



TECHNO

THE BIG IDEAS THAT
ARE CHANGING EVERYTHING

TRENDS

FARMING FOR FUEL

BY DANIEL BURRUS, CEO OF BURRUS RESEARCH



The first flexible fuel vehicle was not made a few short years ago by innovative car manufacturers; it was made in 1908 by Henry Ford. That's right, the Model

T was made to run on either gasoline or ethanol. At the time gasoline was cheaper to make and had more firepower, so gasoline won. From that point forward, the modern world focused its attention on oil.

Now that we are faced with increasing greenhouse gasses, rising oil imports and higher prices at the pump, we are falling into the trap of looking for a single solution replacement - another silver bullet. For example, hydrogen seems like the ultimate fuel with its exhaust pipe emitting only water and oxygen. This captures our attention and we read articles titled "The Hydrogen Economy." That is until we discover how much energy it takes to produce hydrogen and the problems with safe storage and distribution. So we look elsewhere.

Lately, we have turned our attention to ethanol. Brazil has had great success using sugar cane to make ethanol. If American farmers could grow our fuel, it would help employ more people in rural America and at the same time reduce our dependency on foreign oil. *Continued on page 2*

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VOL. XXIII, NO. 2

- "Power" Windows
- Nerve Cables
- High Efficiency Biofuel Engine
- Hydrogen Storage Shells
- Ultracapacitor Battery
- Ultrasound Breakthrough
- Email Without A Computer
- Ultra-Intelligent Gadgets
- Home Wind Generators
- Implantable Hearing Aid

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FARMING FOR FUEL *(continued from page 1)*

Ethanol is alcohol distilled from fermented mashed grain. Sugar cane is a very good plant for producing ethanol. Unfortunately, much of our climate does not support the wide scale growth of sugar cane, so American farmers turned to corn. In 2005 Congress noticed, and wrote into the Energy Bill a mandate requiring refineries to double the amount of ethanol they blend into the nation's gas by 2012. In 2006, production had already exceeded the mandate by 25% with five billion gallons produced. To date, there are 112 ethanol refineries, with another 76 under construction, and an additional 200 in the planning stages.

Unfortunately, farmers and investors might be putting too many eggs in one basket. Corn is a key crop that is used for both food for humans, and feed for animals such as dairy and beef cattle, pigs and chickens. In 2006, 20% of the U.S. corn crop went to make ethanol, pushing up the price of corn, and the cost of both food and feed as well. This year, farmers are on track to plant 88 million acres of corn, up over 10 million from last year. But even such an increase won't make up for the fact that ethanol will consume half of all corn production by 2008. At its peak, a few years from now, U.S. ethanol production will be at about 15 billion gallons yearly. At first this sounds like a lot, but the sad news is that it will only represent 4.3% of gasoline sold. In other words, corn-produced ethanol will help reduce our dependence on foreign oil, but only by a small percent.

Another problem with corn-based ethanol is the large amounts of greenhouse gasses that are emitted to produce ethanol from the trucks, tractors, and nitrogen-based fertilizers that are created by using natural gas. Normally, farmers would rotate their corn crop with soybeans and other crops, but with the profits up on corn, rotation will happen far less and they will have to use more fertilizer and insecticides.

Today, only 2.5% of the cars are flexible fuel vehicles capable of burning E85, which is 85% ethanol to 15% gasoline. That will change, but slowly because big oil companies are not in a rush to offer it. The bigger problem is that E85 costs consumers about \$1.00 more per gallon because of lower fuel efficiency. And, ethanol is not as efficient a fuel as gas. It takes 1.5 gallons of ethanol to drive as far as one gallon of gas. When you look at the amount of energy you have to put in to get energy out, ethanol is almost a wash. Genetically engineered corn designed to produce fuel will help alleviate some of the problems I have outlined, but other engineered plants may work better. Ethanol has a bright future, but not enough to make it the new silver bullet to replace oil.

I predict a multi-fuel future where we target the best fuel for the best use. In the future we will see cars running on gasoline, but also on electricity, bio diesel, natural gas, ethanol, hydrogen and others.

