to try his luck as a laborer at the many export-oriented factories that were opening. He remembers that the area was dotted with small villages and that the dirt streets were packed with bicycles. Back then, he said, no one he knew had a car. These days, few of his friends don't.

Feng ran his fingers along the shiny four-door, brown Buick Excelle sedan in front of him and nodded at the roughly \$22,000 sticker price. He inspected the sunroof, extra-large headlights, all-leather interior.

When he first heard about the increase in fuel prices in China, Feng said he gave the idea of a smaller car a few seconds of thought — and ruled it out. "If you want to go golfing or fishing, it's not very convenient," he said.

Salesman Xie Bin elaborated: "A small car is for people with money problems or if they want it as an extra car to give to

their wives, daughters or girlfriends to go buy food."

As recently as a few years ago, automakers were betting that the future of the Chinese car market was in small vehicles that could easily maneuver the narrow alleyways of its ancient cities. Then they discovered a quirk in Chinese consumers' tastes.

Many car owners, even those who are lower middle-class, want to appear wealthy enough to have a chauffeured automobile. That means extra room for the owners in the rear. As a result, even big cars in China tend to be a third of a foot or more longer than their American counterparts.

This helps explain why roomy cars, such as the Volkswagen Santana — a family sedan based on the Passat that is the country's top-selling car — the Audi A6, Honda Odyssey and various Buick models are doing so well in China.

In China, the roomy Buick is associated with Sun Yat-sen, the father of the modern Chinese state, and Zhou Enlai, one China's most respected leaders. Both used to ride around in classic black Buicks. Buick's advertisements in China these days add a modern twist, depicting two tall businessmen in suits giving each other high-fives as if they have just closed a sweet business deal.

* * *

Another factor driving the sale of bigger cars in China is the rapid emergence of suburbs. Many of these satellite cities are romanticized versions of how the Chinese imagine the United States and other Western countries, rich with spacious villas and two-car garages, big-box chain stores, strip malls and office parks.

Zhai Yongping, an energy specialist with the Asian Development Bank, fears the Chinese are buying into the American lifestyle: "big houses, big air

conditioning, big roads." Compared with the breakneck pace of road construction, public transit has developed slowly.

To encourage the Chinese to go green, General Motors, which has ranked first for passenger car sales in China in each of the past three years, is preparing to market hybrid vehicles or cars that run on alternative fuels.

But Zhang doesn't expect Chinese consumers to change their car-buying habits. "Fuel economy is probably the last thing Chinese look for," Zhang said as he drove around the Shanghai suburbs in his Hummer. He said he wasn't worried about filling up the tank even after the government trimmed oil subsidies last month, raising gas prices about 18 percent.

Zhang bought the Hummer in 2006, on special order from the United States. It cost him \$220,000, including hefty shipping and import fees. "It feels like a man's car," he said.

Last month, he and two friends set up a Web site announcing the formation of a Hummer club in Shanghai. Some 20 other owners e-mailed him within days. They included several other businessmen but also coal mine bosses from inland provinces and three women in their 30s who are friends and purchased identical Hummer H3s.

Zhang said he and other club members were talking about organizing off-road trips, perhaps to the mountainous parts of Sichuan Province to help with reconstruction efforts in areas hard hit by the recent earthquake. For now, however, Zhang said he's happy just using his car to visit friends, cruising along at 17 miles per gallon on China's ever-growing network of highways. ■

Staff writer Steven Mufson in Washington and researchers Wu Meng and Crissie Ding contributed to this report.

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OIL SHOCK

Calif. Field Goes from Rush To Reflection of Global Limits

By STEVEN MUFSON
Washington Post Staff Writer

• Originally Published July 29, 2008

BAKERSFIELD, Calif. — In May 1899, a pair of oil prospectors wielding picks and shovels dug into a bank of the Kern River where some gooey liquid had seeped to the surface. About 45 feet down, they hit oil, and when the local newspaper printed the news, it set off an oil rush that swept up hundreds of fortune seekers, oil companies, a big railroad and even some enterprising school districts that bought up tracts in hope of turning a profit.

Today, on an arid square of land the size of Manhattan, thousands upon thousands of black derricks crowd the landscape, bobbing gently up and down and sipping crude oil from the field discovered a century ago. The wells aren't gushers these days, but they still squeeze out a few barrels a day here, a few more there.

Chevron has injected steam into the reservoirs, coaxing the sedimentary rock into giving up millions of barrels of heavy oil that was too thick and sticky to retrieve using the technology of decades past.

But the Kern River field, like most U.S. oil fields, is in decline. After surging to new highs during the 1980s, Kern River production has dropped to just over 80,000 barrels a day, more than 40 percent below its peak. Enhanced recovery techniques will continue to prolong its profitable life, but its days are numbered.

Kern River is the story of America's oil supply. Four decades ago, the United States was the world's biggest oil producer. But U.S. crude oil output peaked in 1970, at 9.6 million barrels a day, which was enough to cover the bulk of the country's needs back then. Now, U.S. crude production stands at 5.1 million barrels a day. Together with liquids derived from natural gas and other inputs, domestic production covers only 42 percent of the country's needs. The balance comes from imports. Ever since President Richard Nixon called for "Project Independence" in a 1973 address to the nation, U.S. energy

independence has been little more than a throwaway line in political speeches.

The United States is at the leading edge of what may lie ahead for worldwide oil production. Global petroleum output is still rising, but the rate of growth is slowing. Supply is not increasing fast enough to keep up with soaring global demand, putting ever more upward pressure on oil prices.

New technology is opening virgin areas for exploration — especially off the shores of Brazil, the west coast of

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BY JAHI CHIKWENDIU — THE WASHINGTON POST
The Yoder and Mattla families play in a back yard adjacent to an oil field in Bakersfield, Calif., where century-old fields are slowly running dry.

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Africa and the Gulf Coast of the United States — and extending the lives of older fields. But elsewhere, war and other political obstacles are impeding the development of prospects that would otherwise be the most accessible and cheapest to exploit.

Even if these fields become fully available, many oil experts warn that the world's production will hit a peak soon if it hasn't already. With the exception of Iraq's, most of the "easy oil" in large reservoirs close to the surface is gone. Mexico's biggest field, Cantarell, is in steep decline. Indonesia has become a net oil importer, withdrawing from the Organization of the Petroleum Exporting Countries as output from its largest fields has slipped and new discoveries have lagged. Production in the North Sea is plummeting, and Russian output is hitting a plateau.

Future discoveries may not turn the tide. New deepwater fields peak fast and then decline because of their unique geology. Deepwater prospects and fields of heavy oil, like those already being exploited in western Canada and Venezuela, are expensive and energy-intensive to develop.

In the meantime, it's getting more expensive to keep oil flowing from existing fields. Older infrastructure, including aging pipelines on the North

Slope of Alaska and outdated equipment in Iran, cry out for costly maintenance.

* * *

Christophe de Margerie, chief executive of the French oil giant Total, says the "optimistic case" for future global output is 100 million barrels a day. That's just 15 million more than the current figure. If de Margerie is right, global oil demand is on track to outstrip maximum possible supply by the middle of the next decade.

