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SINCE 1786

THE PRINCETON PACKET

SOLUTIONS Huck Fairman

Princeton Day student building an electric car

Ideas have long been percolating in this complex community, and the recent pace hasn't slowed. Among local mechanics/engineers/innovators is a high school junior who is about to get his driver's license, but he is not just *dreaming* about a car to drive; he's *building* one, and it's electric powered.

With his baseball season about to begin, and college on the horizon, the competition for his time is intense, but he's been finding weekend hours to push the project ahead. In a state that has been home to Edison and Einstein, among many other creative minds, it should not come as a surprise that someone like Robert Hrabchak is following in their footsteps.

And this type of ability and innovation is what the country needs going into the future. Bill Gates began in a garage. Thomas Friedman of The Times has been writing about developing and using our intellectual capital, something that Hrabchak has undertaken, while still in high school.

His idea to build an electric car was the culmination of several learning experiences. At home, he and his father service their cars, changing the oil and performing other maintenance tasks, which has familiarized him with auto mechanics.

At Princeton Day School, he took a course, Literature and Nature, with Liz Cutler who teaches literature and is the sustainability coordinator. As a member of the Environmental Action Club, he has become increasingly aware of the threat that high CO₂ levels in the atmosphere present to us all — as our strange weather, here and around the globe, suggests.

On the radio, he happened to hear guests discussing the conversion of gas-powered engines to electric power. The idea intrigued him. Three summers ago, he took a course at Roger Williams University in Rhode Island in electrical engineering. Last summer he took a course in computer science at Cornell. Both courses contributed to the knowledge necessary for his project.

But perhaps most directly helpful has been an online site he discovered, EVTV.ME, which presents video instruction for these conversions.

In short, Hrabchak both prepared himself and found the necessary guidance to pursue his idea. As he got into it, he continued to research conversion details online where he found not only technical information but the experiences of others feeling their way. And not surprisingly, he has also found that the parts he needs can be obtained online.

Once the project took shape, he needed a car to convert. He found a '99 Porsche Boxster whose engine had been destroyed and was available very cheaply. The car is ideal because of its small size, light weight, and potential to be fun to drive when he completes the conversion and gets that license. To pay for it all, he borrowed the money from his parents and will repay them by eventually re-selling the car and its un-needed parts.

And so in his family's garage, he

began the conversion. The first step was to strip the car of its engine, drive train, gas tank, and other parts. With his father's help, he was able to hoist the 500-pound engine up and out and onto the garage floor. In the front trunk, designed for baggage, he will fasten the tied-together batteries. In the back, where the original engine sat, he will place and connect the new, smaller electric motor. He figures the entire project will have taken him six months when he takes the car for its first spin in June.

Along the way, he familiarized himself with several of the manufactured electric cars, such as the Chevy Volt, the Nissan Leaf, and the more expensive Tesla. His car, he estimates, will have a range of about 100 miles, depending on driving habit and conditions — comparable to the Leaf. He readily acknowledges electric car technology needs further development, particularly the batteries. He also notes that the price needs to drop before electric cars will become widely popular. But, as happened with computers, that re-

duction should follow increased public interest.

Looking ahead, Hrabchak sees no appreciable fall in gas prices, but more likely a steady rise. A further, but unpredictable, influence on gas prices is the forecast for continued global warming, which should exert pressure to reduce carbon emissions.

But in the meantime, Hrabchak will have gained invaluable knowledge and experience, while providing himself with an environmentally clean set of wheels at a very reasonable cost. And last but not least, he is providing his friends and classmates with a tangible example of what can be done, as they enter a competitive and rapidly changing world.

Huck Fairman is a local writer who in the course of researching another project was confronted by the overwhelming evidence that we are changing the earth's environment. And that will affect life as we have known it. He hopes to present the many good local responses to this situation that are already under way.



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Electric cars can offer solutions to pollution

Drought one summer followed by unusually heavy snows and then a rain storm and hurricane that shut down the town. This isn't Africa, Texas, Siberia or Pakistan, but Princeton, New Jersey. With heavy flooding to our south and north.

What can be done? Scientists tell us to reduce our carbon dioxide emissions, which trap the heat. Without that, everything changes, as we're beginning to see.

A number of local individuals, organizations and businesses are doing just that. This column will share their many ideas and innovations and will offer steps the interested can take.

One technology most of us use and many could change is the gasoline-powered automobile and truck. Increasingly, there are electric car options available.

For instance, Phil and Kyra Duran of Lawrenceville bought their electric car, a Chevy Volt, a year ago. He says it's the best car he's ever owned. It accelerates impressively, holds the road, is well-made and is cheap to run.

