

Michigan**Science**

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ON THE COVER: *This 1972 photograph features the first satellite image of Earth's southern polar ice cap. The Antarctic ice sheet contains between 6 and 7.2 million cubic miles of ice, or around 70 percent of the planet's fresh water.*

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BY THE NUMBERS

Beyond propaganda and rhetoric, numbers tell the real story



The gray wolf population has increased enough to warrant its removal from Michigan's list of threatened species.

A RECENTLY RELEASED JOINT STUDY by the Global Invasive Species Programme and the Nature Conservancy claims that damage from invasive species costs the world \$1.4 trillion annually — about 5 percent of the global economy. Among the invasive species highlighted in the report are two proposed biofuel crops. The giant reed, a wildfire-prone plant from western Asia, is already establishing itself in North and Central America, while the African oil palm is encroaching on the Amazon rainforest in Brazil. According to the study, the United States spends \$120 billion each year controlling damage caused by non-native plants and animals, including purple loosestrife, zebra mussels and emerald ash borers in Michigan.

For more information, visit <http://www.nature.org/initiatives/invasive-species/strategies/art24885.html>

GRAY WOLF AND BALD EAGLE populations have increased enough to warrant their removal from Michigan's list of threatened species, along with the osprey

and two insect species. In the 1950s, only 412 pairs of bald eagles were breeding in the 48 contiguous states; today there are 515 nesting pairs in Michigan alone. The gray wolf's comeback is similarly dramatic, growing from just three in 1989 to more than 500 in 2007, though the species remains endangered federally. Currently, 40 animal species are designated under Michigan's Endangered Species Program, with another 41 listed as threatened. The state Department of Natural Resources is considering amendments shifting three threatened species to the endangered list. Forty-six other species — 30 of them mollusks — would be listed as endangered or threatened for the first time.

For more information, visit http://www.mlive.com/environment/index.ssf/2008/06/bald_eagle_gray_wolf_may_leave.html

http://www.michigan.gov/dnr/0,1607,7-153-10370_12141_12168--,00.html

THIS YEAR MARKS THE 100TH anniversary of the first Ford Model T to roll off the production line. Though the gas-

powered automobile premiered in Germany in 1885, the Model T was the first car to be mass-produced with interchangeable parts. According to the Henry Ford Museum, its 20-horsepower, four-cylinder engine allowed it to cruise at a top speed of 45 miles per hour with gas mileage of 13 to 21 miles per gallon. More than 15 million Model Ts were built from 1909 until 1927. During that time the price declined from \$825 to \$260.

For more information, visit www.hfmgv.org/exhibits/showroom/1908/model.t.html

RESEARCHERS AT TEXAS A&M University are hoping that hormonal contraceptives can reduce the population of wild hogs, which can cause millions of dollars in property damage and carry infectious diseases. Beginning at six months of age, swine can produce litters of four to eight piglets twice annually throughout their 15- to 25-year lifespan, meaning that a small population of pigs can increase their numbers significantly over the course of several years. The contraceptive addresses this by preventing the sow's eggs from maturing. According to the Department of Natural Resources, Michigan wild pig sightings have increased over the past several years, totaling 116 between 2001 and 2007. An additional 127 hogs were shot by hunters during the same period. The DNR says that pork from feral swine is safe for human consumption if it has been cooked to a temperature of 170.6 degrees Fahrenheit.

For more information, visit http://www.gjc.com/living/content/news/stories/2008/05/19/wildhogs_0519.html?cxntlid=inform_sr



*Just
the Facts

BY KENNETH M. BRAUN

MORE THAN 60 YEARS AGO, the Ogoki River and Long Lac (Long Lake) in Ontario were re-routed from the undrinkable salt water of Hudson Bay to Lake Superior to generate hydroelectric power for Canada. This diversion continues to add almost 1.2 trillion additional gallons of fresh water to the Great Lakes each year. If this were captured as one-gallon bottles that sold for \$1 each, it would fetch more than twice the combined gross state product of Arizona, Nevada, New Mexico and Utah. Our second wealthiest state, Texas, wouldn't be able to buy it all; California would need to surrender almost two of every three dollars. And just as awe-inspiring, all of the world's desalination plants combined convert more than 1.2 trillion gallons of seawater into drinkable water every year.

These perspectives belong in "Great Lakes for Sale: From Whitecaps to Bottlecaps," a recent book about Great Lakes water diversions and the bottled water industry. Unfortunately, author Dave Dempsey too often avoids facts that undercut his stated premise — that Great Lakes water should not be "disturbed for anything but the most paramount human priorities." Those diversions into Lake Superior are not discussed in the book's 100 pages, but the quantitatively smaller man-made Chicago River diversion — the largest single removal of water from the Great Lakes Basin — rates four written references, two photographs and one map.

The book also examines the 2001 decision by the Michigan Department of Environmental Quality to allow Perrier (which was later purchased by Nestlé) to bottle and remove 300 million gal-

lons of Great Lakes Basin groundwater per year from Mecosta Township, near Big Rapids. However, readers are not informed that this represents less than three hours worth of the freshwater added to the basin yearly via the Ontario diversion mentioned above.

Similarly, the 2000 U.S. Census counted just 1,184 homes in Mecosta Township. With this in mind, did the 200 jobs that Nestlé was providing to the local economy by 2003 rise to the level of a "paramount" human priority when matched against the amount of water at issue? You won't find out by reading this book.

In fact, the MDEQ and the Michigan Department of Labor and Economic Growth did weigh this trade-off when those jobs were put in jeopardy. On Nov. 25, 2003, when a local judge decided in favor of a group suing Nestlé over the water removal and ordered the plant to cease operations, the state agencies jointly filed an amicus brief asking the Michigan Court of Appeals to prevent the shutdown. The brief specifically cited concerns over the lost jobs and pointed out that the local water level was at a three year high — even after the plant had been in operation for the prior year and a half.

