



EEVC NEWSLETTER

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HYBRID VEHICLES AND HYBRID HOMES

Michael Skelly

The development of America's first solar-hydrogen powered home with seasonal storage, located in East Amwell Township near Hopewell, New Jersey, followed in the path created by an electric pick-up truck. The pickup truck is a 1981 Ford Courier converted to battery electric by Jet Industries of Texas. It



This Ford pickup, converted in 1981 by Jet industries, has a 30 Horsepower DC motor and GE SCR-1 controller.

was converted by Eco Living Fellowship to use hydrogen-solar and electricity and called "Electric Blue." It pointed the way for the future. The triple-hybrid powered truck won First Place in the Hydrogen Vehicle category in the 2002 national electric vehicle championship: American Tour de Sol.

In the Beginning

Both the home and the pick up truck were conventional in many respects and had advanced "off the shelf" technology added to collect, convert, store, and supply the power needed to make them run.

The home is a fairly typical two story "colonial" styled home with four bedrooms and two and half baths. The house has a full package of standard appliances and conveniences such as a large screen TV and dishwasher. Heating and cooling are supplied by a heat pump using a ground-water loop. The heat pump system is over ten years old. The house was originally fac-

story "colonial" styled home with four bedrooms and two and half baths. The house has a full package of standard appliances and conveniences such as a large screen TV and dishwasher. Heating and cooling are supplied by a heat pump using a ground-water loop. The heat pump system is over ten years old. The house was originally fac-

tory built (modular) as a “Good Sense” home. This modest level of thermal efficiency was achieved through using six inches of fiberglass insulation in the walls and dual pane windows.

The pickup truck is a typical light duty truck from Ford. It was converted in 1981 to battery electric power by Jet industries. It has a 30 Horsepower DC motor and GE SCR-1 controller. It was put into service by a telephone company in Texas and later went to a Florida phone company. When it was retired by the utility, it was purchased by an AT&T employee in New Jersey. In his enthusiasm, he drove it home from Florida to New Jersey. It soon became his “daily driver” and devotion until he retired and later fell ill and passed away. The truck was donated by his widow to Eco Living Fellowship and took on a new life as rolling laboratory and teaching vehicle.

Both the home and truck are fairly representative of the majority of existing housing and transportation stock in North America. In 2006 the majority of new passenger vehicles sold in North America were light duty trucks. Of the 13.9 million light duty vehicles sold in the U.S. during January through October 2006, sales of light duty trucks outnumbered car sales, 7.3 million light duty trucks, to 6.6 million cars.

Before conversion, they were also typical in that they were largely powered by large quantities of imported energy, that is not sustainable, not renewable, and the burning of which causes pollution damaging human health and planetary systems. The Eco Living team sought to answer the question, “Can the convenience and comfort of typical homes and light duty trucks be retained while changing to locally sourced, non-polluting, renewable energy?” A demonstration using available technology was needed.

Demonstration

In order to demonstrate that it is technically possible to transition from current energy supplies without giving up much of the convenience and comfort of the existing homes and light duty trucks the Eco Living team conducted two projects. A demonstration that existing technology could be used to fuel a home and a light duty truck. This

would be a good first step to addressing the environmental, social, and economic problems posed by the typical housing and passenger vehicle stock.

The truck had two “H-Power” 2.5 kW fuel cells added to provide on-board electric charging for the lead-acid battery pack. The fuel cells were fueled by compressed hydrogen and oxygen extracted from the air. The fuel cells could charge the pack either when the vehicle was moving or while parked. The battery pack also received charging from the grid and a trailer with a mobile solar array. The truck was detached from the solar array during the day to simulate leaving the home or garage with attached solar panels. The solar array had a battery storage bank. It collected and stored solar energy during the day which was used to refill the truck in the early evening. On average, the truck received 36% of its power from the sun during the Tour de Sol in May, 2002. This was the highest percentage for any vehicle on the Tour that year. It also demonstrated the potential for solar plug-in hybrid electric vehicles. The on-board hydrogen supplied approximately 60% of the electric power and the grid “topped off” the battery pack supplying the final 4%.

The house uses a 5 kW “Plug Power” fuel cell, hydrogen stored at relatively low compression (approximately 150 p.s.i. max), solar panels, lead-acid batteries from Exide’s GNB division, and grid power. The hydrogen is made on-site by splitting water in an electrolyzer using solar power and storing the gas in steel tanks.

