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THE SELF-RELIANCE ISSUE

Disaster-Proof Your House, Your Car, Your Life

6 Wild
Emergency
Car Repairs

PLUS

Science Automotive Technology Home Outdoors

Popular Mechanics

Beyond Survival

HOW TO LIVE THROUGH
ANY DISASTER

—For a Day, a Month or Forever

Going Off
The Grid
Homegrown
Power, Fuel, Food

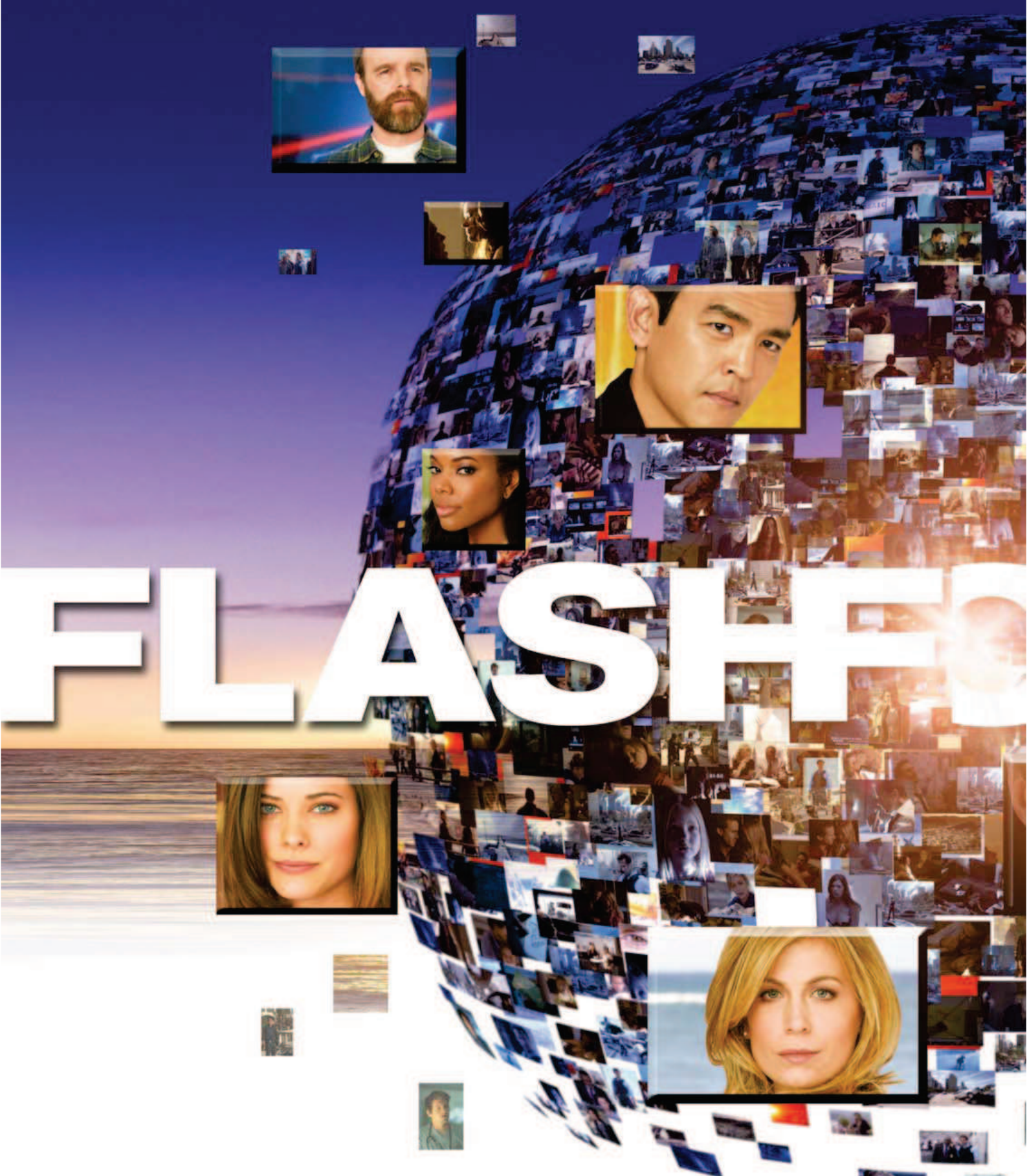
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First in Flight



THE NEXT BIG WARPLANE We are now fighting in two wars that are primarily focused on infantry troops, helicopters and unmanned aerial vehicles. As Defense Secretary Robert Gates continues to restructure the military, the future of big-ticket warplanes appears to be hanging in the balance.

How will the Pentagon weigh the needs of current wars against those of possible conflicts with high-tech enemies? Is the Defense Department responding to battlefield demands for more surveillance aircraft rather than more bomb-dropping warplanes? Will the Air Force's planned Next Generation Bomber have pilots at all—or a price tag the nation can afford? For all these critical issues, PM provides expert, behind-the-scenes analysis and news.

COMMERCIAL TROUBLES Recent Airbus A330 crashes and production delays for Boeing's 787 Dreamliner have called into question the reliability of modern aviation materials, pilot training and manufacturing. PM walks you through the search for black-box flight data recorders and pores over the details of crashes with aviation experts to keep readers current on all the day's major aviation safety issues.

For breaking news, go to popularmechanics.com.

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WHAT THEY'RE DOING



★ BUZZ ALDRIN

Aldrin is marking the 40th anniversary of the Apollo 11 moon landing this summer with two new books, *Magnificent Desolation* and *Look to the Stars*. In the August issue of PM, he set out his vision for space exploration, arguing that NASA should focus on establishing a Mars colony. And Aldrin recently worked with Snoo Dogg to record a song called "Rocket Experience." The key line: "It's time to venture far; let's take a trip to Mars; our destiny is to the stars."

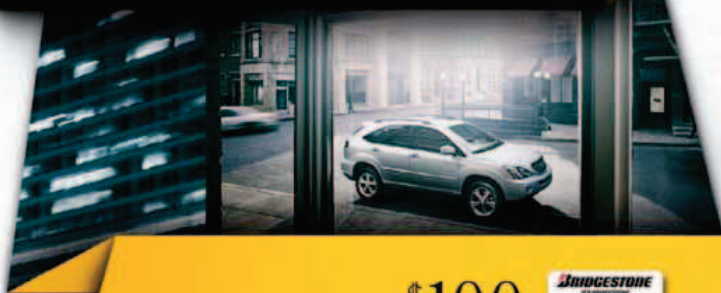




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THE SELF-RELIANCE ISSUE

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A hallmark of the competent man is the ability to take care of himself. Starting with editor-in-chief James B. Meigs's Editor's Note, this special issue celebrates the rebirth of American independence: the skills, ideas and technology that can ensure both disaster survival and long-term sustainability.

56 The New Homesteaders

A growing movement of DIYers is living self-sufficiently on both urban farms and remote, off-the-grid communities alike. PM pays a visit to the new colonists. **BY JAMES VLAHOS**

66 The Rules of Survival

When faced with disaster, some people freeze with fear; others take action. Here's how to stay alive in a calamity. **BY JOHN GALVIN**

74 The Electric Cold-Beer Gadget Test

PM's senior tech editor builds a portable energy system to see if he can run his gadgets—including a fridge full of frosties—off the grid. **BY GLENN DERENE**

78 Apocalypse Chow

Hungry taste-testers scarf MREs—meals ready-to-eat—to find out if survival grub can fuel the body *and* boost morale. **BY EMILY MASAMITSU**

80 The Soul of an Old Machine

For some DIYers, fixing gear isn't about being practical—it's about enjoying the rewards of repair in a throwaway world. **BY JIM GORMAN**

86 The Race to Zero

Students in an international contest take up construction to show that solar power can sustain an attractive, livable net-zero house.