TECHNOLOGY NEWS HIGHLIGHTS

“POWER” WINDOWS

A new type of photovoltaic cell, which uses microscale titania particles as a semiconductor, will soon be available in the form of solar power-generating windows. The particles are dipped into a light-sensitive dye and sandwiched between two panes of glass. As the dye absorbs light, it releases electrons to the titania to generate current. One big advantage of the new technology is its ability to be made optically transparent, making it suitable for windows, skylights and building facades. The new panels also operate over a wide range of lighting conditions and temperatures, can be manufactured in various colors, and are less expensive to produce than those using traditional silicon-based solar technology.

For information: Konarka Technologies, Inc., 116 John Street, Suite 12, 3rd Floor, Lowell, MA 01852; phone: 978-569-1400; fax: 978-569-1401; Web site: www.konarka.com

NERVE CABLES

Researchers at the University of Pennsylvania are working on a new way to connect computers to the human nervous system using “extension cord-like cables” made of nerve tissue. To create the cables, culturing neurons are placed on top of an electrode array system. When two plates of neurons are placed 100 microns apart (about the width of a human

hair), they join together. The plates are then slowly moved apart, stretching them up to 1 cm per day. When traditional metal electrodes are used, they cause scarring at the implant site; but these organic cables will actually grow together with nerve cells inside the body to form new connections. A free end of cable would be available to create an external interface that could be connected to a prosthetic device or other mechanism. The principle may also work for interfacing artificial organs (such as eyes or ears) to the brain. Testing has already demonstrated that the cables can transmit bi-directional signals. The next step will be to test their viability in animals.

For information: Doug Smith, University of Pennsylvania, 3451 Walnut Street, Philadelphia, PA 19104; phone: 215-898-0881; email: smithdou@mail.med.upenn.edu; Web site: www.upenn.edu

HIGH EFFICIENCY BIOFUEL ENGINE

A new bio-diesel engine developed in Japan is claimed to drastically reduce nitrogen oxide emissions. It combines exhaust gas recirculation with a high-boost technology, and burns fuel at a pressure three times that of conventional diesel engines. In tests using a mixture of rapeseed-based bio-fuel and diesel fuel, the new engine cut exhaust gases by 40 percent and nitrogen oxide by 80 percent.

For information: Yuzo Aoyagi, New A.C.E. Institute Co., Ltd., 2530 Karima, Tsukuba-shi, Ibaraki 305-0822, Japan; email: aoyagi@nace.jp; Web site: www.nace.jp

HYDROGEN STORAGE SHELLS

Finding ways to store hydrogen fuel is a major hurdle in the shift toward a hydrogen economy, but chemists at Virginia Commonwealth University have come up with a theoretical model for a material that may be up to the task. Buckyballs are soccer-ball-shaped nanoparticles that are made up of 60 carbon atoms. When coated with lithium, the researchers calculate that the special buckyballs could hold up to 60 hydrogen atoms. In addition, the system is reversible under moderate temperatures and pressures, making it easy to liberate the hydrogen for fuel. Industry standards for hydrogen-storage materials state that hydrogen should comprise at least 9 percent of the total weight. The system being proposed is capable of storing up to 13 percent of its total weight in hydrogen, at a volume density twice that of liquid hydrogen. The next step is to see if production can be scaled up to manufacture sufficient quantities cost-effectively.

For information: Peru Jena, Virginia Commonwealth University, Department of Physics, 1020 W. Main Street, Richmond, VA 23284-2000; phone: 804-828-8991; email: pjena@vcu.edu; Web site: www.vcu.edu

ULTRACAPACITOR BATTERY

A new breakthrough in battery technology is reportedly poised to change the way we power everything from pacemakers to locomotives, and even improve utility-scale storage of electricity. Like a capacitor, the Electrical Energy Storage Unit (EESU) stores energy between two plates. However, unlike traditional capacitor devices, it utilizes barium titanate powder as an insulator, which is capable of storing large amounts of energy – about 280 watt-hours per kilogram. In comparison, lithium ion and lead acid batteries have specific energies of 120 watt-hours per kg and 32 watt-hours per kg, respectively. Other advantages of EESU over batteries include the ability to absorb and release a charge quickly and with little cycle degradation. For example, a 100-pound system for a small electric car, with a driving range of 200 miles, could be recharged in as little as ten minutes. Best of all, it is estimated that an EESU-powered vehicle could travel up to 500 miles on only \$9 worth of electricity. The company plans to begin shipping production units to ZENN Motor of Toronto.