With so many fields in decline, the International Energy Agency said in a sobering July 1 report that "over 3.5 million barrels a day of new production will be needed each year just to hold global production steady." That amount is so great that it would fill up a reservoir the size of Kern River every year.

The prophet of limited supply is Matthew Simmons, a volatile Houston-based consultant who says the world hit its sustainable peak oil level in May 2005. He argues that even Saudi Arabia's super-giant Ghawar field — with original reserves of 82 billion barrels and covering a 160-by-30-mile expanse — is in decline. A self-labeled "Darth Vader of darkness," he travels the world and preaches his message in presentations to investors, military officers and Chinese officials.

According to his philosophy of "peak oil," supply is so tight that the price of

oil, even at its current level, is still too low. He predicts it is headed to \$500 a barrel.

At the other end of the debate is Saudi Oil Minister Ali al-Naimi, a voice of optimism. "I am bullish about the role of technology in meeting future and current needs," Naimi said at a meeting in Washington. "Tight conditions in oil markets have caused some observers to speculate that oil supplies are at or near their peak," he said. "I believe such views are short-sighted and ignore the extent to which technology has enabled us to find and produce oil." If technology enables the portion of oil recoverable from Saudi fields to rise 1 percent, he noted, that would amount to 3.5 billion barrels, or about a year's worth of Saudi production.

Naimi's role is to assuage a nervous market. He blames the continued run-up in prices on "speculators." And he asserts that Saudi Arabia would be able to meet the world's rising demand for years to come.

Many experts find themselves between these two poles.

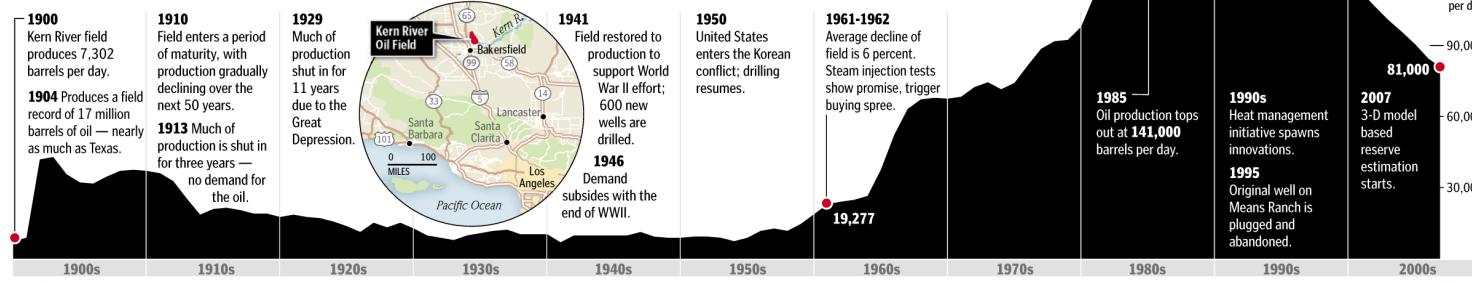
Sadad Husseini, who spent 31 years as a petroleum engineer for the Saudi state oil company Aramco, says Saudi Arabia faces challenges as it cranks up its production capacity to 12.5 million barrels a day. That's 2 million barrels a day more than the record production it

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OIL SHOCK

Kern River: A Case Study

The global oil supply may well mirror the life of California's Kern River field. Discovered in 1899 through a hand-dug shaft, the field grew to more than 10,000 active wells and at its peak produced 141,000 barrels a day. Over time, new technologies were used to eke out more, but now the field is in decline.



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reached during the Iran-Iraq war almost three decades ago. "They're developing everything they can," Husseini said.

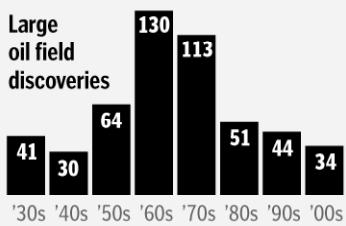
Though Saudi Arabia drilled fewer than 300 new wildcat, or exploratory, wells from the early 1930s through 2006, Husseini said even a sharp increase in exploration in Saudi Arabia wouldn't uncover the type of super-giant fields that made the kingdom the center of the petroleum universe.

"Usually, the largest fields are the easiest ones to discover," he said. "Whenever you go someplace, when you go offshore or anything, you discover the biggest fields because they're the easiest ones to catch. It doesn't mean that there aren't

other ones, but they will be smaller and not as long-lasting. With the exception of the Red Sea, Saudi Arabia is pretty well explored."

* * *

Some of the biggest obstacles to getting more oil out of the ground are not geological but political. In the United States, oil companies are trying to persuade Congress and state governments



to remove prohibitions on drilling in Alaska's wilderness preserves and on the Outer Continental Shelf off the Atlantic, Pacific and eastern Gulf of Mexico coasts. Environmental groups and leading Democrats in Congress counter that the wilderness and offshore prospects aren't big enough to fundamentally alter the U.S. or world market.

Mexico's constitution forbids alliances with foreign oil companies, which often have the technology and expertise required for exploration and production. In Nigeria, insurgents from the oil-rich Niger River delta, eager for a greater share of petroleum revenue and unhappy about environmental degradation blamed on production, have blown up oil facilities and trimmed 20 to 30 percent of the country's output. Venezuela has been bickering with foreign companies and employees of its state-owned oil company, and production has never returned to the level that preceded a labor strike that ended in 2002.

And in Iraq, where the world's biggest untapped prospects lie, violence and the absence of a national petroleum law have kept major oil firms from investing. If these problems could be resolved, experts say, Iraq's production could nearly triple.

These foreign impediments are part of the reason so many U.S. companies keep drilling holes in the United States. California, which has accounted for about one-third of the oil produced in the United States, is like a pin cushion. At the Kern River field, Jeff Hatlen and other Chevron engineers and technical experts are trying to wring the last oil from the earth there. One well drilled in 1902 is still producing.

"When I came here 30 years ago, people thought this would be shut down in 15 years," said Hatlen, a senior technical adviser at Chevron, as he paused beneath the brutal sun at the spot where the original prospectors drilled.

This area of California is the setting for the fictional story told in the film "There Will Be Blood." But the region has lost any frontier feel it once had. Drive down Interstate 5, steer through the suburban tracts and malls of Bakersfield, and the road leads to Chevron's strange landscape.

Silver steam pipes wind their way along the dusty roads and up and down the hills here. Small collection tanks dot the area. Crews tug and push drilling equipment into place for new wells.

Even in the parking lot of the main office, small derricks are busy sucking oil from the ground. Inside, workers scan an electronic topographical map mounted on the wall displaying daily production and maintenance orders. Elsewhere in the building, geologists study three-dimensional seismic maps of the rock below in search of the last oily pockets.

When he worked in Saudi Arabia, Hatlen recalled, some wells produced 25,000 barrels a day. By comparison, extracting oil from the Kern River field is like filling the world's gas tank with an eye dropper. Still, he added, "This is important for Chevron and the country because if we do it economically, it can be useful to our company and country."

Standing beside the river bank where oil first seeped to the surface, Hatlen reflected on nature's legacy. "The river has flooded here for 5 million years and laid down these sediments," he said.