The Trend

Power for our homes and automobiles has come from relatively few sources distributed by centralized facilities owned by relatively few companies. For reasons of economy and security, made partly possible by lower cost technology for small scale production and storage, the new trend is to derive our fuel from local sources and manage the resources on a neighborhood or community scale. The truck and home projects clearly show that the technology is in hand. Policies and regulations are being developed nationally and in the States that will permit safe, reliable, distributed energy collection, conversion and storage. What is needed is the eco-

conomic and social will to put these systems into widespread use.

'TIS THE SEASON California Pete



As does the rest of the country, northern California has seasons; they're just, like so many other things around here, a little odd. In general, they boil down to rain, fire and mud slide. The fourth season — earthquake — lasts all year.

Last year's rainy season was wetter than usual, which mean that the subsequent fire season was a little worse than usual. The biggest was the Day fire in September, which burned 167,702 acres (254 square miles) in Ventura county northeast of Los Angeles, cost \$73.5 million, according to authorities, and was clearly visible from I-5 over Tejon Pass, as can be seen from the photo my wife took from the car on September 25. On that trip the sunlight stayed an odd amber color for several hundred miles as we went north.



The Day fire was considerably larger than October's Esperanza fire in Riverside county, which burned 40,200 acres and took five lives,

but it grew more slowly, taking two weeks to reach 24,000 acres, while the Esperanza fire, driven by Santa Ana winds that at times exceeded 60 mph, did it in 18 hours.

The rains finally came ("rainy season" is a relative term; we get about half as much rain as Eastern Pennsylvania in about half the time, and locals can't believe there are places where it rains like this all year long) and the fire danger is past, which means it must be time for landslides — or, at the moment, floods. The state is scrambling to fix 71 of the most vulnerable and eroded places in the levee system around Sacramento; if they fail the resulting floods could displace 500,000 people and destroy property valued at \$47

billion. This is in addition to the 33 other sites repaired during the summer at a cost of \$176 million. Sacramento is considered the most vulnerable metropolitan area in the country, and it remains to be seen what will happen if and when severe winter storms strike.

On the other hand, Christmas is almost here; you can tell because the magnolia trees are in bloom.

Did I mention that things are a little odd around here?

NEWS UPDATE

GM announces PHEVs

General Motors CEO Rick Wagoner, speaking at the Los Angeles Auto Show in late November, announced that the company would introduce a plug-in hybrid Saturn Vue Green Line SUV using what GM calls its 2-mode hybrid system. It will use a 3.6 l V-6 engine, a nickel-metal hydride battery pack (to be replaced by lithium ion when available), four fixed mechanical gears and two motors. At low speeds the vehicle will run electric-only, while in high-speed mode the engine will come on. GM expects a 45% mileage improvement over a conventional SUV.

In addition, Reuters reports, GM plans to expand the hybrid system to the Saturn Aura Green Line and Chevrolet Malibu sedans in 2007.

Honda FCX debuts in California



On November 14 Honda rented the Laguna Seca Raceway in Monterey, CA to show off its FCX fuel cell car, billed as the only production fuel cell car.

The car can go about 270 miles on a fill-up of 8.8 pounds (4 kg) of hydrogen, which it will get from either a home filling station that makes hydrogen from natural gas or one of the stations on the much-touted "hydrogen Highway," which presently consists of 23 stations,

mostly clustered around Los Angeles plus four in the Bay Area and two near Sacramento, with 14 more on the way, although those will be in L.A. and the Bay Area as well.

One new station recently opened: at a BC Transit depot in Langford, in Victoria, British Columbia, the third of seven proposed for the province, with more on the way, according to *Victoria News*. The city also plans to develop a fleet of hydrogen fuel cell buses.

Toyota wants hybrid tax credits extended

The federal tax credit for hybrid cars passed in 2005 allowed up to \$2500 per car in tax credits, but it had a limit: the full credit applied only to the first 60,000 cars, and Toyota reached that number over the summer, reports an AP story dated November 29. The result? “The automaker's U.S. hybrid sales in October dropped to its lowest levels since March.”

In response, the story continues, “Toyota North American President Jim Press called for U.S. Congress to extend federal tax credits for hybrid vehicles and accelerate its buying of hybrids and alternative fleet vehicles.”

NIST suggests ethylene for H₂ storage

Researchers at the National Institute of Standards and Technology (NIST) and Turkey's Bilkent University have published a report suggesting that ethylene, an inexpensive molecule with many uses, can be modified to store large amounts of hydrogen. Adding a titanium atom to each end of the ethylene molecule H₂C=CH₂ allows up to ten hydrogen molecules (20 atoms), or about 14 percent of the weight of the titanium-ethylene complex, to adhere. “As important,” NIST says, “the engineered material is predicted to release the hydrogen with only a modest amount of heating.”