For information: Richard Weir, EESStor, Cedar Park, TX; phone: 512-259-5144; email: dick_weir@eestor.us; Website: www.eestor.us

ULTRASOUND BREAKTHROUGH

The Plug and Play Ultrasound Probe System (Ppups) is the first medical ultrasound-imaging device that is totally contained in a handheld probe. Just plug it into any Windows XP computer (running the proprietary software application) via a USB 2.0 cable and start scanning. Minimal cabling also greatly reduces signal noise, resulting in a clearer image. The lightweight (7.5 ounce) unit comes in 3.5 MHz, 5.0 MHz, 7.5 MHz and 12 MHz configurations to cover a wide range of

applications. At a price of about \$5,000, Ppups stands to revolutionize the ultrasound market by making it more affordable and accessible for almost any size institution. The device is currently awaiting FDA approval.

For information: Direct Medical Systems, 244 Canyon Creek Court, San Ramon, CA 94583; phone: 925-465-1490; fax: 925-465-1502; Web site: www.dmsww.com

EMAIL WITHOUT A COMPUTER

Keeping multi-generational lines of communication open can be a challenge if everyone doesn't share the same passion for technology. But a new email service now makes it possible to share messages and pictures with friends and family even if they don't have a computer. The system, called Celery, converts messages into image files that can be sent to the recipient's fax machine for printing. The two-way service will also convert a handwritten message into a PDF, use handwriting recognition to link the addressee's name to an email address stored in the Celery device, and send it off.

For information: Celery LLC, 212 River Street, Troy, NY 12180; phone: 518-833-6807; Web site: www.mycelery.com

ULTRA-INTELLIGENT GADGETS

Researchers at MIT are looking at ways to predict a person's daily activities using data collected from cell phones and other mobile devices. They studied 100 students and faculty members, logging over 350,000 hours of data, including where they went, whom they talked to, and the relative location of other participants. From this they developed an algorithm that can analyze a few morning activities and forecast (with 79 percent accuracy) people's actions and associations for the remainder of the day. Eventually information such as this could enable personal mobile devices to schedule meetings or recommend activities based on behavioral patterns.

For information: Nathan Eagle, Massachusetts Institute of Technology, Design Laboratory, E48-319, 77 Massachusetts Avenue, Cambridge, MA 02139; phone: 617-253-9880; email: nathan@media.mit.edu; Website: www.mit.edu

HOME WIND GENERATORS

Starting this year, several companies will be marketing wind turbines that are sized for individual home use. For example, the Skystream 3.7 is available in heights from 34 to 70 feet, has a 12-foot rotor, and weighs only 170 pounds. The system can operate at wind speeds as low as 9 miles per hour, and will generate approximately 400 KW hours of electricity per month at an average wind speed of 12 miles per hour. That's about 80 percent of the average household's usage. Pending legislation may also make the \$13,000 price tag somewhat more palatable by offering tax credits of up to 30 percent of the cost of the system.

For information: Southwest Wind Power, 1801 S. Route 66, Flagstaff, AZ 86001; phone: 928-779-9463; Web site: www.windenergy.com or www.skystreamenergy.com

IMPLANTABLE HEARING AID

For people who have avoided getting a hearing aid for cosmetic reasons, Esteem could be the answer. This revolutionary device is surgically implanted behind the ear just under the skin and uses the body's natural anatomy to boost hearing by up to 30 decibels. Vibrations from the eardrum are transmitted to the processing unit where they are filtered to remove excess noise. The signal is then passed directly into the middle ear, bypassing the damaged connections that typically cause hearing loss. The result is a fidelity and clarity of sound that traditional hearing aids cannot provide, with minimal interference from background noise. The device is powered by an internal battery, which lasts up to four years and can be replaced with a minimally invasive procedure. It is currently in Phase II clinical trials and may be available as early as this summer.

For information: Envoy Medical Corporation, 5000 Township Parkway, St. Paul, MN 55110; phone: 866-950-HEAR; Web site: www.envoymedical.com

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