"Great Lakes for Sale" applauds those suing Nestlé and is dismissive of Gov. Jennifer Granholm and her MDEQ director. But was the brief correct about the local water running at a three-year high? The book fails to mention — let alone refute — the MDEQ finding.

Dempsey says in the prologue that he will not shy away from emotional appeals, and that while he will "give you the facts," sole reliance on them will

lead to "the end of the Great Lakes and so much else."

Drawing outside the lines of provable fact, the author asserts that water has a "spiritual value" and that its private sale should most often be illegal. He nods approvingly at a Minneapolis theater that restored its public drinking fountain so as to create a place "where people meet in the communal act of sharing water," and that also bans bottled water to protest its use as "an individual commodity."

For Dempsey, not all water diversions are equal, despite his assertion that the lakes might die from "a hundred million cuts." The sale of bottled water diverts far less from the Great Lakes Basin than many industries selling the same water in products such as cherries, corn, soft drinks and more. While he doesn't dispute this quantitative disparity, Dempsey declares the difference to be that the water bottlers are asserting "ownership" over the water they use while those other commercial producers are not.

This distinction may explain why he doesn't tell us about Long Lac, Ogoki, and the MDEQ findings on water levels in Mecosta. His main concern doesn't appear to be the quantity of Great Lakes water, but the supposed immorality of anyone owning "the source of life." Left out of the analysis is the fact that private sale and ownership is the norm for other "paramount human priorities," such as food, clothing and shelter.

"Great Lakes for Sale" was written to advance a peculiar legal and political perspective about selling water, one the author admits isn't shared by many of his allies in the environmental community. If the Great Lakes *were* under siege because of employers who bottled water — or used it for any other purpose — then you won't find enough in this book to prove the case. What's left out goes a long way toward undermining that very point. ■

FIELD TRIPS

Area science museums host special programs of interest for budding scientists and their families

Deadly Medicine: Creating the Master Race

What happens when science is corrupted by destructive ideology? The Detroit Science Center attempts to address this issue with an investigation into Nazi Germany's abuse of scientific principles to legitimize violence and genocide. Originally exhibited at the United States Holocaust Museum, "Deadly Medicine" features historical artifacts and photos documenting the Third Reich's quest for racial purity through "scientific" social engineering.

Through March 1, The New Detroit Science Center, 5020 John R St., Detroit, 313-577-8400. Center is open Monday through Friday, 9 a.m.-3 p.m.; Saturday 10:30 a.m.-6 p.m.; and Sunday, 12 p.m.-6 p.m. Admission included with regular admission. This exhibit is not recommended for children under 13.

▶ For more information, visit www.detroitsciencecenter.org.

Mid-Michigan Children's Museum

The state's newest museum specializes in offerings for children and their families. The "Aunt Sugar's Farm" exhibit shows children how food products like potatoes and sugar make the journey from the ground to their kitchen shelves and emphasizes the importance of nutrition and eating healthy foods. "Car Works" gives pint-sized visitors a look at the auto industry with a car-themed playground that introduces basic physics. Other areas of the museum explore water, Michigan's seasons and the human body.

Mid-Michigan Children's Museum, 315 West Genesee, Saginaw, MI 48602, phone 989-399-6626. Museum is open Monday, Wednesday, Friday and Saturday, 10 a.m.-5 p.m.; Thursday 10 a.m.-7 p.m.; and Sunday, 10 p.m.-6 p.m.

▶ For more information, visit <http://www.midmicm.org>.



Dinosaurs: Just Imagine! and Dinosaur Chronicles

Aspiring paleontologists will witness the intersection of science and imagination as they learn how scientists piece together fossil clues to uncover how dinosaurs looked, ate and lived in a dinosaur double feature at the Public Museum of Grand Rapids. The "Dinosaurs: Just Imagine" exhibit includes animatronic dinosaurs and opportunities for hands-on play while digging for fossils and assembling skeletons. Within the museum's Roger B. Chaffee Planetarium, visitors can learn more about Earth 65 million years ago and possible reasons for the dinosaurs' extinction with "The Dinosaur Chronicles."

February 21 through May 25, Public Museum of Grand Rapids, 272 Pearl Street NW, Grand Rapids, MI 49504, 616-456-3977. Museum is open Monday through Friday, 9 a.m.-5 p.m.; Sunday, 12 p.m.-5 p.m. Exhibit is \$2 after regular admission; planetarium show is \$3.

▶ For more information, visit <http://www.grmuseum.org>.

Test your reading of this issue of *MichiganScience*. Students in grades six through 12 can compete for a \$100 gift certificate from Edmund Science Kit. The winner will be determined by a random drawing from entries with all the correct answers. Please send entries to walker@mackinac.org.

1. **What is the initial construction cost for a new nuclear power plant?**
A. \$6 million
B. \$7 billion
C. \$8 trillion
D. \$700,000
2. **Which city's museum is hosting a hands-on exhibit about dinosaurs?**
A. Lansing
B. Detroit
C. Grand Rapids
D. Ann Arbor
3. **How many people worldwide use cell phones?**
A. 3 million
B. 30 million
C. 3 billion
D. 300,000
4. **How many species are listed as endangered or threatened under Michigan's Endangered Species Act?**
A. 41 B. 40 C. 81 D. 127
5. **What does the America's Climate Security Act of 2007 propose to do?**
A. Establish a flat-rate carbon tax on all greenhouse gas producers
B. Encourage investment in compressed natural gas
C. Set up a cap-and-trade system for greenhouse gas emissions
D. Offer tax breaks for wind turbine construction
6. **How many new nuclear power plants are currently applying for permits?**
A. 17 B. 31 C. 70 D. 15
7. **Where is the Palisades Nuclear Generating Station?**
A. Bridgman, in Berrien County
B. Monroe County
C. Rural Alabama
D. Van Buren County
8. **Which of the following is not a source of compressed natural gas?**
A. Condensate wells
B. Oil wells
C. Nuclear generators
D. Coal bed wells
9. **From which country does the United States import most of its natural gas?**
A. Canada
B. Mexico
C. China
D. Most CNG is produced domestically, not imported
10. **At what age can a feral pig begin to reproduce?**
A. 6 months
B. 1 year
C. 18 months
D. 15 years



SHOW US WHAT YOU KNOW! WIN CASH AND PRIZES!