DOE reports 40% solar cell efficiency

The Department of Energy reported on December 5 that a concentrator solar cell produced by Boeing-Spectrolab had achieved a world-record conversion efficiency of 40.7 percent. This could eventually, DOE suggests, bring the installation cost of solar electricity down to \$3 per watt and produce electricity at 8-10 cents per kilowatt/hour.

“The 40.7 percent cell was developed

using a unique structure called a multi-junction solar cell,” says DOE. “This type of cell achieves a higher efficiency by capturing more of the solar spectrum.”

For more information, visit the Solar America Initiative web site at: http://www.eere.energy.gov/solar/solar_america.

Do gas prices change demand?

Two recently-issued studies differ on the effect of increasing fuel prices on driving habits.

On December 1 a story by David R. Baker in the *San Francisco Chronicle* reported that a survey conducted by UC Davis found that recent increases in gasoline prices have had less than expected effects on driving, and that gas prices must rise substantially to make much difference at all. Comparing two periods of rising prices — 1975 to 1980 and 2001 to 2006 — the study found that demand fell 2.1 to 3.4 percent for every 10 percent gas price increase in the first, but only 0.34 to 0.77 percent in the second, and concluded that only very great price increase would be likely to have a significant effect.

On the other hand an item by Jasmina Kelemen in *MarketWatch* on the same day cited a study by Cambridge Energy Research Associates that “the rate of growth in gasoline demand slowed sharply last year to 0.3% from 1.6% per year from 1990 to 2004,” before “rising at a 1% rate during the first 11 months of 2006.” Kelemen finds this significant (Baker does not) and also points out that Americans are making a significant shift from gas-guzzling vehicles to more thrifty ones. “By 2005, the share of all vehicles that were SUVs rose to 41% from just 16% in 1975,” she says. “SUV sales peaked at 56% of all new vehicles sold in 2004. In 2005, the SUV share of total sales slipped to under 55% and 53% in 2006.” And many SUV buyers, she continues, have shifted from the biggest boats to the better-mileage crossover types.

But high prices help renewables

An item by Steve Hargreaves in *CNN-Money.com* for November 13 reports that a study by Rand Corp. predicts that, if fossil fuel prices remain high (more than \$5/bbl) and the cost of renewable sources decreases

by 20 percent by 2025, renewables could increase to 25 percent of domestic energy consumption from today's 6 percent. The oil companies, says Hargreaves, do not share that opinion, with Exxon Mobil insisting that renewables will continue to account for just a few percent of supply through at least 2030. It is interesting to note that one of the technical sessions at the SAE 2007 World Congress, to be held in Detroit April 16-19, will be entitled "Policies and Issues Impacting Consumer Choice of Vehicles and Fuels."

Politics may or may not help renewables

An item by Alex Halperin in *BusinessWeek.com* for November 14 looks at the possible effect of the election results on investments in the renewable energy industry and concludes that it won't be a no-brainer. While the Democrats have promised a big push for renewables, says Halperin, many of the technologies still need development, and progress will be gradual at best. At this point it looks like watchful waiting may be the way to go. Remember that Carbon, Inc. has long had a habit of waiting until people sink large amounts of money into alternate energy schemes and then dropping the price of oil long enough to bankrupt them.

Southern CA cities reject coal

On November 22 AP reported that officials in Pasadena, Anaheim and several other large cities have notified the Intermountain Power Agency that they would not be renewing their contracts for cheap, coal-fired power. The cities have until the existing contracts expire in 2027 to get alternative lined up, which would "put the region in the forefront nationally of the commercial use of alternative energy in coming years."

Intermountain Power Agency, the item says, is itself taking steps to comply with California's recent greenhouse-gas legislation, and "is exploring burning biomass such as switchgrass, wheat straw and cornstalks instead of coal, or possible burial of carbon dioxide."

USABC Awards \$15 Million contract to A123Systems

On December 8 the United States Advanced Battery Consortium (USABC), an

organization composed of DaimlerChrysler, Ford and General Motors Corporation, announced the award of a \$15 million lithium iron phosphate battery technology development contract to A123Systems of Watertown, Mass. The 36-month contract, awarded in collaboration with DoE, is for the development of lithium iron phosphate battery technology for hybrid-electric vehicle applications and focuses on systems that are high-power, abuse-tolerant and cost effective.