After the discovery of oil, it took 85 years to produce the first billion barrels from the field. It took 24 more years for the next billion. And Hatlen and Chevron hope to milk out 650 million barrels or so more over the next couple of decades.

If they succeed in retrieving those final drops, it would be an achievement of modern technology. But then all the oil that can be recovered here — the inheritance of a natural confluence of events lasting millions of years — will be gone. ■

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OIL SHOCK

Gas Prices Apply Brakes To Suburban Migration

BY ERIC M. WEISS
Washington Post Staff Writer

• Originally Published August 5, 2008

That 1958 brick rambler inside the Beltway is suddenly looking a lot better to Dawn and Jeff Schaefer, who are buying their first house in Northern Virginia.

Not too long ago, they were looking farther out — for a newer house, a bigger yard and all the amenities. But no more. "You get less house and property

for the same price, but we're willing to make that sacrifice to save on gas prices and commuting costs," Dawn Schaefer said.

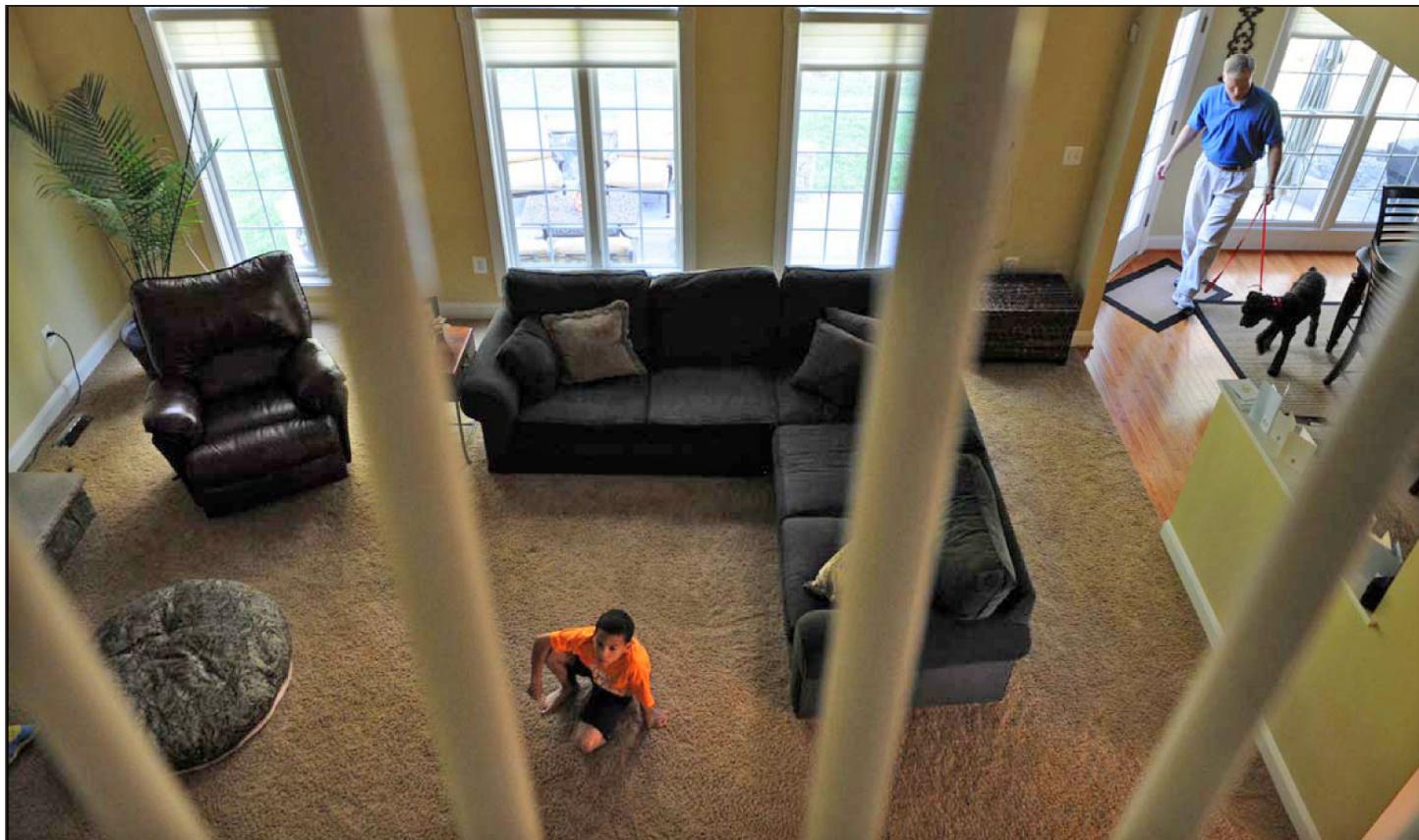
Cheap oil, which helped push the American Dream away from the city center, isn't so cheap anymore. As more and more families reconsider their dreams, land-use experts are beginning to ask whether \$4-a-gallon gas is enough to change the way Americans have thought for half a century about where they live.

"We've passed that tipping point," U.S. Transportation Secretary Mary Peters said.

Since the end of World War II, government policy has funded and encouraged the suburban lifestyle, subsidizing highways while starving mass transit and keeping gas taxes much lower than in some other countries.

Americans couldn't wait to trade in the cramped city apartments of the

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Guy Saffel, at home with dog and son Grayson, isn't ready to give up the house in South Riding, but he wants to sell his wife Shellie's SUV.

PHOTOS BY JAHI CHIKWENDIU —THE WASHINGTON POST

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Kramdens and Ricardos for the lush lawns of the Bradys. Local land-use policies kept housing densities low, pushing development to the periphery of metropolitan regions and forcing families who wanted their dream house to accept long commutes and a lack of any real transportation choices other than getting behind the wheel.

Even the way the government pays for roads and transit is dependent on gas taxes, which is effective only if Americans keep driving.

"There is a whole confluence of government policies — tax, spending, regulatory and administrative — that have subsidized sprawl," said Bruce Katz, director of the Metropolitan Policy Program at the Brookings Institution. A gallon of gasoline costs more than \$8 in Britain, Germany, France and Belgium, according to the U.S. Department of Energy. Much of the price difference is due to higher taxes.

Federal spending is about 4 to 1 in favor of highways over transit. Today, more than 99 percent of the trips taken by U.S. residents are in cars or some other non-transit vehicle, largely as a result of decades of such unbalanced spending.

The policies — building so many highways and building so many houses near those highways — have had a direct bearing on how and where people live and work. More Americans, 52 percent, live in the suburbs than anywhere else. The suburban growth rate exceeded 90 percent in the past decade.

But there's been a radical shift in recent months. Americans drove 9.6 billion fewer highway miles in May than a year earlier. In the Washington area and elsewhere, mass transit ridership is setting records. Last year, transit trips nationwide topped 10.3 billion, a 50-year high.



PHOTOS BY JAHI CHIKwendiu —THE WASHINGTON POST

Home prices in the far suburbs, such as Prince William and Loudoun counties, have collapsed; those in the District and inner suburbs have stayed the same or increased. A recent survey of real estate agents by Coldwell Banker found an increased interest in urban living because of the high cost of commuting.

