senic, but it can undergo a reduction to DMA(III), which is as toxic or even more toxic than inorganic arsenic compounds, he adds.

Although Le and colleagues have not seen DMA(III) in urine samples from people who eat seaweed, they have seen it in the urine of people who are highly exposed to arsenic from their drinking water, such as individuals from Bangladesh, India, Inner Mongolia China, and Romania. "We haven't seen DMA(III) with seaweed ingestion, partly because we haven't really looked carefully for it. Analytical methods for DMA(III) have only been available for two years now." In the past two years, Le and colleagues have spent most of their time analyzing the urine of people who have been exposed to arsenic in drinking water and the urine of rodents that have been fed arsenic.

Most experts believe that it is probably safe to eat seaweed and shellfish that contain arsenosugars in moderation. The major form of arsenic in these foods is arsenobetaine, which is not metabolized by humans and has been shown to be essentially nontoxic, says Le. Shellfish, such as shrimp, crab, and lobsters, contain significant amounts of arsenobetaine, but they do not contain arsenosugars. Bivalves, on the other hand, contain both arsenobetaine and arsenosugars, he says.

Feldmann and colleagues point out that currently there is no evidence that arsenosugars are toxic. However, because of the high absorption of arsenosugars by sheep and humans, and the similarities they share with inorganic arsenic in terms of metabolism to DMA(V), the researchers believe further studies on arsenosugar metabolism are warranted.

In addition, the researchers are concerned about the growing use of seaweed as a fertilizer in Scotland. In a second paper, also reported in this issue of *ES&T* (pp 951–957), Feldmann and colleagues show that soils amended with seaweed fertilizer accumulate arsenic compounds. "In the soil, arsenosugars break down fairly quickly into DMA and then over time, they are demethylated to inorganic arsenic. We also see it happening the other way around, depending on what kinds of microorganisms are living in the soil. We see methylation from inorganic arsenic to DMA," says Feldmann. Within a month, all of the arsenosugars had been transformed into DMA and inorganic arsenic, he says. "That means if you plant potatoes or other crops there, they will be exposed to these arsenic compounds."

It is unclear whether crops will take up DMA directly. "The uptake seems to be mostly inorganic arsenic," says Le. However, according to Francesconi, it depends on the crop. DMA is not readily taken up, but you do see it in some plant species, he says. "Our studies showed that DMA(V) can be taken up by rice plants, but not as efficiently as inorganic arsenic species," adds Feldmann. —BRITT E. ERICKSON

Sulfur-free fuels mandated

European Union (EU) ministers and the European Parliament agreed last December to further lower sulfur in fuels by requiring refiners to phase in gasoline and diesel with less than 10 parts per million (ppm) of sulfur by 2005. The new legislation is designed to lower emissions of various pollutants and improve vehicles' fuel efficiency.

These "sulfur-free fuels" should be fully available by 2009, including for nonroad mobile machinery and agricultural tractors. The EU had already set limits of 150 ppm for gasoline and diesel by 2005; present limits are 350 ppm for diesel and 150 ppm for gasoline. This compares with the U.S. EPA's gasoline limits of 120 ppm for 2004 and 30 ppm by 2006, and 15 ppm by 2007 for diesel.

As well as lowering emissions of conventional pollutants such as particulate matter and nitrogen oxides (NO_x) from existing vehicles, sulfur-free fuels will improve the

News Briefs

More gas, less oil

The Powder River Basin of Wyoming and Montana contains 14 times more coal bed methane than previously thought, according to new estimates of oil and gas reserves in five Rocky Mountain basins. The U.S. Geological Survey now finds 14.3 trillion cubic feet of technically recoverable coal bed gas in the Powder River Basin. The significantly higher assessment is based on exploration and drilling records and studies of source and reservoir rocks that were not available when the last estimate was made in 1995. Meanwhile, better data and analysis from the five Rocky Mountain basins lowered estimates of technically recoverable oil by 30%, down to 1.9 billion barrels of crude oil. The report *New (2002) Energy Policy and Conservation Act (EPCA) Results* is available at http://energy.cr.usgs.gov/oilgas/noga.