BY HARRY SAWYERS

ON THE COVER
Photo illustration
by Joe Pugliese,
Echo Park, Los
Angeles, photo-
graphed on
July 22, 2009.



Will cheap electric planes like this Sonex E-Flight soon soar in U.S. skies? Not if the feds can help it (page 16).

Popular Mechanics

PM DEPARTMENTS

NEW TOOLS

CARS

HOME

HOW-TO

PM DO-IT-YOURSELF

★ TECH WATCH

15 Supersonic Car

A new British jet- and rocket-powered speedster is capable of shattering the sound barrier. **Plus:** The future of laser weapons is up in the air—literally; advancing robotics with a chewing robot that mimics the human jaw.

★ UPGRADE

25 Meter Maid

The Generac Power Systems XG8000E Generator tells you when too many appliances are plugged in. **Plus:** The iconic Rubik's Cube reinvents itself with touch-sensitive technology; a clean, quiet lithium-ion leaf blower.

★ NEW CARS

33 Dirty Jobs

Toyota Tundra goes all-power, no-frills with the Work Truck package. **Plus:** Ducati's Streetfighter S owns the road; we unleash two luxury crossovers—the Cadillac SRX and Lexus RX 350—to find out who's boss.

★ HOME

93 Sawdust Melodies

Install this clean-burning apparatus and stay warm while slashing fuel bills.

100 Homeowners

Clinic Fresh eggs: a chicken-raising, coop-building primer. **Plus:** Sump pump fixes.

104 Geothermal: Dig It

Cut energy costs by tapping the heat beneath your house.

★ COLUMNS

44 Jay Leno's Garage

In 1966, 16-year-old Jay helped his dad buy a new Ford Galaxie 7 Litre. Now he's restoring the same model. Let the teenage cruising begin (again).

48 Ready for Anything

If we're not prepared for the unthinkable, are we really prepared at all? To avoid the worst disasters, Glenn Harlan Reynolds proposes the use of resilience engineering.

★ AUTO

108 Saturday Mechanic

The good, the bad and the messy of refining your own backyard biodiesel.



114 Car Clinic

Get-home-at-any-cost fixes for common breakdowns. **Plus:** Protect your car against corrosion; clutch advice for extending your slave unit's life span.

★ TECH

119 The DIY Cellphone Charger

Disaster-proof your communications by making a AA-powered emergency cellphone charger (for under \$5).

122 Digital Clinic

The easy way to switch off your watt-sucking surround-sound system when it's not needed. **Plus:** How to bypass annoying slide shows on the Web.

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To Mars or to the Moon

I completely agree with Buzz Aldrin's space plan—we should be making Mars our priority without completely forgetting about the moon ("A Bolder Mission"). Robert Zubrin [founder of the Mars Society] also suggested using the same vehicles and habitats to set up a moon base, which would save the space program billions of dollars. The shuttle was a mistake from the start, and the sooner it is replaced by the SpaceX Dragon, the better.

WES CARR
CLERMONT, FL

Aldrin's article on traveling to Mars is a great read for an explorer, but misses the point of going to the moon. Why are countries interested after 40 years? First, water, which will help us remain there. Second: helium-3, which is readily available on the moon. It's used in fusion and can produce energy on Earth or in rocket engines in space.

CHUCK BARR
NEW BERN, NC

I agree with the majority of Aldrin's plan for Mars. But as far as colonization is concerned, I think bypassing the moon is rash. The distance between Mars and Earth creates some disadvantages. Emergency help is two years away from a colony, and the inhabitants will experience extreme isolation. These problems would be less severe on the moon and could be overcome to eventually establish a Mars colony when the technology and the people are ready.

DANIEL P. JENSEN
FARMINGTON, NM

PM LETTERS

Shaky Science

I must address some of the issues you take with forensic science in your story "Reasonable Doubt." The field's underlying principles and theories originated with scientific studies and analysis of ballistics, blood and fingerprints published in journals such as *Nature* as early as the 1880s. It was this foundation, combined with modern peer-reviewed publications, proficiency tests and validation studies, that established the forensic science disciplines used in crime labs.

Many of the isolated problems associated with forensic science can be prevented through lab accreditation, analyst certification, technical review and the use of opposing experts in court. While these measures will not eliminate all of the problems, they will go a long way in identifying, solving and minimizing their effects.

GEORGE SCHIRO, M.S.,
F-ABC, FORENSIC SCIENTIST
CADE, LA

I was sad to see a negative spotlight put on forensic science. I'm currently studying



ISSUE

08/09

x
Readers responded to forensic analysis, flying the P-51 Mustang plane and Buzz Aldrin's plans for Mars.

biology and have taken two forensic science courses. Although I was relieved that you included the National Academy of Sciences' suggestion to create a National Institute of Forensic Science, accredited colleges and universities already offer degrees in the subject.

CHARISSA GOGGIN
LONG BEACH, CA

Flight of Fancy

Jeff Wise began his article "Flying a Legend" with the words: "You never forget your first 60 seconds airborne in a P-51 Mustang." I could not agree more. While attending an air show, I met a pilot who invited me to ride in his plane. It was a lifelong dream and boyhood fantasy come true. I will be ever grateful to that [pilot], and to people like Wise who help me relive my adventure.

RON MOWERY
ST. LOUIS, MO

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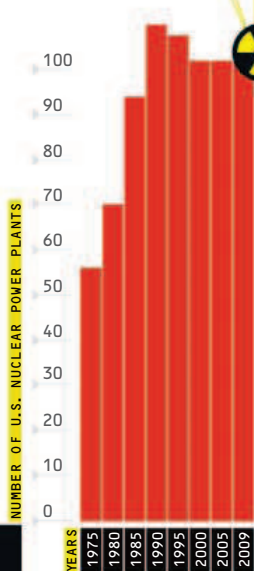
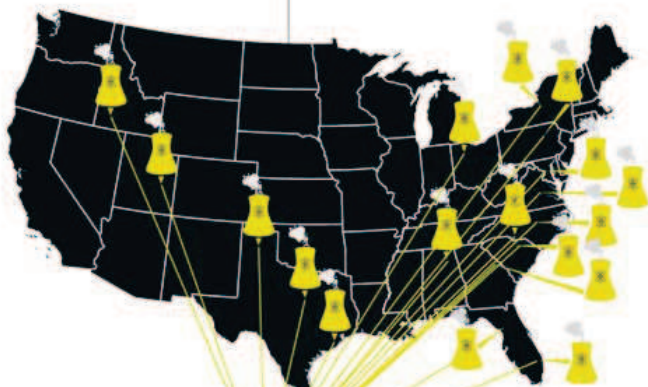
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TechWatch

× NEWS BRIEFS

Compiled by Alex Hutchinson



17 Nuclear power plant

OPERATORS HAVE APPLICATIONS FOR NEW REACTORS UNDER REVIEW WITH THE U.S. NUCLEAR REGULATORY COMMISSION. THE NUMBER OF U.S. REACTORS REACHED ITS APEX OF 112 IN 1990; THAT NUMBER HAS FLAT-LINED AT 104 SINCE 1998.

Hot Wheels Set to Cross the 1000-mph Barrier

A series of successful rocket tests in the Mojave Desert (below) marked another step in the development of a car built to accelerate to more than 1000 mph. The Bloodhound Supersonic Car project is led by the same British-based team that built Thrust SSC, the car that in 1997 set the current land speed record of 763 mph. The design calls for three completely different engines: a custom-designed hybrid rocket for initial thrust, the jet engine from a Eurofighter Typhoon warplane for additional power and a typical gas engine used to start the car and pump high-test peroxide into the rocket engine.