Cell phones are used by more than 3 billion people worldwide.¹ From text-messaging teens in the United States to pre-paid phone users in developing nations, cell phones have revolutionized the way people connect with their world.

Despite their popularity, however, some argue for restrictions on cell phone use because of possible health and safety risks, especially among children and teens. Others say that the danger is minimal and that benefits provided by cell phones exceed their risks. Both sides point to scientific studies to bolster their conclusions about the safety of cell phone use.

Is it better to err on the side of safety and limit the use of cell phones, or is it more important to let users decide for themselves after weighing the risks? What kind of restrictions on mobile phone usage, if any, might be appropriate to protect human health given current scientific knowledge?

MichiganScience will award a cash prize of \$500 to the student (in grades six-12) whose 500-word essay best explores the science surrounding the health effects of cell phones and compellingly advocates for or against restrictions limiting mobile phone use.

Runners-up will receive gift cards good for thousands of fun and interesting products from Edmund Scientific, a premier supplier of science kits and other educational materials.

All essays must be original, legible and no more than 500 words in length. Authors must be in grades six through 12. Each entry must include the attached submission form. The deadline for entries is April 1, 2009. Winners will be announced in May 2009. The winning essay will be published in the Summer 2009 issue of *MichiganScience*.

¹ <http://www.smh.com.au/news/technology/mobile-phone-users-top-33-billion/2008/05/25/1211653822824.html>

NEW

NUKES

BY ROBB FREDERICK

At 12:28 a.m. on Tuesday, March 22, 2007, a nuclear reactor in northern Alabama restarted after 22 years off the grid. And with that, 650,000 people changed the channel and continued their lives uninterrupted. Less than three months later, on June 8, the unit reached its full power — 1,065 megawatts electric. »

NEW NUKES

The restart at Browns Ferry Unit 1 required eight miles of piping, 188 tons of steel and 1,200 tests and inspections. It cost the Tennessee Valley Authority, the government-run corporation that supplies much of the power consumed in the southeastern United States, \$1.8 billion.¹

The reactor idled for a year after a 1975 fire and began more than two decades offline in 1985. Just two days after the 2007 restart, Unit 1 was stopped again when a ruptured pipe spilled 600 gallons of fluid into the turbine hall during testing. Operations have stopped five times since then. But protest has been remarkably absent.

"Need drives a lot of behavior," explains Gilbert Brown, coordinator of the Energy Engineering Graduate Program at the University of Massachusetts at Lowell. "And there's a need for baseload power.² That was happening before the 'inconvenient truth' of global warming."

The high cost of fossil fuels and claims of climate change have sparked a new discussion of energy trends in the United States. The nuclear industry could benefit from the increased interest.

"We need wind," Brown acknowledges. "We need solar. We need to do all that stuff. But nuclear provides baseload. That's 24/7 electricity."

Nuclear power development nearly came to a halt in 1979, when a reactor at the Three Mile Island Nuclear Generating Station overheated, belching a cloud of radioactive gas into the Pennsylvania sky. No one died, but the accident — called a "normal aberration" by Metropolitan Edison's then-vice-president Jack Herbein³ — and public fears, embodied by "No Nukes" concerts and "The China Syndrome," a disaster film starring Jane Fonda⁴, stopped virtually all nuclear development in the nation.

But licensed nuclear facilities continued to operate, funneling a record-high 806 billion kilowatt hours into the power grid in 2007.⁵ In the same year, nuclear power generated 19 percent of the electricity in the

United States.⁶ In six states — Vermont, South Carolina, New Jersey, Connecticut, Illinois and New Hampshire — nuclear power provided more energy than any other source.⁷

In Michigan, the nuclear portion is 26 percent.⁸

Demand for electrical power in the United States has nearly doubled since 1977.⁹ The U.S. Department of Energy predicts an additional increase of 53 percent — from 3,669 billion kilowatt hours to 5,619 billion kilowatt hours — by 2030.¹⁰

If the nuclear sector is to hold almost one-fifth of the domestic supply business — and many experts predict it will, especially when set against the high cost of natural gas and the threat of a tax or cap on carbon emissions — 20 more reactors will have to be built.

"When you think about what we need to add baseload power, which is what we have now, and you factor in the emphasis on climate change and other global goals and challenges, there is absolutely no way that you can get to where we need to be without a healthy contribution by nuclear power," said Mitchell Singer, a spokesman for the Nuclear Energy Institute in Washington, D.C. "And you know what? We can't get by with baseload."

The industry has noticed an opening. Seventeen companies have submitted or are finalizing license applications for 31 new nuclear power plants.¹¹ Among them is Michigan's DTE Energy, which filed an application for a new reactor at the Enrico Fermi Nuclear Generating Station in Monroe County last September.

The designs are more streamlined than previous models. The AP1000 — a product of Westinghouse, which is in negotiations with nuclear plant operators for 10 to 12 new U.S. reactors¹² — uses half as many safety valves and 85 percent less cable.¹³ The company says it can build a working unit in just 36 months.

6 Energy Information Administration, Annual Energy Review 2007, Table 8.2a, http://www.eia.doe.gov/emeu/aer/pdf/pages/sec8_8.pdf.

7 "Nuclear Statistics: U.S. Nuclear Power Plants," Nuclear Energy Institute. http://www.nei.org/resourcesandstats/nuclear_statistics/usnuclearpowerplants/

8 Katz, Diane and Theodore Bolema, "Michigan's Electricity Market," May 2008 <http://www.mackinac.org/article.aspx?ID=9493>

9 "Annual Energy Review 2006," Energy Information Administration, Department of Energy.