Expanding environmental research and education

The future of environmental research will require bridging the divides between engineering, natural science, and social science, says Stephanie Pfirman, past chair of the National Science Foundation (NSF) Advisory Committee on Environmental Research and Education (AC-ERE) upon release of its 10-year outlook on environmental research and education. Integrating the efforts of the public, educators, social and natural scientists, industrial managers, economists, and policy makers is necessary to synthesize environmental research and expand the capacity of electronic data networks and observing systems on a global scale, according to the report. *Complex Environmental Systems: Synthesis for Earth, Life, and Society in the 21st Century* is available at www.nsf.gov/ere.


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EU hopes sulfur-free fuels will clear the skies and reduce pollution.

performance of vehicles' catalytic technology, according to EC officials. Sulfur impairs the effectiveness of some catalysts used in three-way catalytic converters, NO_x traps, and particulate traps.

The EC also says that sulfur-free fuel will improve the performance of gasoline cars fitted with the new "lean-burn" direct injection technology by 1–5% over those using 50-ppm gasoline. This technology depends on NO_x storage catalysts to lower emissions, which perform better with sulfur-free fuels. The EC also says that exhaust after-treatment devices in heavy-duty vehicles will perform better and be more durable with sulfur-free diesel.

Europia, the European fuels industry association, estimates that it will cost industry $11 billion to refine, supply, and distribute sulfur-free fuels. Producing sulfur-free fuels is not straightforward and several technologies are still being commercially proven, says Europia's Bruno Celard. It's also difficult to keep a fuel sulfur-free during distribution because it can get contaminated with sulfur from other fuels in multiproduct pipelines or storage tanks.

Karola Taschner of the European Environment Bureau, a coalition of environmental organizations, welcomes the new law. Nanoparticle formation is significantly lowered by any reduction in fuel sulfur, she adds. —MARIA BURKE

Bush takes a look at climate change

Next month, the Bush administration hopes to finalize its Strategic Plan for the Climate Change Science Program, a 177-page document that will lay out the government's research agenda on climate change. Released in November after input from 13 federal agencies, the wide-ranging plan sets forth the uncertainties associated with changes in the Earth's climate systems and describes research programs under way across the federal government. Bush administration officials say they expect a quick turnaround on some of the research, which should be completed in the next two to five years.

The plan is designed to serve in a fact-finding capacity, providing credible and useful information in three broad categories: science, observations and data, and decision and support services, says James Mahoney, assistant secretary of commerce for the oceans and atmosphere, and director of the newly created Climate Change Science Program (CCSP), which manages the plan. Mahoney presided over a December 3–5 workshop on the plan where he sought public discussion of the document.

The draft envisions a "significant science program" to analyze the causes and projected effects of global climate change. Other research will support changes in observation system design and measurement methodologies. Still other research will analyze mitigation and adaptation technology options, as well as the effects of proposed mitigation strategies on the economy, energy use, and energy delivery systems, Mahoney said.


LONNIE THOMPSON, BYRD POLAR RESEARCH CTR.

The Bush administration wants more research on global climate change, which could mean more analyses of ice cores like this one.

The plan, however, doesn't include policy or implementation recommendations. These studies are intended to be "policy relevant", and as results become available, they will inform administration policy on climate change, he noted. But the studies will remain "policy neutral", by examining the range of climate predictions and various policy options.

Many of those commenting at the workshop were critical of the document, calling the plan in many places "redundant", "poorly focused", and "unspecific". For example, participants noted the confusion throughout the draft between "climate change" (considered to be the buildup of man-made gases in the atmosphere that trap the sun's heat, causing changes in weather patterns on a global scale), and "climate variability". Several suggested that rather than continue the work done for the long-running U.S. Global Change Research Program, the new plan should consider and incorporate the lessons learned from that research (www.usgcrp.gov/usgcrp/nacc/default.htm).

At the close of the public comment period in January, the CCSP received 261 comments, or 800 pages, from academics, business groups, science organizations, and state and local governments. The Edison Electric Institute (EEI), which represents shareholder-owned utilities, generally welcomed and applauded the plan. But EEI also criticized it, writing, "All of the research appears to have the same importance or urgency, even though it would seem that some of the research areas should clearly precede others in order to be effective and timely".

EEI voiced a concern many sci-