Brookings says transportation costs are now second only to housing as a percentage of the household budget, with food a distant third.

The people are leading the revolution, but land-use experts wonder whether a government policy so etched into the American fabric will follow.

"When people bought homes, they punched the numbers and said can we afford the mortgage payment and taxes," Katz said. "This new paradigm is going to have families being more deliberate about the cost of transportation spending and energy costs. That's a new phenomenon in the United States. That will be the change that will change development patterns."

Katz and others said high fuel prices will increase demand for transit-oriented development, where homes, townhouses and office buildings cluster

around transit hubs that link jobs with population centers.

That is Fairfax County's policy at Tysons Corner, where the Board of Supervisors has approved high-rise office buildings, condominiums, a hotel, restaurants and stores — on the condition that the area receive four Metro stops as part of the proposed rail extension to Dulles International Airport. The idea is that residents of Tysons would never have to leave and those wishing to shop, eat or work there could leave their cars at home and take the train.

On a much smaller scale, the county, for years derided for pro-sprawl policies, has approved or is considering similar proposals near the Dunn Loring, Springfield and Vienna Metro stops. Although the policy changes were in the works before fuel costs skyrocketed, the guiding philosophy was getting people out of their cars.

"We need to change the patterns of development," said Gerald E. Connolly (D), chairman of the Fairfax County Board of Supervisors. "We have to move to a new transit-oriented development paradigm and concentrate development and avoid the sprawl that we've allowed in the past and undo some of the environmental damage."

He pointed to nearby Arlington County and its Rosslyn-Ballston corridor, alive with pedestrians and dense housing development.

"We actually know it works," Connolly said.

That is also the model that Tom Darden, chief executive of Cherokee Investment Partners, is betting on. His Raleigh-based firm snaps up urban land, often used industrial sites, near transit stations and transforms it into housing.

He said the days of building giant houses on former soybean fields on the

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outer fringes of metropolitan areas are over.

"What were pluses of that lifestyle are now liabilities: a big SUV, a big home to heat, the energy needed to mow the lawn," he said.

He said his urban properties in Charlotte, Raleigh, N.C., Montreal and Denver are doing well, while exurbs like those in California's Central Valley are "turning into ghost towns."

"And we're only at the shallow end of the pool," Darden said.

In Montreal, Cherokee bought a former General Motors plant in 2004 and is creating a mixed-use development that will include 1,200 residential units on a transit line stop. In Denver, Darden's company is doing something similar with an abandoned rubber plant.

"Longer term, rising fuel prices produces a positive effect: people living closer-in and in smaller homes and close to transit," Darden said.

David Ellis, a researcher with the Texas Transportation Institute, said the desire for such development is driven by demographics and public demand, not government fiat.

"Government can facilitate only when there is a demand," Ellis said. "If government does something against the market, it is going to fail."

But density remains a tough sell to those who want a house with some land and who don't live or work where the

trains go.

"It is fatuous to believe that because fuel costs \$4 a gallon today that we will all decide to live in apartment houses," said Alan E. Pisarski, author of *Commuting in America* and a leading national expert on driving habits and trends.

"The economic reality is that people get forced to the edge of metropolitan areas," Pisarski said, adding that the decades-long outward march made economic sense in the days of lower home prices and cheaper commuting costs.

Even at these high gasoline prices, he doesn't foresee a major shift in those trends.

"The only answer over time is that the jobs come to them," he said, referring to employers moving out to be closer to their exurban workers. That phenomenon is in play in the Washington area, with high-tech jobs along the Dulles corridor and Interstate 270 in Maryland and all the government contracting work near Tysons Corner.

Pisarski and others say technological advances, telecommuting, flexible scheduling, carpooling and stringing errands together can reduce vehicle use. After all, most vehicle trips and miles are compiled not on commutes to work but on other trips. The eventual turnover of the nation's vehicle fleet, with the shift to more fuel-efficient vehicles, will also ease the pain.

Guy Saffel is thinking along those lines. Saffel, who works in the District but lives in South Riding, a fast-growing

exurb near Dulles, is trying to sell his family's GMC Yukon Denali. He said he is sick of buying gas for a vehicle that gets 12 miles a gallon.

The Saffels recently upgraded to a 6,000-square-foot house that doubled their mortgage payment. Saffel, his wife and his son are living what many in the country's far-out suburbs describe as "The American Dream" of a big house, a big lawn and a big vehicle in the driveway.

"We kind of fell into the trap of our neighbors," he said.

But even though he'll trade in the Denali, he's not leaving the big house. "My son is happy with schools and friends," Saffel said. "But I'll be honest, if I was single guy — if we didn't have a kid and my wife was for it — I would probably move out of the area."

The debate over density is not just limited to the East and West coasts.

Mayor Randy Pye, mayor of Centennial, Colo., a suburb of Denver, has been called a socialist by fellow Republicans for his pro-density and pro-transit views. He was a supporter of the Denver area's new light-rail system, a system built largely without federal funds.

Pye said he doesn't see a way out of high gas prices and our collective national traffic jam that doesn't involve higher-density development and mass transit.

"We hate density; we hate sprawl," he said. "But we can't continue doing what we're doing." ■

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Thirst for Oil Feeds Innovation in Oman

Mindful of Its Dwindling Supplies, Nation Focuses on New Techniques to Maintain Production

BY ELLEN KNICKMEYER
Washington Post Foreign Service

• Originally Published August 12, 2008

HARWEEL OIL FIELDS, Oman — Sirens and air monitors surround the more-than-\$1 billion oil installation rising off the flat, rock-strewn desert floor here in the 120-degree heat of Oman's interior.

Construction crews, mostly Indians and Pakistanis in once bright-colored coveralls washed out by the sun, lay out escape routes and raise airtight shelters

intended to save the lives of oil workers if the sirens ever go off.

Far underground, below a mile-thick layer of salt, lies the oil that Oman's state-controlled petroleum company is seeking. It sits in a cloud of pressurized gases laced with hydrogen sulfide at concentrations that can kill in minutes.

In Saudi Arabia, Oman's neighbor, oil production still can be as easy as jamming pipe into the ground and pumping up the oil, or standing back to let it gush forth from the pressure of the reservoir.

But for Oman, "easy oil is over,"

said Khalid Jawad al-Khabouri, a gum-snapping petroleum engineer at the headquarters of Oman's state oil company in Muscat, the capital.

At Harweel and several of the country's complex, aging fields, Oman is going after oil the hard way. More than any country along the Persian Gulf, Oman provides a preview of the future of oil.

A sultanate of fewer than 3 million citizens, Oman has staked much of its future on evolving production

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BY GUIBBAUD CHRISTOPHE — ABACA PRESS VIA NEWSCOM

An oil refinery near the port of Sohar, Oman. The Middle Eastern country 3 million has staked much of its future on evolving oil production techniques known as enhanced oil recovery.

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techniques known as enhanced oil recovery. Geologists and engineers here are employing many technologies also developing elsewhere in the Middle East, North America and China.

