"I wish this state had some vision for energy like we do for water; that way it would make your job [the Texas Water Development Board] a lot easier and more effective if we had some kind of hint of what is going to happen in the future," he said.

That vision is Texas' state water plan, updated every five years, which provides water use projections, water availability, and water management strategies to meet state's water estimation needs.

For the Texas Water Development Board, the energy-water nexus becomes a reality when the board is planning for enough water to meet the state's electricity demands.

"The issue is, with the increase in electric demand, we are going to see increases in water used to produce electricity," said Carolyn Brittin, deputy executive administrator in charge of water resources planning and information for the Texas Water Development Board.

Brittin testified at the September 2008 natural resources committee meeting on the incorporation of steam-electric water demands in state and regional water planning. She also presented results from the study, *Water Demand Projections for Power Generation in Texas*, conducted by the University of Texas' Bureau of Economic Geology.

Brittin agreed that having more knowledge of electric and other energy demands would help the board in its water planning. When the state water plan is updated every five years, she said, "We look for changed conditions and adapt the process to that. If we get better information on power demands in the next cycle, we will incorporate that in the planning process.

"At the end of previous regional water planning in 2006, some water providers came to the board saying we are having requests for water for power generation that are greater than what is projected in the plan," Brittin said. "In one basin, the inquiries were ⇨

## Alternative

While we don't yet have jet-powered flying cars like the old TV cartoon *The Jetsons*, research is producing new ways to fuel our cars and to use "new" water. Even these innovations, however, must consider the energy-water connection.

Hybrid and fully electric cars are getting favorable press as green machines that save energy. They may not, however, save water, according to research done by Dr. Michael Webber and Dr. Carey King of the University of Texas (UT).

In their research, Webber and King compared the amount of water used, withdrawn, and consumed during petroleum refining and electricity generation in the United States. They estimate that plugged-in hybrid and fully electric vehicles could increase the country's water consumption with each mile driven because electricity consumes roughly two times more water than gasoline, and more than eight times more water is withdrawn to produce the electricity.

The researchers note these concerns do not necessarily mean electric cars are undesirable. "It just means there might be some tradeoffs," Webber said.

Biofuels are another research area where this energy-water nexus is apparent. The production of ethanol from corn has come under criticism because of the large amount of water needed to produce the corn. According to Webber, recent analyses indicate that the entire ethanol production cycle, from growing irrigated crops on a farm to pumping biofuels into a car, can consume 20 or more times as much water for every mile traveled than the production of gasoline.

Recognizing this, Texas AgriLife Research's bioenergy program is committed to using rain-fed crops, rather than irrigated crops, in making biofuels from different types of biomass, according to Bob Avant, bioenergy program director.

AgriLife researcher, Dr. William Rooney, professor in the Texas A&M University Soil and Crop Sciences Department, and other researchers are developing a high-tonnage, drought-tolerant sorghum for biofuel production. Researchers are also studying sugarcane and switchgrass crops.

# energy must consider water needs

*By Kathy Wythe*

Another area of bioenergy research is using microalgae to produce biofuels. Both Texas A&M and UT have research programs on growing algae with high oil content to be used in biofuels.

Algae can grow in brackish or salty waters not suitable for drinking or irrigation so it doesn't compete with agricultural, municipalities, and other demands for freshwater resources.

Avant said AgriLife Research has partnered with General Atomics, a technology company based in San Diego, California, to develop jet fuel from microalgae at the AgriLife Research Center at Pecos. In addition to salty water, these algae strains require large amounts of sunlight and carbon dioxide to grow and produce oil, all prevalent in West Texas. "We hope to have jet fuel in three years," Avant said.

UT scientists recently created a cyanobacteria that produces cellulose and secretes glucose and sucrose that can be turned into ethanol and other biofuels, according to a UT news release. The scientists, Dr. R. Malcolm Brown Jr. and Dr. David Nobles Jr., said the microbe could provide a significant portion of the nation's transportation fuel if production can be scaled up.

David Burnett of the Global Petroleum Research Institute at Texas A&M has been working for nine years to find a way to reuse oil field-produced wastewater or brine in an effort to save fresh water and reduce associated costs. Conventional production of oil and gas generates about eight barrels of water for every barrel of oil produced, Burnett said. This water usually is re-injected into the oil reservoir.

With the start of drilling for natural gas by unconventional production methods, such as that used in the Barnett Shale in north central Texas, water has become a critical issue, Burnett said. Unconventional production not only uses more water than conventional methods, but the wastewater created during the drilling process cannot be injected back into the reservoir. Instead, it must be hauled off by trucks to another site.

By using membrane filtration and desalination process technology developed by Burnett and the petroleum institute, this wastewater can be reused in the drilling process, thus saving fresh water, reducing costs, and lowering the impact of environmentally sensitive areas. Texas A&M has recently partnered with M-I SWACO, a worldwide oil field service company, to bring this technology to the market, Burnett said.

"In the Barnett Shale, wells require from 5 million to 7 million gallons of water per well to stimulate gas production from the tight gas-containing formation," Burnett said. "If treated to remove solids and other contaminants, much of this water can be reused, avoiding the competition with communities and agriculture for fresh water.

"In the Permian Basin, fields producing from conventional formations make seven times as much water as oil, with each barrel of water requiring re-injection for disposal. In an area plagued with droughts and water shortages, the potential for reuse of purified water is clear."

Combining "new" energy with "new" water, a Texas Tech University pilot project is using wind power to desalinate brackish groundwater for the city of Seminole. According to a Texas Tech news release, the project is the first in the country to use wind power to desalinate drinking water for an inland municipality. Tech's Wind Science and Engineering Research Center and the Water Resources Center are participating in the project, which will desalinate brackish water from the Santa Rosa Aquifer through reverse osmosis with power supplied by wind turbines.