U.S. AIR FORCE: DRONES COULD FIRE AT WILL BY 2047

+ A recent Air Force report includes a rare reference to robots making the choice to fire weapons without explicit human direction. The "Unmanned Aircraft Systems Flight Plan, 2009–2047" states that artificial intelligence will be powerful enough in 30 years to allow drones to make snap decisions on their own. One notable passage says that autonomous unmanned aerial vehicles could launch nuclear strikes. However, the Pentagon is not obligated to follow the plan of the report, which

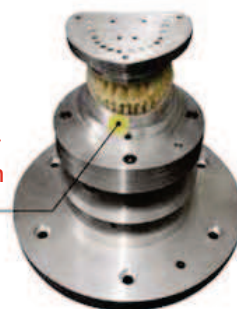
acknowledges that the decision to field machines able to "make lethal combat decisions is contingent upon political and military leaders resolving legal and ethical questions." That could take much longer than the technical development.



+ Biologists from the University of Massachusetts and Tulane University are studying the way people swing hammers to understand how they compromise between force and accuracy while performing manual tasks. Researchers videotape subjects pounding a sensor-studded platform with a hammer, then analyze the images to compare factors like target size, lighting conditions and age.

CHEWBOTS MIMIC CHOMPERS FOR BETTER DENTISTRY

+ The human jaw is a sophisticated machine, with six degrees of freedom in the movement and rotation of the lower jaw—the same range of movement offered by aircraft simulators. Engineers at Britain's University of Bristol adapted the six-actuator design of the mechanism that controls aircraft simulators to build a "chewing robot" that creates a realistically moving mouth. The goal is to test how the metals, polymers and ceramics used to make crowns and bridges wear out over time, difficult and expensive topics to explore in humans.





Global Aspirations for a Solar Plane

Electric airplanes are not being made just for joyrides ("Who's Killing the Electric Plane?", right). Swiss engineers have unveiled the prototype of an airplane they hope will become the first manned vehicle to fly around the world powered only by the sun. The Solar Impulse has the wingspan of a Boeing 747-400 but weighs only 3500 pounds, comparable to a typical family car. The wings are packed with more than 12,000 solar cells that power four 10-hp electric motors and charge lithium-ion polymer batteries. Test flights are expected this year, with a first overnight flight in 2010 and a five-leg world circumnavigation in 2012. —A.H.

Who's Killing the Electric Plane?

U.S. AVIATION DESIGNERS ARE HAMPERED BY FEDERAL RULES RESTRICTING THE USE OF BATTERY-POWERED AIRCRAFT. BY DAVID NOLAND



Powerplant:

The plane uses a 100-volt 50-hp brushless permanent-magnet motor.

Flying for Fun:

The all-composite light sport airplane has a top speed of 100 mph and can stay aloft 2 hours.

Battery Pack:

Four 3-kilowatt-hour air-cooled lithium-ion polymer battery packs can charge from a wall outlet.

Quiet Cruiser:

The large, low-rpm propeller doesn't bother the pilot—or the neighbors.

→ Even as the federal government jump-starts electric cars with \$2.4 billion in research funds, electric airplanes are getting held back. In fact, current Federal Aviation Administration rules prohibit electric motors in light sport aircraft, a class of planes typically flown by less experienced pilots. The FAA decrees that LSAs be powered only by reciprocating engines, a measure intended to keep high-powered turbine engines out of the hands of novice sport pilots. This rule is now thwarting the sale of electric airplanes in the United States. "We're reluctant to introduce new technology on a less experienced pilot population," says the FAA's Steve Flanagan, who helped write the LSA rules. "We need to get some more flight experience with electric motors." That position is frustrating to Randall Fishman, an ultralight pilot who's currently developing an electric two-seat sport plane, the ElectraFlyer-X. The \$65,000 kit plane is being designed to LSA specifications so it can quickly go into production if and when the FAA gives electric airplane motors the okay.



BOEING DEMONSTRATOR

ELECTRAVIA ALATUS

SONEX E-FLIGHT

Electric Flight Line → Aviation designers around the world are experimenting with novel electric-power designs. The Boeing Fuel Cell Demonstrator combines a proton exchange membrane fuel cell and lithium-ion battery to power its electric motor. In January French designers flew the Alatus electric glider for the first time and plan to sell it this year, taking advantage of their freedom from the rules that limit U.S. companies. Makers of the Sonex E-Flight, made in Wisconsin, hope data from their plane will help shape new FAA rules.



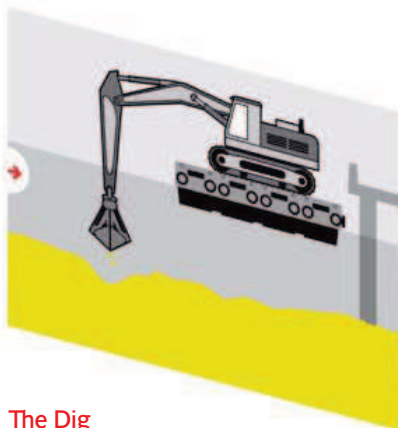
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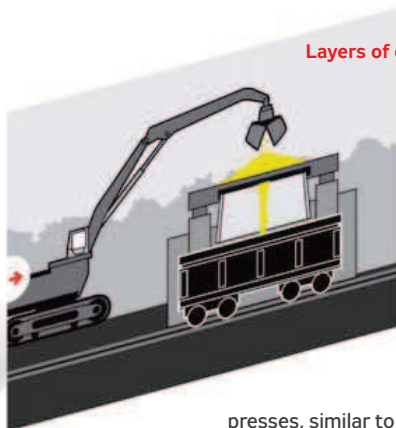
The Dig

✦ An excavator sitting on a barge reaches with a dredging claw to scoop sediment from the river bottom. The contaminated layer averages 21 inches

thick; in certain spots the deposits are piled 10 feet high. Scoop by scoop, workers load the barge with the toxic sludge and head to shore.



Before polychlorinated biphenyls (PCBs) were phased out in the 1970s, companies like General Electric dumped them into New York's Hudson River. In 2009, prompted by a three-decade legal battle, GE marshalled 12 excavators, 18 tugboats and 37 barges to begin digging up 400,000 tons of toxic sludge and then ship it to a specially designed, hermetically sealed hole in West Texas. — HARRY SAWYERS



The Delivery

✦ A second excavator moves the dirt from the barge to a facility where a dozen 32-ton filter

presses, similar to those used in winemaking, squeeze water from the slurry. The resulting filter cake is sealed inside one of 450 plastic-lined railroad cars bound for Texas.

Layers of engineered textiles, clay and plastics entomb the waste.



The Dump

✦ In Andrews, Texas, more than 2000 miles away from Albany, the filter cake is carefully unwrapped and laid to rest in a very sophisticated hole in the ground.

The landfill uses layers of mesh, clay and plastics to isolate the cakes from the surrounding soil, the water below and the air above.

The Doctor Is On

WHEN STEADY HANDS ARE NOT PRECISE ENOUGH, SURGEONS RELY ON SOPHISTICATED ASSISTANTS.

BY AMBER ANGELLE



✦ The tool-wielding wrists of the da Vinci can rotate 540 degrees and have seven degrees of freedom, making the tools of the mechanical surgeon more dexterous than instruments held in human fingers. Examples of instruments include monopolar scissors (A), forceps (B) and grasping retractors (C).