The country has invested \$4 billion to \$6 billion in current enhanced oil recovery projects, said Khalifa al-Hinai, technical adviser to Oman's Oil and Gas Ministry.

Most of the techniques involve pumping some agent — steam and other gases, or chemicals including polymers and detergents — into a reservoir to encourage oil to flow.

Petroleum Development Oman, a consortium that includes Oman's government along with Shell, Total and Partex oil companies, also is adopting *in-situ* combustion, which involves lighting fires within reservoirs to draw out the oil.

For Oman, the plunge into enhanced oil recovery is a necessity.

The world's other oil producers, even Saudi Arabia, will one day follow. With oil prices wedged above \$100 a barrel this year, investors worldwide are sinking billions of dollars into enhanced oil recovery.

"The world has to," said Matt Simmons, an energy investment banker and a leading proponent of the argument that oil will run out sooner rather than later, in a telephone interview from the United States. "Because it's the last game going."

Even Oman has had to realize, however, that there's no single "magic undiscovered field or technology," cautioned Sadad Husseini, a veteran former petroleum geologist for Saudi Aramco.

Less flashy moves than enhanced recovery, such as recent decisions by Oman to open its oil fields to more competitors, are at least as smart, Husseini said.

With enhanced oil recovery, "It's just a case of people catching on to the buzzword that this is going to fix it, and we're going to get a whole lot of oil out of it," Husseini said. "And it doesn't quite do that."

Oman's state-controlled oil company started to see the end of easy oil in 2000, when daily production peaked at 840,000 barrels. Then production fell through one bottom after another, hitting 561,000 barrels a day in 2007.

By most accounts, Oman's sultan, Qaboos bin Said, had used much of the wealth of Oman's glory days of oil wisely.

He created generous public services and a modern, if pervasive, government — police here routinely stop and issue fines to motorists on the road if their car needs washing, and inspectors scour Muscat for any building not painted the mandated white, cream or other light color.

Qaboos's father, Said Bin Taimour, provided fewer than 10 miles of paved road for all of Oman. He allowed Christian missionaries to run the nation's sole hospital.

Since bloodlessly deposing his father in 1970, Qaboos has put schools, clinics and roads within reach of all, thanks to Oman's oil. Air force helicopters shuttle children living in the country's mountains to boarding schools. Navy ships serve as school buses for some of the children living on Oman's islands.

But Qaboos was slow putting into practice plans to diversify Oman's economy. Even now, oil and gas account for nearly 80 percent of government revenue.

So when oil production started falling, Oman's government and oil officials started worrying.

"We as a company were in trouble," said John Malcolm, the managing director of Petroleum Development Oman.

"When you come to the edge of the cliff, you've got two choices," Malcolm

said. "You can walk away from the edge, or you can fall off the edge."

"We think we're too young to fall off the edge," he said.

In 2003, the oil company assembled what would become scores of specialists and gathered up all the reports it could find about its fields. Experts searched for ways that old or undeveloped fields could be made productive.

Harweel, in southern Oman, is one of the results. The plant will pump gas into the reservoir, using the gas as a solvent to make oil flow to production wells. The hydrogen sulfide and other gases pumped up will be separated and treated, and some of it pumped back underground. Pipes with walls more than 3 inches thick will transport the hydrogen sulfide-laced gas.

The cost overall: "A Ferrari a meter," engineers at Harweel said.

Oil producers could expect to get 10 percent of Harweel's oil without enhanced oil recovery. With it, they hope for 30 percent. Without enhanced recovery, Oman could expect to run out of oil within 15 years. With it, said Hinai, the oil ministry adviser, Oman hopes for 40 years.

At company headquarters, Khabouri, the engineer, ran through the evolving recovery techniques. Then he reached up and flicked an imaginary lever.

"After that," he said, "switch off the lights." ■

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Losing Forests to Fuel Cars

Ethanol Sugarcane Threatens Brazil's Wooded Savanna

BY SABRINA VALLE
Washington Post Staff Writer

• Originally Published July 31, 2007

Jaguars, blue macaws and giant armadillos roam the fickle landscape of Brazil's Cerrado, a vast plateau where temperatures range from freezing to steaming hot and bushes and grasslands alternate with forests and the richest variety of flora of all the world's savannas.

That could soon come to an end. In the past four decades, more than half of the Cerrado has been transformed by the encroachment of cattle ranchers and soybean farmers. And now another demand is quickly eating into the landscape: sugarcane, the raw material for Brazilian ethanol.

"Deforestation in the Cerrado is actually happening at a higher rate than it has in the Amazon," said John Buchanan, senior director of business

practices for Conservation International in Arlington. "If the actual deforestation rates continue, all the remaining vegetation in the Cerrado could be lost by the year 2030. That would be a huge loss of biodiversity."

The roots of this transformation lie in the worldwide demand for ethanol, recently boosted by a U.S. Senate bill that would mandate the use of 36 billion

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A worker walks through a sugarcane field in Brazil. The United States imported 300 million gallons of Brazilian sugarcane last year.

BY ADRIANO MACHADO —BLOOMBERG NEWS

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gallons of ethanol by 2022, more than six times the capacity of the United States' 115 ethanol refineries. President Bush, who proposed a similar increase in his State of the Union address, visited Brazil and negotiated a deal in March to promote ethanol production in Latin America and the Caribbean.

U.S. companies and investors — including George Soros and agribusiness giants Archer Daniels Midland and Cargill — are staking out territory in Brazil, expecting even greater growth in biofuels.

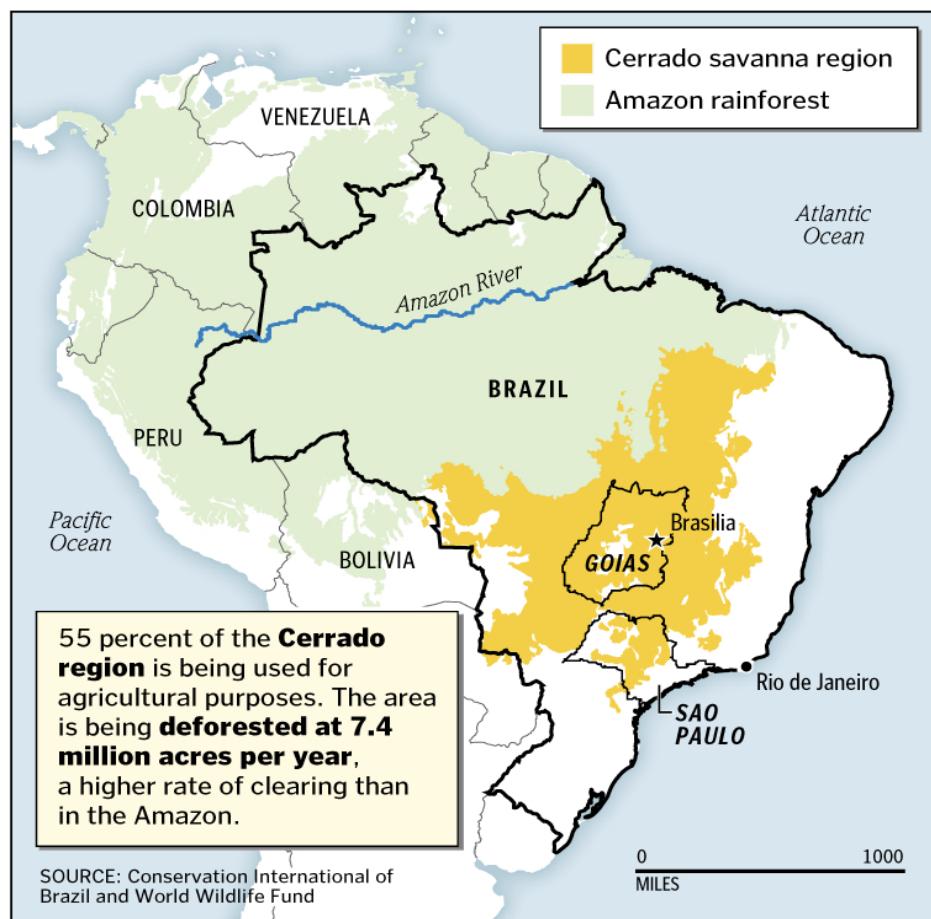
"There was already a race for Brazilian ethanol, and President Bush's announcements gave more credibility to the process," said Roberto Rodrigues, former Brazilian agriculture minister, who formed the Interamerican Ethanol Commission with former Florida governor Jeb Bush in December.