She uses it to commute daily into Trenton and never uses any gas. They charge their car using electricity from their own solar panels. He points out that even owners charging electric cars from their local utility company's power should pay, on average, \$1.50 per day, a lot less than gasoline costs.

And he's happy that he will never again be dependent on imported oil, having lived through the 1973 oil embargo. In fact, he'd like to see the nation wean itself from its dependency on fossil fuels.

He's also eager to point out that the Volt is fun to drive, and, nationwide, is number one in customer satisfaction.

Jay Fox, from south of Bordentown, drove up to Hamilton's Haldean Nissan to order his Nissan Leaf. He decided on this car after doing thorough research on the Leaf website for California owners, where it won their praise.

Available out there for some time, it is just now reaching New Jersey dealers in quantity.

Jay decided on a Leaf for a number of reasons.

(1.) It will save him money, enabling him to make his 20-mile daily New Jersey commute at minimal cost.

(2.) He figures these savings will pay for the car in about four years.

(3.) He likes the fact the car produces no emissions. He feels that this is important with the carbon dioxide levels in our atmosphere rising.

(4.) He feels the car is well-made, handles well, and has a high safety rating, important to him because his teenage daughter has just gotten her permit, and this is the car he wants her to drive, when he's not at work.

(5.) In addition to the operation savings, Jay was swayed by the \$7,500.00 rebate he received and by the additional savings of having to pay no N.J. sales tax on the purchase.

He points out that the installation of the charging system in his garage cost about \$2,000, but he maintains he is nonetheless pleased with his

choice, and the recharging system will be there for his next electric car.

Drive Route 1 at rush hour; there is no end of cars.

If, over the next few years, enough drivers switch to hybrid or electric cars, we should be able to lower emissions, lower temperatures and save money.

Otherwise, the predictions are that these things will continue marching the other way.

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Residence solar catching on

Echewing worry over the Mayan apocalypse, many New Jersey residents are taking matters into their own hands, saving money and reducing their carbon foot prints, so there won't be anything like an environmental apocalypse.

Families, businesses, and institutions have been adopting cheaper and greener energy systems. Indeed, Wikipedia reports that New Jersey is second nationally in total number of homes and businesses that have solar panels installed.

Here are two brief stories of residents who have made the switch. The stories of business and institutions that have changed over will follow in the next column.

Hedy DiSimoni, a Princeton planning analyst for a manufacturer, wanted to renovate the house she and her two daughters live in. One of her reasons for doing so was to lower her energy bills by making the house tighter and possibly by changing energy systems.

Having heard of the possible benefits of solar power, she began calling contractors who install the panels. She wanted to hear not only their overall price but what services they included, such as applying for approval to the state and township and yearly maintenance. She notes that it is important not only to shop around for the right installer but also to make sure the installer uses the best solar panels.

Once she made her decision, she found that the approval process, handled by the contractor, took longer than anticipated, but with its completion, the installation itself went smoothly and quickly. The average state-wide installation cost is \$40,000, but the federal tax credit (of 30 percent) reduces that by \$12,000. And from her energy savings, the state's energy upgrade rebate, and with the state's Solar Renewable Energy Credits (SRECs,) she can expect to meet the average payback period of 3.8 years for a 6.3 kilowatt system, the largest permissible size.

(One SREC certificate is earned for every 1,000 kilowatt hours of electricity generated, and those certificates can be sold directly or through an intermediary back to electricity suppliers, primarily

utility companies. The selling price varies widely depending on demand and supply.)

Interest-free loans for this upgrade are also available from the NJ Clean Energy Program, with payback due in 10 years. She pointed out that the township will continue to inspect her system two to three times a year, primarily the metering, while her installer will continue to provide yearly maintenance.

Her goal in installing the solar panels has been reached; she has substantially reduced her electricity bill, and the SRECs offer further income to offset the remaining cost.

William Wolfe, a Princeton architect who has designed or co-designed many local residential, commercial and institutional buildings, including his own handsome borough home, first became intrigued by solar heating as a Princeton University undergraduate taking a drawing course that investigated the effects of sun and shadow on buildings.

Passive solar heating and the shading of windows by overhangs were two of those effects that he eventually incorporated in his designs. He went on to earn his master's in architecture at the university, then worked for a local design firm before forming his own partnership.

More recently he has concentrated on residential projects. (He points out that the basic photovoltaic technology was developed right here at the former RCA complex in Princeton Junction for the space program.) His first step for clients is to determine what insulation and sealing improvements would make the house more energy efficient and, if necessary, to design possible structural changes toward that end.