➔ Once considered oddities, multiarmed tools are becoming mainstays of hospital operating rooms. The industry trailblazer in the human-robot medical team is the da Vinci HD Surgical System, a multiarmed assistant that is directly controlled by a surgeon who sits at a nearby console. The system, made by Intuitive Surgical of Sunnyvale, Calif., has been steadily adopted by hospitals performing urology, gynecology and cardiology operations since the HD's introduction in 2006. A new version of the da Vinci includes a powerful high-definition camera, a fourth arm for complex procedures, and dual control stations used for teaching new surgeons or to allow two doctors to collaborate during surgery. Jim Hu, a surgeon at Brigham and Women's Hospital in Boston, has removed more than 600 cancerous prostates with the da Vinci. He says that robotic assistance allows him to overcome the limitations of human doctors, allowing smaller incisions and less blood loss. The system even auto-corrects for any shaking as the doctor manipulates the tools from the console. But could the assistant one day operate without a doctor's guidance? "Unless they develop

artificial intelligence that can recognize variations in human anatomy, physicians will always be needed," Hu says. "But who knows? If you had told me when I was in medical school in the '90s that I would be using a robot to make incisions one day, I wouldn't have believed it."

G is for joy.

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*Compared against prior generation non-VVEL engines. 2009 EPA fuel economy estimates. Actual mileage may vary. January 2008 Ward'sAuto.com. Always wear your seat belt, and please don't drink and drive. ©2009 INFINITI.



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A Tale of Two Laser Planes

THE FUTURE OF LASER WEAPONS REMAINS UP IN THE AIR, BUT A PAIR OF BOEING PROGRAMS HINT AT A DIRECTION. BY ERIK SOFGE

→ When a missile punched through the clouds off the coast of California this past June, the world's most powerful mobile military laser had it in its sights. But the Airborne Laser (ABL), a 747 with a chemical laser mounted in its nose, fired only a low-intensity beam to track its target. Officials at Boeing, which heads a coalition of companies that make ABL, say it is a crucial step to proving that lasers can destroy ballistic missiles as they launch, yet the success may not be enough to save the program. Testifying before

Congress, Defense Secretary Robert Gates said that ABL would likely never be deployed for its mission. "You would need a laser something like 20 to 30 times more powerful than the chemical laser in the plane right now to be able to get any distance from the [defenses that protect the target missile's] launch site," Gates said. He also scrapped plans to build another ABL aircraft—and program officials in the Pentagon admit funding is in limbo.

But there is another flying prototype in Boeing's hangar that hints at a more promising future for laser weapons: the Advanced Tactical Laser. ATL's kilowatt-class chemical laser is significantly smaller than the ABL's, since it is designed to hit targets at shorter ranges, essentially replacing bullets and bombs with a more precise beam of lethal light. Boeing won't release specifications, but in a recent test at the White Sands Missile Range in New Mexico, ATL hit a target from 9 miles away, roughly a tenth of the planned test range for ABL mentioned by Gates. A smaller laser could find wider use on helicopters, warships or unmanned aerial drones, making potential sales worth the steep development costs.

Advanced Tactical Laser

- **Platform:** C-130H; 97 ft 9 in. long
- **Armament:** Kilowatt-class chemical-oxygen iodine laser
- **Potential Targets:** Vehicles, communications infrastructure and unhardened enemy facilities

Bright Future?

An array of lasers are rolling onto firing ranges



Laser Avenger

- **Platform:** Humvee
- **Range:** Not released
- **Potential Targets:** Improvised explosive devices, small unmanned aerial vehicles (UAVs)
- **Next Step:** Further counter-IED tests could be conducted this year
- **Total Cost:** Unknown, internally funded by Boeing



Maritime Laser Weapon System

- **Platform:** Navy ships, including the planned Littoral Combat Ship
- **Range:** Line-of-sight
- **Potential Targets:** Small boats, anti-ship missiles
- **Next Step:** Sea tests within 18 months; deployed within 5 years
- **Total Cost:** \$500,000 to date; \$98.5 million by 2014

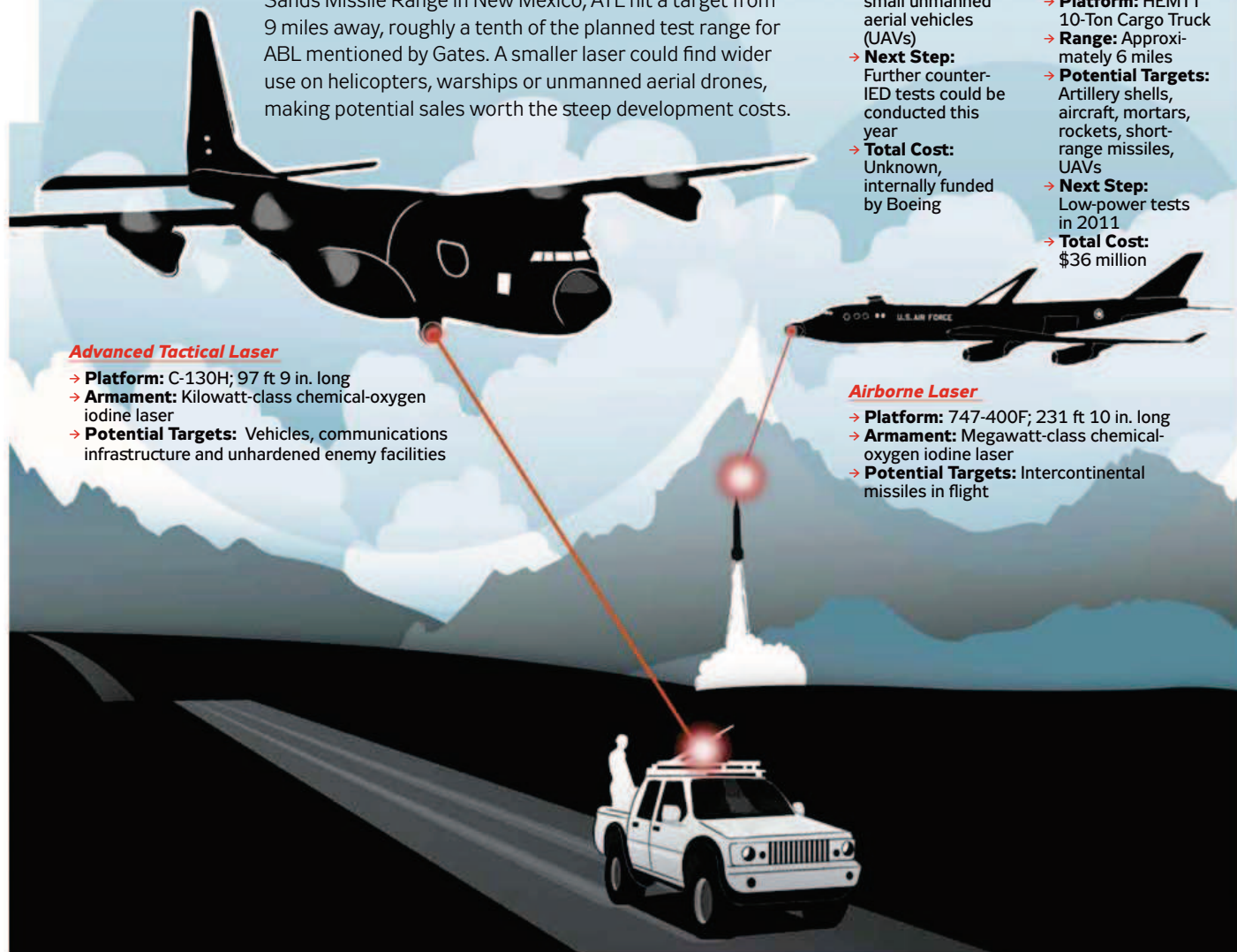


High-Energy Laser Technology Demonstrator

- **Platform:** HEMTT 10-Ton Cargo Truck
- **Range:** Approximately 6 miles
- **Potential Targets:** Artillery shells, aircraft, mortars, rockets, short-range missiles, UAVs
- **Next Step:** Low-power tests in 2011
- **Total Cost:** \$36 million

Airborne Laser

- **Platform:** 747-400F; 231 ft 10 in. long
- **Armament:** Megawatt-class chemical-oxygen iodine laser
- **Potential Targets:** Intercontinental missiles in flight



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IMPORTANT: Grain Marketing and Seed Availability: Genuity™ SmartStax™ has received the necessary approvals in the United States, however, as of October 2009, approvals have not been received in certain major corn export markets. Genuity™ SmartStax™ will not be launched and seed will not be available until after import approvals are received in appropriate major corn export markets.