The Brazilian government and big agribusiness companies say that the expansion of soybean and sugarcane fields doesn't necessarily mean devastation of the Cerrado, which hosts an estimated 160,000 species of animals and plants, many threatened with extinction. They say they plant on wastelands and pastures where cattle once grazed, improving the soil quality and productivity.

But environmental groups argue that as soy and sugarcane displace cattle and less lucrative crops, ranchers are moving farther into the unspoiled areas of the Cerrado.

"There are ranchers substituting sugarcane for cattle in the Sao Paulo area, for instance, and displacing cattle to the state of Bahia, both in the Cerrado. So what is the point?" asks Ricardo Machado, author of a study about the Cerrado for Conservation International.

Sugarcane and soybeans play a crucial role in Brazil's agriculture, one of the



BY RENEE RIGDON — THE WASHINGTON POST

most dynamic sectors of the country's economy. And both are under pressure to expand as a result of the ethanol boom.

Sugarcane is touted by environmentalists as a better option than corn for producing ethanol. Sugarcane ethanol costs half as much to produce, and the process is five times as efficient in its use of fossil fuels.

Lured by the prospect of making ethanol from Brazilian sugarcane, many U.S. firms are trying to catch up with European and Asian investors. The company Soros is backing, Adecoagro, has become one of the main investors in Brazilian ethanol, planning to spend \$1 billion to build three plants over

the next five years. Goldman Sachs and Carlyle Group are also behind new ethanol investments in Brazil.

In addition, as use of corn-based ethanol grows in the United States, rising prices are influencing American soybean farmers to switch to corn. And as the United States, the world's largest soybean producer, cuts soybean plantings, buyers are looking to Brazil, the No. 2 soy producer, to expand its production. Brazilian soybean production is already at record levels and is predicted to increase another 4.5 percent this year, according to Abiove, an industry association.

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"There is a dual pressure in Brazil," Buchanan said. "The direct pressure to expand production of sugarcane and the indirect pressure to expand Brazilian soy, if U.S. soy is reduced."

The agriculture business and the Brazilian government say that there are nearly 350,000 square miles of already-cleared land available for agricultural expansion in the Cerrado. The government says more than 115,000 square miles of cattle pastures could be used — that's enough land to more than double soybean production and increase sugarcane production five times and ethanol by at least 10.

"Brazil is the only country with a vast amount of land available for immediate expansion of sustainable agriculture. If the U.S. races after ethanol, soybean prices tend to climb and demand will be supplied by Brazil," said Carlo Lovatelli, corporate affairs director for Bunge, one of the largest soy traders in Brazil, headquartered in White Plains, N.Y.

Lovatelli, who also represents companies responsible for 93 percent of all soy traded in Brazil, said that if demand escalates, Brazilian production could double in as little as three to four years.

And the target region has already been chosen: "Cerrado is perfect for agriculture and will be used — there is no question about it," Lovatelli said.

But Frank Guggenheim, executive director of Greenpeace Brazil, said Brazil's advantage could easily become a disadvantage. "Brazil is in a special situation because of the vast amount of land available, if it uses it in a prudent way," Guggenheim said. "But if it just pushes the agriculture frontier and causes devastation, it will be a disaster."

Brazil is already the scene of the most extensive deforestation in the world, accounting for 42 percent of the world's net forest losses from 2000 to 2005, according to a report by the Food and Agriculture Organization, an arm of the United Nations. Nongovernmental organizations say 7 million hectares of the Amazon were cleared in the past five years by soybean farmers with the help of multinational companies such as Cargill.

Faced with pressure from its clients, Cargill brought other traders together with advocacy groups and established a moratorium under which no soybeans would be bought from

devastated areas of the Amazon for two years, beginning July 24, 2006. Although the moratorium ends next year, not even the advocacy groups say the situation will return to what it was before.

The Cerrado, however, has not had the spotlight that the Amazon has, and so the environmental impact of expansion of the sugarcane business into the savanna is under less international scrutiny.

This month, Brazilian Agriculture Minister Reinhold Stephanies announced new measures to avoid devastation from sugarcane plantations. But some groups say enforcement would be effective only with large investments in mapping tools and ground supervision, which the Brazilian government could not afford.

And ethanol investments keep growing. The sugar industry estimates that \$17 billion will be invested through 2012 in 86 new sugarcane processing plants, adding to the 330 plants in Brazil today.

So far, the impact of the U.S. thirst for Brazilian ethanol has been blunted by the 51-cent-per-gallon subsidy paid to American corn ethanol producers and by the 54-cent-per-gallon tariff on imported ethanol. The Senate extended the tariff until 2009, even though Bush signed an accord to jointly promote biofuel production with Brazil.

Nevertheless, of the 680 million gallons of ethanol the United States imported last year, about 500 million gallons came from Brazil, the world's leading ethanol exporter.

"The tariff was not an eliminating factor when we, last year, had \$78-a-barrel oil on a sustained basis," says Roger K. Conway, director for the Agriculture Department's Office of Energy Policy and New Uses. "There certainly could be more imports from Brazil. It depends on energy prices."

Soros's company in Brazil is betting that the United States will have to increase ethanol imports and that a calendar for gradual reduction of the tariff could be established from 2010.

"If the U.S. entirely lifts the tariff, demand for ethanol will go through the roof and the pressure on the environment would be enormous," said a former Brazilian secretary of state for science and technology, José Goldemberg, speaking at a seminar on Brazilian ethanol in Washington last month. ■

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OUTLOOK

ETHANOL HYPE

Corn Can't Solve Our Problem

By DAVID TILMAN AND JASON HILL

The world has come full circle. A century ago our first transportation biofuels — the hay and oats fed to our horses — were replaced by gasoline. Today, ethanol from corn and biodiesel from soybeans have begun edging out gasoline and diesel.