10 <http://www.eia.doe.gov/oiaf/ieo/leohecon.html>

11 "Status and Outlook for Nuclear Energy in the United States," Nuclear Energy Institute, April 2008.

12 "New Commercial Reactor Designs," U.S. Energy Information Administration, November 2007.

13 http://www.ap1000.westinghousenuclear.com/ap1000_glance.html

1 http://www.tva.gov/power/nuclear/brownsferry_unit1_facts.htm

2 Base-load power refers to the minimum amount of power that must be produced to meet all expected power demands of a utility or distributor. See http://www.energyvortex.com/energydictionary/baseload__base_load__baseload_demand.html for more information.

3 "A Nuclear Nightmare," Time Magazine, 9 April 1979.

4 Directed by James Bridges. Released on March 16, 1979.

5 "Safety Indicators Show U.S. Nuclear Industry Sustained Near-Record Levels of Excellence in '07," Nuclear Energy Institute, April 2008.

“This is not your father’s nuclear plant,” Singer said. “In the old days, back in the ’70s and ’80s, every one of these was a custom job. Now there are a handful of designs, and they’re simplified. They have fewer pumps, fewer valves, less piping and less cable. And that all brings the cost down.”

Nuclear facilities are increasingly efficient. The average U.S. reactor operates at 90 percent of capacity. The electricity it generates costs just 1.7 cents per kilowatt hour, a 30 percent price decrease from a decade ago.¹⁴

The real cost comes in development. Each new nuclear facility will cost around \$7 billion¹⁵.

The 2005 federal Energy Policy Act offered a number of incentives, including accident indemnity and “standby support,” taxpayer-funded protection against delay costs incurred by the builders of the first six new power facilities.¹⁶ The measure also guaranteed 80 percent of the loans for any project — nuclear included — that employs “new or significantly improved technologies” for reducing emissions.

Nuclear companies have found an even more efficient route: extending the life span of existing plants. The operators of 91 percent of nuclear reactors in the U.S. have requested license renewals. Forty-eight have extended their original licenses by 20 years.¹⁷

The \$380 million Palisades Nuclear Generating Station in Van Buren County had been scheduled to shut down in 2011, but is now expected to operate until 2031.¹⁸ Unit 2 of the Donald C. Cook Nuclear Plant in Bridgman was to shutter in 2017. It is now licensed through 2037.¹⁹

Critics say that’s courting disaster. “We’re living on borrowed time,” said Kevin Kamps, a Kalamazoo native who works as an analyst for Beyond Nuclear, an advocacy group based in Washington, D.C. “These plants are badly deteriorated. At some we’ve seen equipment falling off the ceiling.

“It’s pretty dramatic stuff,” he said.

Gilbert Brown has a different view. “It’s like an old

car,” he said. “A car today and a car from the ’70s are pretty much the same machine. There’s an engine, some oil, a fan belt and a transmission.

“With a new car, you get seat belts, air bags, antilock brakes — all these features that add to the safety of a car. And that’s nice. But you can retrofit the old car. You can put in a better seat belt and upgrade the existing safety features. And that’s exactly what the nuclear industry is doing.”

Nuclear companies also are hiring new workers. For years, public worries steered would-be nuclear engineers into other fields, including medicine. Now, an aging workforce and a sudden demand for increased capacity have brought a full press from the nuclear HR department.

“They are in a very aggressive hiring mode,” said Larry Foulke, a professor emeritus at the University of Pittsburgh’s Swanson School of Engineering. “It’s almost obscene, the way they try to recruit these students.”

Foulke takes his classes on a tour of the Beaver Valley Nuclear Generating Station, a 500-acre facility in Shippingport, Pa. Students spend the first hour with human resources staff who cite the benefits of FirstEnergy employment, which range from medical insurance and pension plans to assistance for adoption and continuing education.

The stigma against the nuclear field is fading. “The public perception is much more positive today,” Foulke said. “It’s been 30 years since Three Mile Island. My students weren’t even alive then. And now you have the bugaboo of global warming, which is a much bigger fear in people’s minds.”

His fall class — Introduction to Nuclear Engineering — has 80 students. That’s up from 72 in the fall of 2006. This trend is even more drastic at the national level. The U.S. Department of Energy’s Oak Ridge Institute for Science and Education reports that enrollment in undergraduate nuclear engineering programs more than doubled between 1999 and 2007.²⁰ The same study also found that post-graduate degrees were on the rise.

By that measure, and by the full-page help wanted ads for Westinghouse, FirstEnergy and DTE Energy, the future of nuclear power is already here. ■

¹⁴ “Nuclear Power Plant Contributions to State and Local Economies,” Nuclear Energy Institute, January 2008

¹⁵ Dolley, Steven. “NEI sees up to 8 new reactors running by 2016; restates need for US backing,” Inside Energy, February 2008

¹⁶ <http://www.doe.gov/about/EPAct.htm>

¹⁷ “Status and Outlook for Nuclear Energy in the United States,” Nuclear Energy Institute, April 2008.

¹⁸ <http://www.nrc.gov/info-finder/reactor/pali.html>

¹⁹ <http://www.nrc.gov/info-finder/reactor/cook2.html>

²⁰ <http://orise.orau.gov/sep/files/NE-Brief-62-2007-data.pdf>

Michigan**Science**

THE TRUE COSTS OF EPA GLOBAL WARMING REGULATION

BY BEN LIEBERMAN

Legislation designed to address global warming failed in Congress last year, largely due to concerns about its high costs and adverse impact on an already weakening economy.

The congressional debate will likely resume in 2009, as legislators try again to balance the environmental and economic considerations on this complex issue. Meanwhile, the Environmental Protection Agency, pursuant to a 2007 Supreme Court decision, has initiated steps toward bypassing the legislative process and regulating greenhouse gas emissions under the Clean Air Act.