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IMPORTANT: Grain Marketing and Seed Availability: Genuity™ VT Triple PRO™ has received the necessary approvals in the United States, however, as of October 2009, approvals have not been received in all major corn export markets. Genuity™ VT Triple PRO™ seed will only be available as part of a commercial demonstration program that includes grain marketing stewardship requirements. It is a violation of national and international law to move material containing biotech traits across boundaries into nations where import is not permitted. Consult with your seed representative for current stewardship information.

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Simulated Society

DIRECTOR JONATHAN MOSTOW ENJOYS HIS LATEST ASSIGNMENT: BUILDING THE POPULATION OF AN ALL-ROBOT WORLD.
BY ERIN MCCARTHY

android:

a mobile robot, usually with a human form. Derived from late Greek *andros* (manlike), circa 1751
Merriam-Webster's Dictionary

MARCH OF THE MOVIE ANDROIDS

Androids have captured filmmakers' imaginations since the earliest days of cinema.

→ **When robot stand-ins** populate the world in a movie—as they do in Disney's *Surrogates*, out Sept. 25—every character in the frame has to look perfect. And that turned into a headache for director Jonathan Mostow. "Usually you hire background actors off the street," he says. "We were flying in models."

In the near future, humans never leave their homes. Instead, they send sophisticated robot surrogates into the world. Piloting these proxies from a special chair that plugs into their brain, operators experience everything their surrogates do, but incur none of the risks. That is, until someone starts

Director Jonathan Mostow with a surrogate used in the film to show buyers the mechanics of their potential proxies.

destroying the robots in a way that kills their operators too. Agent Harvey Greer (Bruce Willis) must stop the rampage.

Mostow's team created the film's various surrogate forms using a combination of computer graphics, animatronics and prosthetics. Effects-house KNB built 70 machines—from FBI watcher drones to the display models used to sell surrogates to customers. The team also layered silicon skin over robotic frames, then digitally added details like circuit boards in postproduction. And for scenes where Greer's surrogate is mangled, Willis wore prosthetics to gain a more realistic visual result than CGI. "It's just more fun to build stuff and film it," Mostow says. "We're all little kids with our electric train sets. Our electric train set just happens to be a big Hollywood movie with all the bells and whistles on it."

Creating the illusion of robotic perfection also required some subtle alterations. For example, when actors were portraying surrogates, visual-effects artists digitally cleaned their skin of flaws in postproduction. "Before I started this movie, I [thought] Hollywood was full of fabulous-looking people," Mostow says. "But the number of people who look like ideal prototypes is actually not that many."



2009
Surrogates
Agent Greer



2007
Futurama: Bender's Big Score
Bender
Rodriguez



1982
Blade Runner
Roy the Replicant



1973
Westworld
Gunslinger



1927
Metropolis
Maschinen-mensch



1939
The Wizard of Oz
The Tin Man



1956
Forbidden Planet
Robby the Robot

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Upgrade



[1]

[2]

1. The GFCI outlets have weather-resistant cover plates.

2. The PowerBar meter lets you know when the generator's output is approaching its capacity.

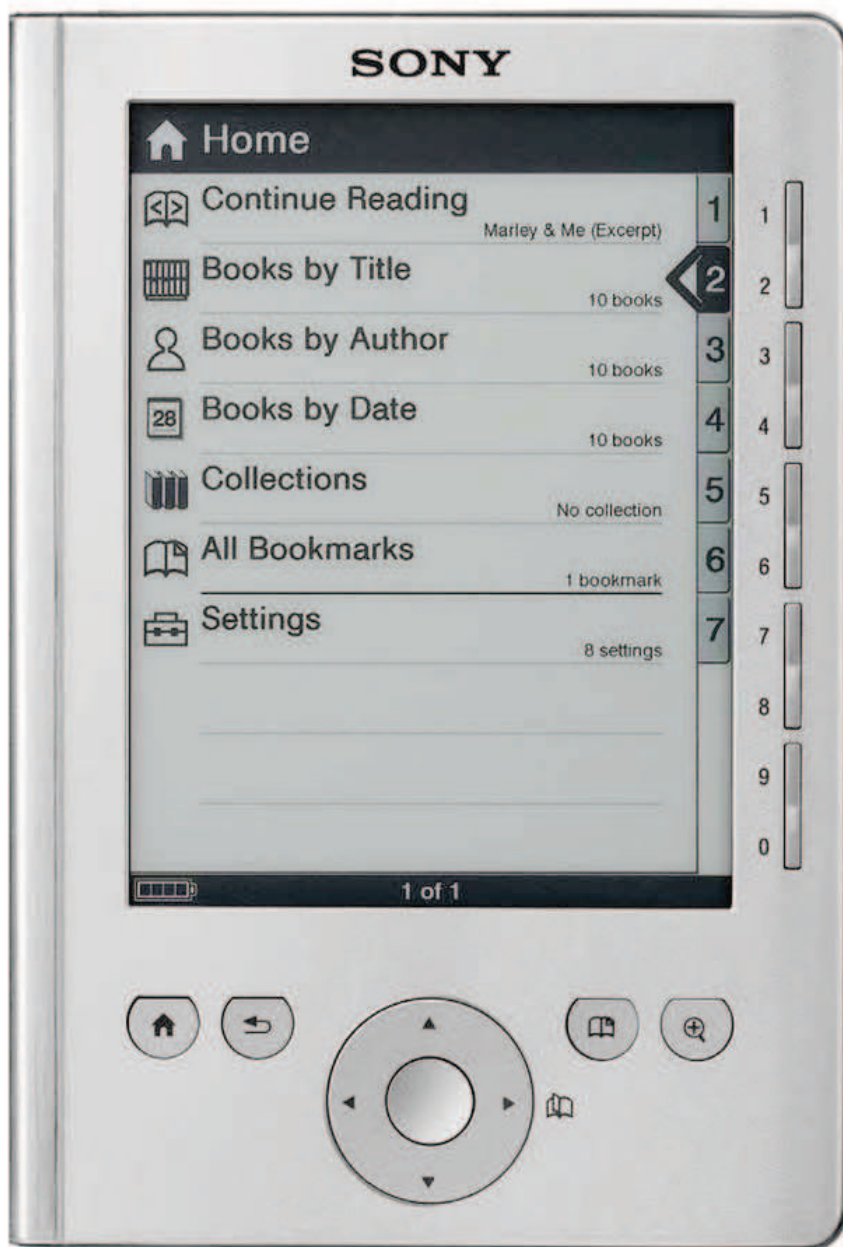
Meter Maid

Using an emergency generator is both a balancing act and a guessing game. It's tempting to try to pull as many watts from the machine as possible, but plug in too many appliances and you'll trip the circuit breaker. The **Generac Power Systems XG8000E Generator (\$1299)** features a unique power meter that indicates when the unit is approaching its limit. Given that the machine can produce a hefty 8000 watts (10,000 for brief surges), you'll have more than enough power to run a well pump, a full-size fridge, a fan, lights, a microwave and a space heater before that happens. — **SETH PORGES**

Lilliputian Literature

→ E Ink e-book readers are pricey items—the standard-bearer Amazon Kindle weighs in at \$300. **The Sony Reader Pocket Edition (\$200)** is sort of the paperback to the Kindle's hardcover. It's more portable and a whole lot less expensive. We like it as a budget-priced e-book reader, but its lack of an internal 3G connection (translation: no downloading books over the air) might be a deal breaker for anybody who has ever used a Kindle.