Following those steps, he will design and have installed a solar panel array. For his own house, he designed and had installed an array, but then added geothermal heating. As a result, his energy consumption from PSE&G nets out close to zero. In the coldest weather he buys electricity, but during the rest of the year, he sells his excess back to the utility, which gives him credits to be applied against his usage.

His total energy expenditure averages, at most, a couple of hundred dollars per year. In addition, the energy he generates also provides him with, on average, 12 SRECs a year which, again, are auctioned through an intermediary (or broker) back to the electrical suppliers. These sales easily exceed his minimal energy costs.

Wolfe notes that it's important for those interested to understand that while a south facing roof will be most efficient in collecting sunlight, current panel technology enables them to collect solar energy even when off-line, that is, facing southwest for southeast. He adds that panels also pick up reflected light from other surfaces. In fact some solar installations use large, sun-tracking mirrors to focus sunlight onto panels.

There is a website, Solar Angle Calculators, that can provide an idea of how much energy a solar panel installation could produce. To put these individual systems in a national context, Wolfe points out that buildings consume, through heating and cooling, 40 percent of the energy used in this country, and produce 40 percent of the CO₂.

In a typical home, 46 percent of the energy used is for space heating, while 14 percent is used for water heating. In the Northeast region of the country, these percentages are higher.

Locally, everyone I have spoken with voices enthusiasm over their decision and investment. Not only have they reduced monthly expenditures on heating and cooling their homes, but the remainder of their installation costs, that portion not covered by tax credits and rebates, can be paid off, over varying times, by energy savings and the SRECs. And, as all these new owners mention, they are helping reduce CO₂ emissions through reduced consumption of fossil fuels.

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Geothermal is clean, efficient heat source

The Earth, we know, has been a bountiful home. As Robert Frost wrote, "I don't know where it's likely to go better."

The planet has provided, among other things, wood, coal, petroleum, natural gas and nuclear power to warm and cool us. But now, with demand and populations levels rising, the costs of and pollu-

tion from these traditional systems, not to mention their potential dangers, have sent many to investigate new energy systems.

Several local New Jersey residents have researched the options and have chosen one right under our noses, or under our homes and businesses anyway, geothermal energy, which is perhaps the cleanest and most efficient of the new technologies.

This system uses heat existing naturally below the Earth's surface. Hot springs have long been a visible manifestation of it. What's nice is that it can be used to both heat and cool buildings, doing so efficiently, cheaply and quietly.

David Wittenburg lived in a townhouse before he and his family moved into a South Brunswick single-family home. His townhouse utility bills were low as the adjoining houses provided good insulation. But the utility bills in their new home were high enough to send him searching for alternatives.

He first investigated, and had installed, solar panels on his roof, as fortunately one side faces south. This system generates enough power to provide most of the electricity they need, but he wanted something to replace the house's gas heat system, largely to avoid the cost.

Having used and been pleased with the service provided by Princeton Air on his existing system, he went back to them to inquire about geothermal. They first recommended an energy audit to find out what the house might need in terms of insulation and sealing to make it more efficient. (It should be pointed out that any contractor who is accredited and certified by the Building Performance Institute (BPI) can do this audit.) Then together they concluded that geothermal was feasible and affordable for the family.

While the initial outlay is high, approximately \$40,000, several factors make it more affordable. First, there is a 30 percent of-the-total-cost tax credit available from the IRS. Second, the NJ Clean Energy

Program provides a \$10,000 loan interest-free to be paid back in 10 years. Third, NJ CEP offers a rebate, depending on energy savings, up to \$5,000. David used loans to finance the remaining costs. He figures the savings he gains with this system will pay off over 8 to 10 years.

For this reason, he recommends geothermal for those owners planning to stay in their houses for at least that period. On the other hand, some real estate agents have reported that a geothermal system in a house commands as much as a 50 percent price increase over what it otherwise might sell for.

To reach the heat in the earth, Princeton Air drilled down 350 feet in the Wittenburg's front lawn and a vertical pipe, or loop, was inserted through which the geothermally heated air is pumped to the house. In the winter the cool house air is exchanged (pumped) for the warmer geothermal air; in the summer the warmer house air is exchanged for the now comparatively cooler air from the earth.

Is he happy with his new system? Very much so. It offers a high comfort level where once the thermostat is set at 70 degrees, the system keeps the house temperature even, without frequent re-setting. And it does so quietly, with no furnace noise clicking on and off.