The EPA's Advance Notice of Proposed Rulemaking is nothing less than the most costly, complicated and unworkable regulatory scheme ever proposed. Under ANPR, nearly every product, business and building that uses fossil fuels could face requirements that border on the impossible. The overall cost of this agenda would likely exceed that of the legislation rejected by Congress.¹

CLIMATE LEGISLATION

Concern that carbon dioxide and other greenhouse gases are gradually warming the planet has emerged as the major environmental issue of the day, and certainly the most hyped one. Carbon dioxide is a naturally occurring component of the air, but is also the ubiquitous and unavoidable by-product of fossil fuel combustion, which currently provides 85 percent of America's energy. Thus, any effort to substantially curtail such emissions would have extremely costly and disruptive impacts on the economy and on living standards.

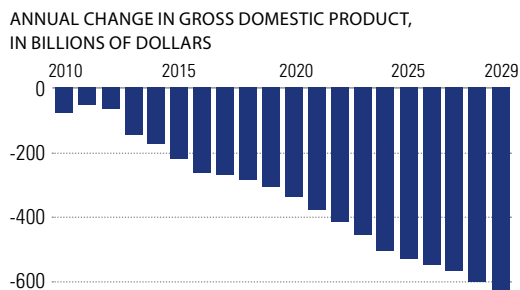
For this reason, the federal government has been cautious about embarking on mandatory carbon reductions. In 1997, the U.S. Senate unanimously resolved

¹ This Backgrounder is a companion to: David W. Kreutzer and Karen A. Campbell, "CO₂-Emission Cuts: The Economic Costs of the EPA's ANPR Regulations," Heritage Foundation Center for Data Analysis Report No. 08-10, October 29, 2008, at <http://www.heritage.org/Research/EnergyandEnvironment/cda08-10.cfm>.

to reject any international climate change treaty that unduly burdened the U.S. economy or failed to engage all major emitting nations, such as China and India. Although the Kyoto Protocol was signed by the U.S. later that year, neither President Bill Clinton nor President George W. Bush ever submitted the treaty to the Senate for the required ratification. This has shown itself to be a wise move: Many, if not most, of the European and other developed nations that ratified the treaty are failing to reduce their emissions due to the prohibitive costs in doing so.

Graphic 1: Lost Gross Domestic Product Due to Clean Air Act Regulation of CO₂

By restricting CO₂ emissions, the Clean Air Act will create higher energy costs and decrease the U.S. economy by an average of \$339 billion every year through 2029.



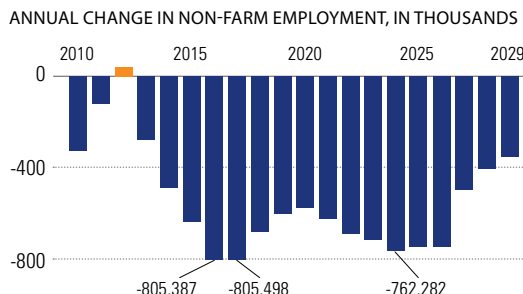
Source: Centers for Data Analysis. Heritage Foundation calculations from the Global Insight macroeconomic model.

Legislatively, Congress has thus far rejected every attempt to control carbon dioxide emissions. Chief among the legislative proposals in 2008 was S. 2191, the America's Climate Security Act of 2007, originally sponsored by Senators Joe Lieberman (I-CT) and John Warner (R-VA). This was a so-called cap-and-trade bill that would set a limit on the emissions of greenhouse gases, especially carbon dioxide from the combustion of coal, oil and natural gas. Each power plant, factory, refinery or other regulated entity would have been allocated rights to emit limited amounts of carbon dioxide and other greenhouse gases. Those entities that reduced their emissions below their annual allotment could sell their excess allowances to those that did not — the trade part of cap and trade. The bill would start with a mandated emissions freeze at 2005 levels in 2012, and end with a 70 percent reduction by 2050.

In effect, this bill would have acted like a tax on energy, driving up its cost so that businesses and consumers are forced to use less.

Graphic 2: Clean Air Act Regulations Will Cost Millions of Jobs

The U.S. will lose 10.7 million jobs cumulatively through 2029.



Source: Centers for Data Analysis. Heritage Foundation calculations from the Global Insight macroeconomic model.

Last June, America's Climate Security Act was withdrawn by its Senate supporters after only three days of debate. A Heritage Foundation analysis detailed the costs of the bill, which included a 29 percent increase in the price of gasoline, net job losses well into the hundreds of thousands, and an overall reduction in gross domestic product of \$1.7 to \$4.8 trillion by 2030.² At the time of the debate, gasoline was approaching \$4 per gallon for the first time in history and signs of a slowing economy were beginning to emerge. Economically speaking, the bill was one of the last items on the agenda that Americans wanted, and its Senate sponsors recognized that. Beyond the costs, the bill would have — even assuming the worst case scenarios of future warming — likely reduced the earth's future temperature by an amount too small to verify.³

The debate is sure to resume in 2009, but the economic concerns about such measures remain. Though gasoline prices may be lower next year than the last time climate legislation came to a vote, unemployment will likely be higher as will unease about the overall state of the economy. Thus, the legislative effort to place costly restrictions on energy still faces an economic headwind. Notwithstanding the state of the economy, such measures will always fail any reasonable cost-benefit test given their high costs and environmental benefits that are marginal at best.

2 William W. Beach et al., "The Economic Costs of the Lieberman-Warner Climate Change Legislation," Heritage Foundation Center for Data Analysis Report No. 08-02, May 12, 2008, at <http://www.heritage.org/Research/EnergyandEnvironment/cda08-02.cfm>.

3 Ben Lieberman, "The Lieberman-Warner Climate Change Act: A Solution Worse Than the Problem," Heritage Foundation Background No. 2140, June 2, 2008, pp. 6-9, at <http://www.heritage.org/Research/EnergyandEnvironment/bg2140.cfm>.