ACTUAL SIZE



Stud-Seeking Radar

→ If you're just searching for a stud, any old stud finder (or even a magnet) will do. But if you're drilling into concrete and need to avoid rebar, you'll want something with slightly keener radar. **The Milwaukee M12 Cordless Sub-Scanner Detection Tool (\$350)** can pinpoint materials buried under 6 inches of concrete (not to mention ceramic tile, marble or gypsum). That's a full 2 inches deeper than anything else on the market. And, yeah, it'll find a stud, too.



Reinventing Rubik

→ The Rubik's Cube is one of the best-selling toys ever—a frustrating symbol of the '80s whose six sides and 43 quintillion possible configurations have remained unchanged. The new **Rubik's TouchCube (\$150)** seeks to replicate the experience with what can only be described as an

unnecessary technological overload. Instead of relying on mechanical manipulation, its touch-sensitive sides allow users to change the squares' colors with the swipe of a finger. Fancy? Definitely. But its price tag could buy you a dozen old-style cubes and, honestly, it's just not the same.



CHRIS ECKERT/STUDIO D (RUBIK'S CUBE)

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Test Drive

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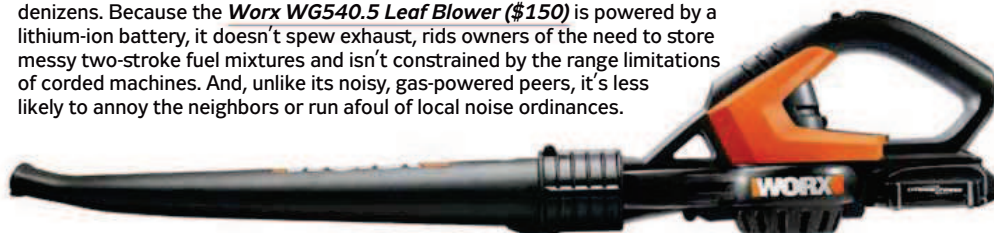
The adjustable stilts come in three sizes, allowing for lengths between 15 and 40 inches.

An articulating hinge mimics a heel's natural motion.



Leaf Mover and Shaker

➔ Two-stroke, gas-guzzling leaf blowers are some of the tool shed's dirtiest denizens. Because the **Worx WG540.5 Leaf Blower (\$150)** is powered by a lithium-ion battery, it doesn't spew exhaust, rids owners of the need to store messy two-stroke fuel mixtures and isn't constrained by the range limitations of corded machines. And, unlike its noisy, gas-powered peers, it's less likely to annoy the neighbors or run afoul of local noise ordinances.



STUDIO D (STILTS)



→ Reaching the heights necessary to hang drywall has traditionally involved a choice of two tools: stilts, which can be dangerous and tiring, or a ladder, which needs to be continually moved. Because the **Tru-Stride Drywall Stilts (\$320)** have an anklelike articulating motion built into their heel, they purport to better mimic a natural stride, allowing for greater comfort and mobility. To see for ourselves, we strapped them on and started lifting 30-pound pieces of wallboard. Our findings: While the heel took some getting used to, we quickly found ourselves able to handle drywall tasks with greater speed and efficiency. But if you've never used stilts before, the height can be intimidating. (Our suggestion: Wear a helmet.)

The PC-Free Printer

→ Printers are typically useless without a PC to tether to. The **HP PhotoSmart Premium with TouchSmart Web (\$400)** has a 4.3-inch touchscreen that allows users to pull and print online coupons, movie tickets, maps and news stories without having to take the time to boot up a computer. And while we can't help but feel frustrated that the printer is only able to access content from preapproved partners such as Google, Coupons.com and Fandango (meaning no access to the open Web), it's a promising start.



Wrangler

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P M U P G R A D E
Wish List



Escape Artist

→ An earlier iteration of Channellock's Frankenstein-like six-in-one rescue tool allowed anybody to play fireman in an emergency. We gave it a workout by shutting gas valves, puncturing windows and prying open doors—but its plierlike tip wasn't designed to cut through more than a few wires. The new **Channellock 89 Rescue Tool (\$55)** adds shears that are thin enough to squeeze into tight spots, yet tough enough to cut through battery cables and more.

1.	2.	3.	4.	5.
Metal shears slice through battery cables and soft metals.	A gas shut-off slot makes it easy to shut down a house.	A pry bar can open windows, doors and sealed containers.	A spanner wrench tightens and loosens couplings up to 6 inches in diameter.	The steel punch can puncture safety glass.



Motorola Clutch i465
(Boost Mobile)



Cricket TXTM8
(Cricket Wireless)



Samsung Finesse
(MetroPCS)

→ There are few things Americans despise more than their mobile phone carriers—poor service, high fees and seemingly inescapable contracts make many consumers feel ripped off and trapped. One way out: prepaid phone services. These plans have been around for years, but because the major players are currently waging a hard-fought price war, unlimited voice, text and data plans can now be had for about \$50 per month on

Boost Mobile, Cricket and MetroPCS. That's less than half the monthly cost of AT&T's unlimited iPhone plan. And because they don't require long-term contracts, these plans could be particularly appealing to the commitment-phobic. Just know that if you do go the prepaid path, you'll likely have to live without frills such as high-speed 3G networks and the latest lust-worthy handsets (so no iPhone or Palm Pre).