Honda moves into solar power

On December 1 Honda Motor Co., Ltd. announced plans to establish a wholly-owned subsidiary, Honda Soltec Co., Ltd., to produce and sell the next-generation thin film solar cell independently developed by Honda. The cells, developed by subsidiary Honda Engineering Co., Ltd., use a thin film made from a compound of copper, indium, gallium and selenium (CIGS) and take half as much energy to manufacture as conventional crystal silicon cells.

The new facility will become operational in fall 2007 with an annual capacity of 27.5 megawatts.

Nissan going green?

Nissan Motor Company has announced several steps it plans to take in the next few years to improve its environmental performance, including launching an EV early in the next decade, developing a hybrid targeted for launch in FY2010 (as well as the hybrid Altima scheduled, which went into production on December 11 and is scheduled for 2007) and accelerating development of plug-in hybrid technology.

In support of this, the company says, it will launch the next generation fuel cell vehicle with its own in-house developed stack and a battery-powered electric vehicle in the early part of the next decade. It is also preparing for a new company to develop, produce and market advanced lithium-ion batteries.

Yet all may not be green with Nissan after all. A story by Ken Thomas in the *Detroit Free Press* for December 7 reported that Dominique Thormann, Nissan North America's senior vice president for administration and finance, said that hybrids remain unprofitable in North America: "Hybrids today are

not a very viable economic proposition. It's still a loss-making proposition and we'll see."

Insurance discounts for hybrids

Farmers Insurance Group of Companies has announced that it is offering a new discount to its auto insurance customers who own a hybrid or alternative fuel vehicle. Discounts of up to 10% (5% in California) will be available in 41 states for gas/electric hybrids, electric only, natural gas only, ethanol only, methanol only and propane only. Not qualifying will be diesel, flex-fuel, and gasoline engines converted to use other fuels.

Cellulosic ethanol in Iowa

On November 20 Sioux Falls-based ethanol producer the Broin Companies announced that it was planning to build a cellulose-to-ethanol production facility in Emmetsburg, Iowa. The Voyager Ethanol plant will be converted from a 50 million gallon per year (MGPY) conventional corn dry mill facility into a 125 million gallon per year commercial scale bio-refinery designed to utilize advanced corn fractionation and ligno-cellulosic conversion technologies to produce ethanol from corn fiber and corn stover.

Around the world on solar power

Green Car Congress has a piece by Rafael Seidl dated December 10 on a proposed round-the-world trip by Swiss adventurer Louis Palmer in a solar-powered three-wheel EV of his own design called the Solartaxi. Palmer has already made a 3000 km (1865 mile) trip from Lucerne to Barcelona, using mostly grid power.

COMING EVENTS

6th EVer Electric Auto Association Chapters Conference, in conjunction with 2007 Battery Beach Burnout.

Weekend of Jan 26-28, 2007, West Palm Beach, FL. Go to www.eaaev.org and www.FloridaEAA.org

Hybrid Vehicle Technologies Symposium — 2007

Feb. 7-8, 2007, San Diego. Check SAE at www.sae.org.

2007 motors & drive systems conference

Feb. 7-8, Dallas, TX. Go to http://www.e-driveonline.com/motors_conf_index.htm or e-mail jeremym@infowebcom.com.

2007 Clean Heavy-Duty Vehicle Conference

Feb 13-15, Universal City, CA. Contact Monica Alcaraz or Debie Dubose, 626-744-5600, malcaraz@weststart.org or ddubose@weststart.org, www.calstart.org

SAE 2007 World Congress

April 16-19, 2007, Detroit. Go to <http://www.sae.org/congress>

Battery Council International 119th Convention and Power Mart

April 22-25, 2007, Myrtle Beach, SC. Phone: 312/644-6610, Fax: 312/527-6640, info@batteryCouncil.org.

Fuel Cell 2007

June 14th - 15th, Rochester NY. Contact Marsha Hanrahan, marshah@infowebcom.com or go to www.fuelcell-magazine.com/fc_2007_conf_index.htm

Duryea Day #42

Sept. 1, Boyertown, PA. Call 610-367-2090 or go to www.boyertownmuseum.org.

Panasonic World Solar Challenge

October 21-28, Australia. CALL 61 8 8463 4500 or go to www.wsc.org.au

Michelin Challenge Bibendum 2007

Shanghai, Nov 14-17. Contact mail.challengebibendum@fr.michelin.com, www.challengebibendum.com

MEETING SCHEDULE

Meetings are held in Room 49, Plymouth-Whitmarsh High School, 201 East Germantown Pike in Plymouth Meeting, PA, and begin at 7:00 p.m.

January 10

February 14

March 7

April 11

May 9

June 13