REGULATION AS AN ALTERNATIVE TO LEGISLATION

While proponents of greenhouse gas restrictions have lobbied for additional legislation, they have also tried to force the EPA to regulate carbon dioxide as a pollutant under existing law. In 1999, an environmental activist group sued the EPA over its refusal to restrict such emissions from motor vehicles under the Clean Air Act. The case eventually reached the Supreme Court, which in April 2007 ruled in a five-to-four decision against the EPA.

The decision did not require the EPA to change its position and begin regulating carbon dioxide from vehicle exhaust; it only required the agency to demonstrate that whatever it chooses to do complies with the requirements of the Clean Air Act. Nonetheless, the agency's detailed ANPR, published on July 30, 2008, appears to treat such regulation as a foregone conclusion. Although the ANPR is preliminary in nature, the level of detail (the ANPR and supporting documentation exceed 18,000 pages) suggests that the EPA has already decided to impose regulations that are unprecedented in their cost, complexity, and reach.

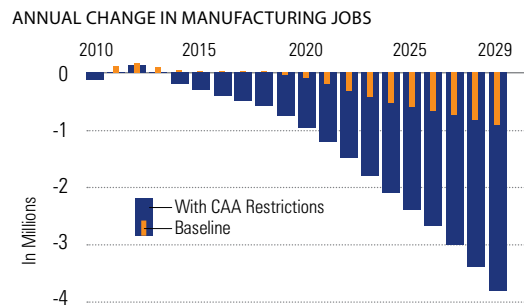
The reasons that Congress has been reluctant to enact global warming legislation are every bit as relevant to the debate over whether or not the EPA should achieve the same results through regulations. This is especially true given the many shortcomings of the Clean Air Act as an instrument for regulating carbon dioxide emissions — for which the statute was not intended. In effect, the measures detailed in the ANPR would require action at least as costly as comparable cap-and-trade bills, and likely more so given the added difficulty of doing it in a much more convoluted fashion.

REGULATING VEHICLES — AND ALMOST EVERYTHING ELSE

Because no technology exists to date that offers the possibility to filter out carbon dioxide emissions from motor vehicle exhaust, the only way to reduce emissions is to use less fuel. In the ANPR, the EPA contemplates higher gas mileage standards for motor vehicles beyond those already scheduled to be imposed in accordance with the 2007 Energy Independence and Security Act. The EPA also discusses strict requirements

Graphic 3: Manufacturing Jobs Will Take Significant Hit

Primarily due to increasing productivity, manufacturing can expect to see employment losses approaching 1 million jobs even without restrictions on CO₂ emissions. This is the baseline case. Higher energy costs from CO₂ restrictions under the Clean Air Act will lead to nearly 3 million more lost jobs in addition to the baseline losses.



Source: Centers for Data Analysis, Heritage Foundation calculations from the Global Insight macroeconomic model.

for everything from airplanes to ships to trains to lawnmowers, all of which could be subject to new design specifications and usage limitations as well as fuel economy standards, as described in painstaking detail in the ANPR.

Beyond regulating anything that is mobile and uses energy, the ANPR also contemplates targeting anything that is immobile and uses energy — commercial and non-commercial buildings, large and small businesses, and farms. Under the Clean Air Act, once carbon dioxide emissions from motor vehicles are regulated, emissions from stationary sources must also be controlled under the New Source Review (NSR) and other Clean Air Act programs because they apply to all pollutants subject to regulation anywhere else in the statute. Even if the agency tries to rein in the reach of its regulation, it will almost certainly face litigation by environmentalists opposing such restraint.

Given that the existing threshold for regulation under the Clean Air Act — 250 tons of emissions per year, and in some cases as little as 100 tons per year — is easily met in the case of carbon dioxide emissions, the agency could impose new and onerous NSR requirements heretofore limited to major industrial facilities. Other Clean Air Act programs, such as the Title V permitting program and the hazardous-air-pollutants program, have even lower thresholds, creating a regulatory maze both restrictive and redundant.

Most pollutants regulated under the Clean Air

Act are trace compounds like ozone or mercury that are typically measured in parts per billion, so these threshold levels are sensible to distinguish *de minimis* contributors from significant ones. But carbon dioxide is not a trace compound, thus, existing Clean Air Act thresholds are ill suited. Background levels alone account for 275 parts per million, and even relatively small usage of fossil fuels could reach these thresholds. Thus, even the kitchen in a restaurant, the heating system in an apartment or office building, or the activities associated with running a farm could cause these and other entities — potentially more than a million buildings, 200,000 manufacturing operations, and 20,000 farms⁴ — to face substantial and unprecedented requirements. Churches, hospitals, schools and government buildings could also be subjected to these requirements.

This type of industrial-strength EPA red tape that imposes an average of \$125,000 in costs and takes 866 hours to complete⁵ could now be imposed, for the first time, on a million or more entities beyond the large power plants and factories that have traditionally already been regulated in this manner. Even more significant than the administrative costs is that all of these entities would be required to install costly technologies and operate under certain restrictions, as determined by EPA bureaucrats.

In sum, a host of complicated and redundant regulations could be applied to nearly every product, nearly every business and nearly every building in America that uses fossil fuels. The ANPR, if finalized in anything near its current form, would create an environmental regulatory scheme more costly and intrusive than all the others combined.

THE COSTS OF THE ANPR

Either through legislation or regulation, efforts to reduce fossil fuel emissions will impose costs throughout the economy. For purposes of this analysis of the ANPR, the Heritage Foundation ignores the up-front administrative and compliance costs of imposing such an unprecedented crackdown both for regulated entities and for federal and state regulators. Heritage analysts instead assume the unlikely scenario of successful ANPR implementation and

focus only on the cost of the rules in the form of higher energy costs.