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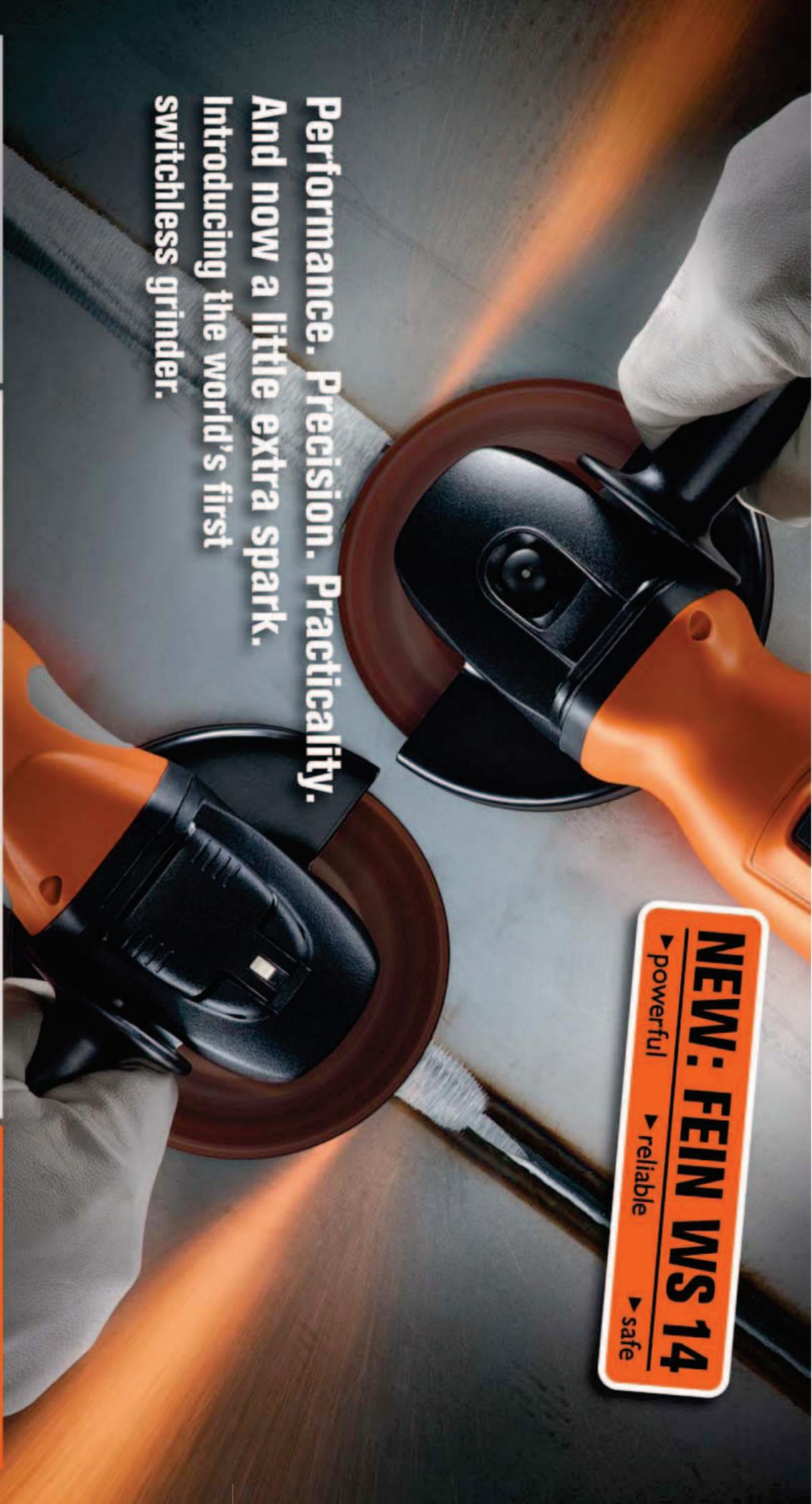
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2010
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WORK TRUCK

Base Price: \$24,355



New Cars

Dirty Jobs

The Tundra's new Work Truck package strips away all pretense and accentuates the utility at this pickup's core. Carpeting is gone, the upholstery is an unabashed gray vinyl, the dashboard is mostly flat black plastic, and the windows roll up with six hand-wound turns of a crank. It's everything you'd have wanted and expected in a 1955 Chevrolet pickup, done with 21st-century technology. Our \$25,155 truck was powered by a new 310-hp 4.6-liter V8, backed by a six-speed automatic that provided quiet and seamless thrust. Frankly, the 4.6 doesn't feel like it's giving up 71 hp to the top-choice 5.7-liter V8. Inside, there's plenty of storage behind the bench seat—at least enough to carry the day's hand tools, lunch and maybe a small generator. The decor is strictly plastic bucket. But sometimes a plastic bucket is exactly what you need. —JOHN PEARLEY HUFFMAN



inside:

comparison:

+

first look:

DUCATI STREETFIGHTER S
SUBARU LEGACY | CADILLAC SRX vs. LEXUS RX 350
PORSCHE PANAMERA S | CHEVY EQUINOX | KIA FORTE
FORD FOCUS RS |

JAGUAR XJ

pm TEST DRIVEN

2010

Ducati Streetfighter S

2010

Subaru Legacy

++

++

1

The S model comes with Ducati Traction Control (DTC), which measures lean angle and will retard the ignition when dangerous levels of wheelspin are detected. The system can be set to one of eight sensitivity levels or switched off. We only felt the system intrude once, gently cutting engine power and perhaps saving our hide.

Softer Side

Superbikes are focused, hardcore machines. But the stretched-out ergonomics can wear you out. Ducati's new \$18,995 Streetfighter S aims to scratch the itch for power without leaving you with sore wrists and a hefty chiropractic bill. The beating, barking soul of the 368-pound Streetfighter is a 155-hp 1099-cc twin. The frame has altered geometry that makes this Ducati much more street-friendly. The fork rake has been relaxed, the swing arm has been extended for more stability and the handlebar sits higher too. The Streetfighter produces extreme forward thrust, but its Brembos yield equally stunning stops. Initial bite from these brakes is tremendous. Our S model's Öhlins suspension exhibited a firm ride but excellent control in the turns. After canyon carving, urban commuting and slogging the Ducati Streetfighter S along stretches of interstate, we hung up our leathers entertained and impressed. — BASEM WASEF

2

Closing the Gap

The Legacy has never sold in numbers that challenge mainstream juggernauts like the Honda Accord and the Toyota Camry. But that might change with this new model. It comes in powertrain tiers—2.5i, 3.6R and 2.5GT—and eight trim levels. The new Legacy feels markedly more grown up than its predecessor. And, yes, it's much bigger too, with almost 4 inches more rear legroom and 9.5 more cubic feet in the trunk. A four-cylinder and V6 are available, but our hearts belonged to the 265-hp 2.5GT turbo. Externally differentiated by its hood scoop, the turbo is a blast to drive, offering smooth power with a torque peak that plateaus between 2000 and 5200 rpm. Apart from the painfully slow, manual-transmission-equipped base model, there isn't a Subaru Legacy we wouldn't enjoy driving at length—especially that lively 2.5GT. — B.W.

TOYOTA TUNDRA WORK TRUCK | DUCATI STREETFIGHTER S
SUBARU LEGACY | CADILLAC SRX VS. LEXUS RX 350
PORSCHE PANAMERA S | CHEVY EQUINOX | KIA FORTE
FORD FOCUS RS | first look: JAGUAR XJ

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Luxury Sweets

CAN CADILLAC'S ALL-NEW SRX OUT-GUN LEXUS'S RX 350—THE UPSCALE CROSSOVER LEADER?

BY LARRY WEBSTER

vs.

++



Comparison

2010 Lexus RX 350

\$52,965
3.5-liter V6, 6A
275
7.5 sec
15.5 sec
@ 90.1 mph
115.4 ft
21.5

TESTED PRICE
ENGINE/TRANS
HORSEPOWER
0-60 MPH
QUARTER-MILE

60-0 BRAKING
FUEL ECONOMY

2010 Cadillac SRX

\$49,000 (est.)
3.0-liter V6, 6A
265
8.7 sec
16.7 sec
@ 84.6 mph
118.8 ft
19.5

the SPECS

Not surprisingly, the specs of the Cadillac mirror those of the Lexus—the outside dimensions of these crossovers are within 3 inches of one another. Under the hood, the RX has more power, and only Lexus offers a hybrid model. Both have generously sized, leather-lined interiors. But when it comes to hauling, there are differences. The Lexus rear seats adjust fore and aft, a feature the SRX lacks. The Cadillac has two-tiered shelves in all the doors, adjustable thigh support for the driver's seat and a power tailgate with adjustable opening height that can prevent the gate from hitting garage ceilings—smart. The SRX's navigation system can discern the speed limit of the road you're traveling and display it on the gauge cluster. Lexus packs its own tech: The Remote Touch haptic device that controls the interior functions is incredible. It's natural to use and offers feedback in the joystick with noticeable resistance when the cursor moves over any of the buttons. Impressive.

the DRIVE

Bouncing over the pockmarked Detroit streets in the SRX, we noticed swiveling heads. We're fans too. The designers really spent time on the details; by comparison, the Lexus is a bit plain. But open the doors and the situation reverses. The Caddy's interior is too highly stylized and busy for our taste, while the Lexus interior is handsome, with materials two notches above those of the SRX. The Lexus offers a far softer ride—impacts are barely audible. The structure feels solid, and the resilient suspension makes road imperfections disappear. The SRX is noticeably stiffer. The payoff is sharper steering response and cornering: The Caddy eagerly takes to the curves. This is one buttoned-down crossover. The steering stays fluid, with a natural buildup of effort. But squeeze the throttle, and that Lexus will out-hustle the Caddy—every time.