The system is most efficient when outside temperatures range between 35 and 85 degrees. He has kept his existing gas furnace for additional heat in the coldest weather. And there is no sign of the drilling hole in front of his house. But most important, he feels, is the savings, in not having to pay a substantial monthly energy bill.

When Scott Neal moved into a Hunterdon County house, he discovered an old oil-burning furnace. For safety and cost reasons, he wanted to replace it. But natural gas was not available in his neighborhood. His subsequent research took him to various renewable energy websites, and eventually, also, to Princeton Air, where he was given a better quote for an energy audit.

The audit recommended insulation, particularly in the second floor. Scott followed up on the recommendation and now says that it alone has substantially improved the house's comfort.

The geothermal installation was next, and Scott is pleased to report that everything works as advertised. Because he lives in the country, he added a propane-powered, back-up generator, should a storm interrupt electric service.

And like Dave Wittenburg, he filed for the 30 percent-of-cost tax credit. In addition to the improved safety and energy costs for his house, he notes that both his wife and he find the air quality inside seems cleaner, more comfortable, with improved humidity levels, and without any traces of the former oil furnace.

Overall, he is very pleased that he made the effort to learn about and have installed this new technology.

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Solar panels more abundant

According to New Jersey's Clean Energy program, this January saw a record number of solar panel installations. Before that, the state was already ranked second nationally in the number of installations. Why has this interest spread through much of the state? Charles Yedlin of Yedlin Associates in Princeton says that it's first about re-

ducing costs, but an added benefit is reducing CO2 emissions from fossil fuel generation of electricity.

Mr. Yedlin was one of Sustainable Princeton's 2011 Leadership Award winners.

Tom Eldridge of the Lawrence Township School System points out that beyond saving their system money, their solar panel installations

raise students' awareness of electricity consumption and alternative power sources.

Thus, in a surprise to many, including this writer (because the solar panel arrays are not always easily visible) an impressive number of New Jersey companies, institutions and home owners have decided to invest in solar energy.

Not only can it save them

significant money on their electricity bills, but, importantly, they can earn income by selling excess electricity back to suppliers for credit against usage, taking advantage of what is termed "net metering."

It was this innovation that made solar energy really attractive to electricity users of all sizes. In addition, the Solar

Renewable Energy Credits (SRECs) that owners can earn and trade on the New Jersey market, provide another source of income. While the price of SRECs has been down recently, and varies widely according to supply and demand, NJ CEP is working on several ways to stabilize that price. And finally, there remains in place a Federal Tax Credit of 30 percent of installation costs.

Yedlin and the Lawrence Township Schools have found that they can cut their electricity costs by 25 percent. From these savings and credits earned, the companies calculate that they can pay off their investment in five to nine years. Lawrence Township, now with panels on their seven school buildings, has decided to invest in additional panels for their roofs.

Another local business that has made this investment is Firmenich Inc. of Plainsboro, which installed panels on its parking garage roof and has reduced its electricity costs 7 to 10 percent.

Other New Jersey businesses and institutions that have installed panels include: Merck, Princeton Business Park (Rocky Hill), Princeton/Nassau Tennis Club, Dow Jones, Whole Foods, Congregational Church in Ewing, Johnson & Johnson, Unitarian-Universalist Congregation of Princeton, Christ Congregation (Princeton,) Loreal, the Hamilton Train Station, and Kennections Hair Salon (Lawrenceville.)

Local schools that have invested in significant installations are: Rider University, Princeton University and The Lawrenceville School. The latter has installed a "solar farm" in a 30-acre field which provides 90 percent of the school's electricity needs. Woven in among the panels

are cultivated flowers to be sold by the farmer who tends them and beehives to produce honey. Princeton University's new solar farm is set on 27 acres across the lake from the main campus. It is anticipated to generate 5 percent of the total campus power usage, and it avoids adding an estimated 3,091 metric tons per year of CO2 to the atmosphere. They expect to cover the installation costs in about nine years through savings and credits. Several alternative plans for financing installations exist. One has been to have the installing company pay for and own the solar panel system. That company then receives the Federal Tax Credit, the benefits of 'net metering,' and the SRECS. The property owner must buy electricity from the installing company, but at a competitive rate.

Other possibilities include County Improvement Authority Bonds or Municipal Bonds as sources of financing. One interesting point for SRECs owners is that because they may be used for 15 years, and the investment payback takes typically 5 to 9 years, the final years of ownership can earn clear income.

These technologies (solar, geothermal, and wind) are relatively new and still evolving — the cost of solar panel installation has dropped markedly and there are now several types of panels. Those interested should investigate the latest information on the technology and financing.

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