The impact on the overall economy, as measured by gross domestic product (GDP), is substantial. The cumulative GDP losses for 2010 to 2029 approach \$7 trillion. Single-year losses exceed \$600 billion in 2029, more than \$5,000 per household (see Graphic 1). Job losses are expected to exceed 800,000 in some years, and exceed at least 500,000 from 2015 through 2026 (see Graphic 2). Note that these are net job losses, after any jobs created by compliance with the regulations — so-called green jobs — are taken into account. Hardest-hit are manufacturing jobs, with losses approaching 3 million (see Graphic 3). Particularly vulnerable are jobs in durable manufacturing (28 percent job losses), machinery manufacturing (57 percent), textiles (27.6 percent), electrical equipment and appliances (22 percent), paper (36 percent), and plastics and rubber products (54 percent). It should be noted that since the EPA rule is unilateral and few other nations are likely to follow the U.S. lead, many of these manufacturing jobs will be outsourced overseas.

The job losses or shifts to lower paying jobs are substantial, leading to declines in disposable income of \$145 billion by 2015 — more than \$1,000 per household.

CONCLUSION

Virtually every concern heightened by the economic downturn, especially job losses, would be exacerbated under the ANPR. As with cap-and-trade legislation, the EPA's suggested rulemaking would be poison to an already sick economy. But even in the best of economic times, this policy would likely end them. The estimated costs — close to \$7 trillion dollars and 3 million manufacturing jobs lost — are staggering. So is the sweep of regulations that could severely affect nearly every major energy-using product from cars to lawnmowers, and a million or more businesses and buildings of all types. And all of this sacrifice is in order to make, at best, a minuscule contribution to an overstated environmental threat. ■

4 Portia M. E. Mills, Mark P. Mills, "A Regulatory Burden: The Compliance Dimension of Regulation CO2 as a Pollutant," U.S. Chamber of Commerce, September 2008, p. 3.

5 Carrie Wheeler, "Information Collection Request for Prevention of Significant Deterioration and Nonattainment New Source Review," U.S. Environmental Protection Agency, no date.

NATURAL GAS AS AN ALTERNATIVE FUEL FOR CARS AND TRUCKS

BY RUSS HARDING

Last summer's substantial increases in the cost of gasoline and more recent uncertainty over how high prices may return has vaulted energy issues to the center stage of national policy. National security issues regarding U.S. reliance on foreign oil and environmental concerns about burning fossil fuels are causing many to push for alternative sources of fuel to power our cars and trucks. »

NATURAL GAS AS AN ALTERNATIVE FUEL FOR CARS AND TRUCKS

T. Boone Pickens, a well-known Texas oilman, has captured the attention of many Americans by broadcasting national television ads suggesting that our economy and national security are threatened by reliance on imported oil. His solution is to use wind energy and other alternative energy sources to fuel our power plants and employ compressed natural gas to power our automobiles. But is compressed natural gas (CNG) a viable alternative source of fuel to power our nation's vehicles?

WHAT IS COMPRESSED NATURAL GAS

CNG is colorless, odorless and non-corrosive. In vehicles, it is most commonly used in its gaseous form where it is compressed to pressures above 3,100 pounds per square inch. Natural gas is extracted from condensate wells (which contain natural gas in gaseous or liquid states), oil wells and coal bed methane wells.

ADVANTAGES OF CNG VEHICLES

CNG has several advantages as a motor vehicle fuel. One major advantage is that North America currently produces almost all of the natural gas used in the United States. According to the Energy Information Administration, U.S. consumption of natural gas was 23,055 billion cubic feet in 2007. The United States produced 19,278 bcf of natural gas during the same year, and imported 3,777 bcf from Canada and 54 bcf from Mexico. Natural gas imports from countries outside of North America totaled 776 bcf. It is possible that in the future we may need to import more natural gas from countries outside North America due to projected increases in the use of natural gas as a fuel for power plants. The Energy Information Administration predicts that by 2025 more than 15 percent of our natural gas supplies will be imported from non-North American sources. These projections may prove incorrect

as development of new technology, such as horizontal drilling, has already resulted in the ability to economically extract natural gas from extensive coal bed methane reserves from U.S. land-based and deep-water sources.

The U.S. Environmental Protection Agency rates the Honda CNG Civic (the only CNG-powered vehicle currently for sale in this country; General Motors and Ford stopped producing CNG vehicles due to limited customer interest and instead are focusing on gasoline-electric hybrids and hydrogen fuel cell vehicles) as the least polluting passenger vehicle, cleaner even than hybrid vehicles such as the Toyota Prius. The CNG Civic produces approximately 80 percent less smog-producing tail pipe emissions than comparable gasoline-powered vehicles. Although CNG vehicles generally produce less greenhouse gas emissions than comparable gasoline powered vehicles, they typically produce more greenhouse gas emissions than hybrids.

Fuel costs are also lower for CNG powered vehicles than similar gasoline models. The costs comparison depends upon such variables as the cost of natural gas in a particular region and the price of gasoline at that given time. Although the cost of CNG varies by region of the country and the price of gasoline is continually changing, a general rule of thumb is that the cost of fuel for operating a CNG vehicle is approximately 40 percent less per mile than a comparable gasoline powered vehicle. Of course, if more U.S. vehicles run on natural gas, the increased demand without a corresponding increase in supply will cause natural gas prices to increase. However, according to the Natural Gas Vehicle Association, a 100-fold increase in natural gas vehicles over the next 10 years (5 percent of U.S. vehicle fleet) would only result in a 4 percent increase in U.S. natural gas consumption.

The CNG Civic is rated by the EPA at 24 mpg city and 36 mpg highway compared

to 25 mpg city and 36 mpg highway for the gasoline model. Fleet vehicle operators report that engine life is greatly extended by using CNG vehicles due to its non-corrosive properties, which can lead to considerable cost savings in high mileage applications.

There also exists an option of fueling a CNG vehicle at home, provided your home has a natural gas line. The Fuel-Maker Corp. produces a device called Phill, about the size of a pay telephone, that can be mounted outside or in a garage. Phill uses about the same amount of electricity as a small appliance and requires about eight hours to provide enough fuel to drive approximately 100 miles. The cost is about \$3,900, and the device is eligible for a \$1,000 tax credit. The price of natural gas varies, but \$1.25 a gallon cost to fuel a vehicle with Phill is a reasonable average. Assuming a \$260 tax break for purchasing Phill and gasoline averaging \$3.50 a gallon, it would require approximately 48,000 miles of driving using Phill as the fuel source to recoup the cost.