This has been hailed as an overwhelmingly positive development that will help us reduce the threat of climate change and ease our dependence on foreign oil. In political circles, ethanol is the flavor of the day, and presidential candidates have been cycling through Iowa extolling its benefits. Lost in the ethanol-induced euphoria, however, is the fact that three of our most fundamental needs — food, energy, and a livable and sustainable environment — are now in direct conflict. Moreover, our recent analyses of the full costs and benefits of various biofuels, performed at the University of Minnesota, present a markedly different and more nuanced picture than has been heard on the campaign trail.

Some biofuels, if properly produced, do have the potential to provide climate-friendly energy, but where and how can we grow them? Our most fertile lands are already dedicated to food production. As demand for both food and energy increases, competition for fertile lands could raise food prices enough to drive the poorer third of the globe into malnourishment. The destruction



Promises at the pump: Biofuels such as ethanol are promoted as Earth-friendly.

of rainforests and other ecosystems to make new farmland would threaten the continued existence of countless animal and plant species and would increase the amount of climate-changing carbon dioxide in the atmosphere.

Finding and implementing solutions to the food, fuel and environment conflict is one of the greatest challenges facing humanity. But solutions will be neither adopted nor sought until we understand the interlinked problems we face.

Fossil fuel use has pushed atmospheric carbon dioxide higher than at any time during the past half-million years. The global population has increased threefold in the past century and will increase by half again, to 9 billion people, by 2050. Global food and fossil energy consumption are on trajectories to double by 2050.

Biofuels, such as ethanol made from corn, have the potential to provide us with cleaner energy. But because of how corn ethanol currently is made, only about 20 percent of each gallon is "new" energy. That is because it takes a lot of "old" fossil energy to make it: diesel to run tractors, natural gas to make fertilizer and, of course, fuel to run the refineries that convert corn to ethanol.

If every one of the 70 million acres on which corn was grown in 2006 was used for ethanol, the amount produced would displace only 12 percent of the U.S. gasoline market. Moreover, the "new"

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(non-fossil) energy gained would be very small — just 2.4 percent of the market. Car tune-ups and proper tire air pressure would save more energy.

There is another problem with relying on a food-based biofuel, such as corn ethanol, as the poor of Mexico can attest. In recent months, soaring corn prices, sparked by demand from ethanol plants, have doubled the price of tortillas, a staple food. Tens of thousands of Mexico City's poor recently protested this "ethanol tax" in the streets.

In the United States, the protests have also begun — in Congress. Representatives of the dairy, poultry and livestock industries, which rely on corn as a principal animal feed, are seeking an end to subsidies for corn ethanol in the hope of stabilizing corn prices. (It takes about three pounds of corn to produce a pound of chicken, and seven or eight pounds to grow a pound of beef.) Profit margins are being squeezed, and meat prices are rising.

U.S. soybeans, which are used to make biodiesel, may be about to follow corn's trajectory, escalating the food vs. fuel conflict. The National Biodiesel Board recently reported that 77 biodiesel production plants are under construction and that eight established plants are expanding capacity.

In terms of environmental impact, all biofuels are not created equal. Ethanol is the same chemical product no matter what its source. But ethanol made from prairie grasses, from corn grown in Illinois and from sugar cane grown on newly cleared land in Brazil have radically different impacts on greenhouse gases.

Corn, like all plants, is a natural part of the global carbon cycle. The growing crop absorbs carbon dioxide from the atmosphere, so burning corn ethanol does not directly create any additional carbon. But that is only part of the story. All of the fossil fuels used to grow corn and change it into ethanol release new carbon dioxide and other greenhouse gases. The net effect is that ethanol from corn grown in the Corn Belt does

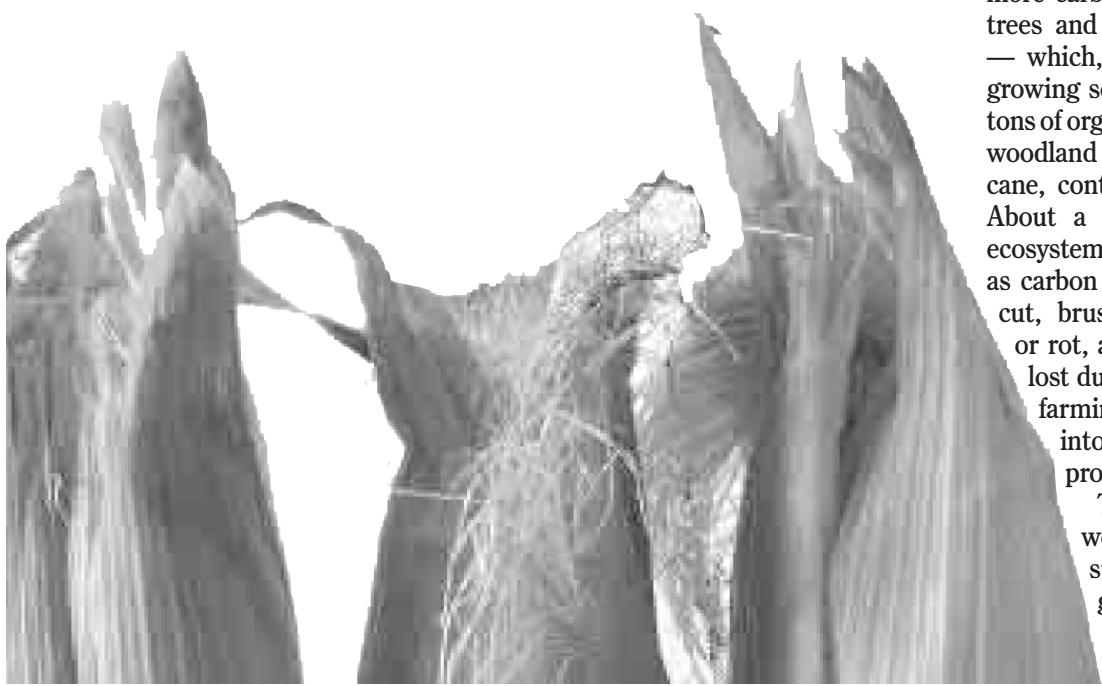
increase atmospheric greenhouse gases, and this increase is only about 15 percent less than the increase caused by an equivalent amount of gasoline. Soybean biodiesel does better, causing a greenhouse gas increase that is about 40 percent less than that from petroleum diesel.

In Brazil, ethanol made from sugar cane produces about twice as much ethanol per acre as corn. Brazilian ethanol refineries get much of their power from burning cane residue, in effect recycling carbon from the atmosphere. The environmental benefit is large. Sugar-cane ethanol grown on established soils releases 80 percent less greenhouse gases than gasoline.

But that isn't the case for sugar-cane ethanol or soybean biodiesel from Brazil's newly cleared lands, including tropical forests and savannas. Clearing land releases immense amounts of greenhouse gases into the air, because much of the material in the plants and soil is broken down into carbon dioxide.