Additionally, CNG vehicles do not require significant reengineering from their gasoline counterparts in order to run on CNG. Virtually any gasoline powered vehicle can be adapted for CNG use. Gasoline-electric hybrid vehicles require dual power trains, which necessitates complex engineering and increased cost to the consumer. Hydrogen fuel cell vehicles are even more complex and have yet to be perfected for consumer use.

DISADVANTAGES OF CNG VEHICLES

There are several drawbacks to CNG powered vehicles, including the lack of fueling infrastructure. There are about 1,500 natural gas fueling stations nationwide, approximately half of which are available to the public. This lack of fueling stations has led to a decline in the popularity of CNG powered vehicles. The limited number of fueling stations combined with the fact that CNG vehicles currently possess less range than compa-

rable gasoline powered vehicles renders the use of these vehicles impractical for driving long distances.

Fuel tanks in CNG vehicles also are heavier and larger than conventional gasoline tanks. This is particularly a problem in smaller vehicles. The fuel tank in the CNG Civic, for example, reduces trunk space to such an extent that there is only enough room for two small suitcases.

As noted previously, gasoline powered vehicles can be converted to CNG. Conversion costs are high, however, averaging from \$8,000 to \$12,000. A conversion from gasoline to CNG requires EPA certification that can be both expensive and time consuming. Conversions also have the disadvantage of using the existing engine in contrast to factory produced CNG vehicles that are designed to exploit the higher octane of CNG, thereby resulting in greater engine efficiency.

Conversion of gasoline powered vehicles to CNG would substantially increase the quantity of natural gas consumed in the United States at a time when natural gas is being increasingly used for the generation of electricity. The use of more wind power to generate electricity will likely require more natural gas due to the fact that wind power is unreliable and must be backed up by conventional electric generation facilities. Natural gas combined cycle power plants are the most common backup for wind turbines.

Increased demand for natural gas also would increase utility bills for many home owners because natural gas is the preferred fuel for heating American homes. Increased natural gas costs would reduce the savings of motorists switching from gasoline to CNG powered vehicles. The increase in cost of natural gas due to increased demand from shifting from gasoline to CNG vehicles is difficult to estimate; the key variable affecting price is how successful we are in producing and supplying U.S. markets with additional natural gas in the future.

CONCLUSIONS

While it's possible to convert a significant amount of the nation's vehicles from gasoline to CNG in the near future (10 to 15 years), it's not likely to happen. As discussed previously, there are several advantages to using CNG to power the nation's automobiles and trucks. The most compelling argument for CNG vehicles is that abundant natural gas reserves in North America (assuming those reserves are allowed to be developed), could substantially reduce or eliminate our dependence on foreign oil for the transportation sector. This is a significant advantage to CNG as no other suggested alternative comes as close to achieving the goal of U.S. energy independence — with the possible exception of hydrogen fuel cells that still have considerable technical and financial hurdles to overcome before they can be used practically in a commercial application.

CNG vehicles are cheaper to operate compared to gasoline vehicles, and auto manufacturers can utilize existing technology rather than spending the considerable capital necessary for the development of battery technology and hydrogen fuel cells, which would likely offset the packaging limitations and reduced range of CNG vehicles.

So why have auto manufacturers shown so little interest in developing and marketing CNG vehicles? They claim there is little consumer interest, citing poor sales. Consumer interest in CNG vehicles has been limited due to two reasons: historically low gasoline prices and lack of infrastructure to fuel CNG vehicles. Last summer's spike in prices and subsequent plummet has abated the price issue temporarily. However, the lack of infrastructure for fueling CNG vehicles is a major obstacle to increasing the number of CNG vehicles on U.S. highways. Without refueling infrastructure there is little demand from motorists for CNG vehicles, and without customer demand there is no economic incentive for automobile manufactures

to produce CNG vehicles. This situation seems unlikely to change for the foreseeable future. Congress has shown some interest with Rep. Rahm Emanuel, D-Illinois, introducing the "New Alternative Transportation to Give Americans Solutions Act," which would require that by 2018, 10 percent of new vehicles sold in the country be natural gas vehicles. Sen. James Inhofe, R-Oklahoma, introduced the "Drive America on Natural Gas Act," which expands the definition of the Renewable Fuels Standard to allow the use of natural gas to meet renewable fuels mandates. It is questionable whether these bills will become law without considerable public pressure for CNG vehicles.

An increase in the use of natural gas vehicles in fleet applications would be more easily achieved than for individually owned vehicles. The lack of infrastructure for fueling natural gas vehicles is more easily solved for fleet vehicles such as city buses and taxi cabs that operate locally and return to a central location each day. It is also possible to convert over-the-road trucks to run on natural gas. Providing natural gas pumps at truck stops across the country is much more practical and less costly than attempting to install natural gas pumps at most of nation's 117,000 service stations.

It is unclear whether there will be any substantial increase in the use of natural gas to power more vehicles. Government mandates and incentives have generally not proven to be effective and often result in unintended consequences. A recent example is government incentives and mandates regarding corn ethanol that have proven costly and contributed to increases in the price of food as well as several other significantly negative consequences. Ultimately, complex market forces should determine what powers the vehicles Americans will drive in the future. ■

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It's in the mail: Great Lakes dunes featured on U.S. postage stamps

The Great Lakes sand dunes, one of the largest freshwater dune systems on the planet, are featured on postage stamps issued by the U.S. Postal Service last October. The 10-stamp sheet, which portrays 27 images of the flora and fauna of the dunes (and even Petoskey stones), was released at a ceremony at the Sleeping Bear Dunes National Lakeshore in Empire, Mich.

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