Plants and soil contain three times more carbon than the atmosphere. The trees and soil of an acre of rainforest — which, once cleared, is suitable for growing soybeans — contain about 120 tons of organic carbon. An acre of tropical woodland or savanna, suitable for sugar cane, contains about half this amount. About a fourth of the carbon in an ecosystem is released to the atmosphere as carbon dioxide when trees are clear-cut, brush and branches are burned or rot, and roots decay. Even more is lost during the first 20 to 50 years of farming, as soil carbon decomposes into carbon dioxide and as wood products are burned or decay.

This means that when tropical woodland is cleared to produce sugar cane for ethanol, the greenhouse gas released is about 50 percent greater than



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what occurs from the production and use of the same amount of gasoline. And that statistic holds for at least two decades.

Simply being "renewable" does not automatically make a fuel better for the atmosphere than the fossil fuel it replaces, nor guarantee that society gains any new energy by its production. The European Union was recently shocked to learn that some of its imported biodiesel, derived from palm trees planted on rain-forest lands, was more than twice as bad for climate warming as petroleum diesel. So much for the "benefits" of that form of biodiesel.

Although current Brazilian ethanol is environmentally friendly, the long-term environmental implications of buying more ethanol and biodiesel from Brazil, a possibility raised recently during President Bush's trip to that country, are cloudy. It could be harmful to both the climate and the preservation of tropical plant and animal species if it involved, directly or indirectly, additional clearing of native ecosystems.

Concerns about the environmental effects of ethanol production are starting to be felt in the United States as well. It appears that American farmers may add 10 million acres of corn this year to meet booming demand for ethanol. Some of this land could come from millions of acres now set aside nationwide for conservation under a government-subsidized program. Those uncultivated acres absorb atmospheric carbon, so farming them and converting the corn into ethanol could release more carbon dioxide into the air than would burning gasoline.

There are biofuel crops that can be grown with much less energy and chemicals than the food crops we

currently use for biofuels. And they can be grown on our less fertile land, especially land that has been degraded by farming. This would decrease competition between food and biofuel. The United States has about 60 million acres of such land — in the Conservation Reserve Program, road edge rights-of-way and abandoned farmlands.

In a 10-year experiment reported in Science magazine in December, we explored how much bioenergy could be produced by 18 different native prairie plant species grown on highly degraded and infertile soil. We planted 172 plots in central Minnesota with various combinations of these species, randomly chosen. We found, on this highly degraded land, that the plots planted with mixtures of many native prairie perennial species yielded 238 percent more bioenergy than those planted with single species. High plant diversity led to high productivity, and little fertilizer or chemical weed or pest killers was required.

The prairie "hay" harvested from these plots can be used to create high-value energy sources. For instance, it can be mixed with coal and burned for electricity generation. It can be "gasified," then chemically combined to make ethanol or synthetic gasoline. Or it can be burned in a turbine engine to make electricity. A technique that is undergoing rapid development involves bioengineering enzymes that digest parts of plants (the cellulose) into sugars that are then fermented into ethanol.

Whether converted into electricity, ethanol or synthetic gasoline, the high-diversity hay from infertile land produced as much or more new usable energy per acre as corn for ethanol on fertile land. And it could be harvested year after year.

Even more surprising were the greenhouse gas benefits. When high-diversity mixtures of native plants are grown on degraded soils, they remove carbon dioxide from the air. Much of this carbon ends up stored in the soil. In essence, mixtures of native plants gradually restore the carbon levels that degraded soils had before being cleared and farmed. This benefit lasts for about a century.

Across the full process of growing high-diversity prairie hay, converting it into an energy source and using that energy, we found a net removal and storage of about a ton and a half of atmospheric carbon dioxide per acre. The net effect is that ethanol or synthetic gasoline produced from this grass on degraded land can provide energy that actually reduces atmospheric levels of carbon dioxide.

When one of these carbon-negative biofuels is mixed with gasoline, the resulting blend releases less carbon dioxide than traditional gasoline.

Biofuels, if used properly, can help us balance our need for food, energy and a habitable and sustainable environment. To help this happen, though, we need a national biofuels policy that favors our best options. We must determine the carbon impacts of each method of making these fuels, then mandate fuel blending that achieves a prescribed greenhouse gas reduction. We have the knowledge and technology to start solving these problems. ■

David Tilman is an ecologist at the University of Minnesota and a member of the National Academy of Sciences. Jason Hill is a research associate in the Department of Applied Economics at the University of Minnesota.

—Sunday, March 25, 2007

An Integrated Curriculum For The Washington Post Newspaper In Education Program

Academic Content Standards

This lesson addresses academic content standards of Maryland, Virginia and the District of Columbia.

Maryland

Government, Economics: The student will demonstrate an understanding of economic principles, institutions and processes required to formulate government policy (Expectation 4.1)

Environmental Science: The student will evaluate the interrelationship between humans and energy resources. At least — renewable, nonrenewable, human health (6.3.5)

Environmental Science: The student will develop and apply knowledge and skills gained from an environmental issue investigation to an action project which protects and sustains the environment (6.4)

Reading/ELA: Analyze text features to facilitate understanding of informational texts.

- b) Analyze graphic aids that contribute to meaning
 - c) Analyze informational aids that contribute to meaning
- (Standard 2 Comprehension of Informational Text, Indicator 2)

Virginia

Civics and Economics: The student will demonstrate knowledge of how economic decisions are made in the marketplace by a) applying the concepts of scarcity, resources, choice, opportunity cost, price, incentives, supply and demand, production and consumption. (CE.9a)

Civics and Economics: The student will demonstrate knowledge of how economic decisions are made in the marketplace by b) comparing the differences among free market, command, and mixed economies (CE.9b)

Science: The student will investigate and understand the differences between renewable and nonrenewable resources (Earth Science, ES.7)

English: The student will read and demonstrate comprehension of a variety of informational texts.

- c) Distinguish fact from opinion in newspapers, magazines, and other print media.
- d) Identify the source, viewpoint, and purpose of texts.
- e) Describe how word choice and language structure convey an author's viewpoint.
- f) Summarize what is read.
- g) Organize and synthesize information for use in written and oral presentations. (Reading, Grade 7, 7.6)

Standards of Learning currently in effect for Virginia Public Schools can be found online at www.pen.k12.va.us/VDOE/Superintendent/Sols/home.shtml.

Washington, D.C.

Principles of Economics: Students understand common economic terms and concepts and economic reasoning. (Economic Terms, E1)

Principles of Economics: Students analyze the elements of America's market economy in a global setting. (Market Economy, E3)

Principles of Economics: Students analyze issues of international trade and explain how the U.S. economy affects, and is affected by, economic forces beyond U.S. borders. (International Trade, E5)

Environmental Science: Numerous Earth resources are used to sustain human affairs. The abundance and accessibility of these resources can influence their use. Students will differentiate between renewable and nonrenewable resources (including sources of energy, and compare and contrast the pros and cons of using nonrenewable resources. (Natural Resources, H.S., ES.5)

English Language Arts: Distinguish fact from opinion in expository text, providing supporting evidence from text. (Informational Text, Grade 5, E1)

The Maryland Voluntary State Curriculum Content Standards can be found online at <http://mdk12.org/assessments/vsc/index.html>.

Learning Standards for DCPS are found online at www.k12.dc.us/dcps/Standards/standardsHome.htm.