BOTTOM LINE

As much as Cadillac may have had its crosshairs set on Lexus, it built a much different, much sportier car. If you hauled the family to a mountain retreat along some twisty roads, the SRX would be the best tool. But in the daily grind, the RX's greater refinement, power and comfort would make us choose the Lexus.

++ PM Test Driven

TOYOTA TUNDRA | WORK TRUCK | DUCATI STREETFIGHTER S
SUBARU LEGACY | CADILLAC SRX vs. LEXUS RX 350
PORSCHE PANAMERA S | CHEVY EQUINOX | KIA FORTE
FORD FOCUS RS | first look: JAGUAR XJ

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Danica Patrick
IndyCar® Series Driver
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www.peakauto.com

2010
Porsche Panamera2010
Chevrolet Equinox

1 This is the first Porsche to offer a stop/start system to save fuel. The engine turns off when the car comes to a stop and then automatically refires when you take your foot off the brake—just like a hybrid. It's a simple technology requiring only a modified starter, and it improves fuel economy by 10 percent on the urban European cycle.

Game Changer

The most eagerly anticipated Porsche is not an even hotter version of the 911, but the all-new four-door Panamera. So we were eager to climb behind the wheel. The S model receives a 400-hp 4.8-liter V8, but the twin turbo increases the action to 500 hp. Both come paired to a dual-clutch, seven-speed PDK transmission. The V8 lights with a powerful *whumph*. Naturally, we squeezed the throttle flat to the floor. Porsche says it hits 60 mph in 5 seconds—and we had no trouble maintaining 150 mph on our autobahn drive. The Panamera simply excels on home turf; it runs like it's locked to the tarmac. The structure is solid and the suspension compliant, dispatching surface irregularities with little cabin intrusion. Plenty of cars are good at this elevated velocity, but this one is in another league. The \$89,800 Panamera is an amazing machine. —L.W.

Clutch Player

Every new product GM launches in the next few months—or years, or decades—will be scrutinized. So it's crucial that the redesigned \$23,185 Equinox not only be solid, but that it provide a mainstream hit for GM. The basic unibody structure and suspension remain from the previous Equinox. Yet there are two new engines, a 182-hp 2.4-liter four-cylinder that returns 32 mpg highway, and a 264-hp 3.0-liter V6 that delivers 25 mpg highway—both hitched to six-speed automatics. The four-cylinder must work hard to move the 3770-pound Equinox. Fortunately, the six-speed automatic shifts with precision and extracts every bit of thrust available. The V6 offers extra muscle and a calmer driving experience. It's no rocket, but it reaches freeway speeds with less ruckus and makes sweeter noises doing it. Still, the Equinox is more appliance-like than invigorating. But the interior is greatly improved, and rear-seat legroom simply dwarfs the competition's. —J.P.H.

TOYOTA TUNDRA WORK TRUCK | DUCATI STREETFIGHTER S
SUBARU LEGACY | CADILLAC SRX vs. LEXUS RX 350
Porsche Panamera S | Chevy Equinox | KIA FORTE
FORD FOCUS RS | first look: JAGUAR XJ

B I P O L A R D I S O R D E R ?

GETTING HELP MANAGING MY SYMPTOMS WAS A WAY TO MOVE FORWARD.

Maybe ABILIFY can help you.

ABILIFY (aripiprazole) is clinically proven to help control the symptoms of manic and mixed episodes of Bipolar I Disorder in adults and in pediatric patients 10 to 17 years of age. It is one of many treatment options.

Hundreds of thousands of adult patients have been prescribed ABILIFY. Ask your healthcare professional if once-a-day ABILIFY is right for you.



FOR THE ROAD AHEAD

www.abilifyinfo.com

IMPORTANT SAFETY INFORMATION:

Elderly patients with dementia-related psychosis (for example, an inability to perform daily activities due to increased memory loss) taking ABILIFY have an increased risk of death or stroke. ABILIFY is not approved for treating these patients.

Some medicines can increase suicidal thoughts and behaviors in children, teens, and young adults. Serious mental illnesses are themselves associated with an increase in the risk of suicide. When taking ABILIFY call your doctor right away if you have new or worsening mood symptoms, unusual changes in behavior, or thoughts of suicide. Patients and their caregivers should be especially observant within the first few months of treatment or after a change in dose.

- Alert your doctor if you develop very high fever, rigid muscles, shaking, confusion, sweating, or increased heart rate and blood pressure, as these may be signs of a rare but potentially fatal condition called neuroleptic malignant syndrome (NMS)
- If you develop abnormal or uncontrollable facial movements, notify your doctor, as these may be signs of tardive dyskinesia (TD), which could become permanent
- If you have diabetes or have risk factors or symptoms of diabetes, your blood sugar should be monitored. High blood sugar has been reported with ABILIFY and medicines like it. In some cases, extreme high blood sugar can lead to coma or death
- Other risks may include lightheadedness upon standing, decreases in white blood cells (which can be serious), seizures, trouble swallowing, or impairment in judgment or motor skills. Until you know how ABILIFY affects you, you should not drive or operate machinery

Most common side effects ($\geq 10\%$) from all clinical trials involving adults or pediatric patients include:

- **ADULTS:** Nausea, vomiting, constipation, headache, dizziness, an inner sense of restlessness or need to move (akathisia), anxiety, insomnia, and restlessness
- **PEDIATRIC PATIENTS (10 to 17 years):** Extrapyramidal disorder (for example, uncontrolled movement disorders or muscle disturbances such as restlessness, tremors and muscle stiffness), headache, sleepiness, and nausea

Tell your doctor about all the medicines you're taking, since there are some risks for drug interactions. You should avoid alcohol while taking ABILIFY.

You are encouraged to report negative side effects of prescription drugs to the FDA. Visit www.fda.gov/medwatch, or call 1-800-FDA-1088.

Please read the Important Product Information about ABILIFY on the adjacent page.

If you or someone you know needs help paying for medicine, call 1-888-4PPA-NOW (1-888-477-2669). Or go to www.pparx.org



Partnership for
Prescription Assistance



IMPORTANT INFORMATION ABOUT ABILIFY

This summary of the Package Insert contains risk and safety information for patients about ABILIFY. This summary does not include all information about ABILIFY and is not meant to take the place of discussions with your healthcare professional about your treatment. Please read this important information carefully before you start taking ABILIFY and discuss any questions about ABILIFY with your healthcare professional.

Name

ABILIFY® (a-BIL-i-ty) (aripiprazole) (air-ri-PIP-ra-zoll)

What is ABILIFY (aripiprazole)?

ABILIFY is a prescription medicine used alone or with lithium or divalproex to treat manic or mixed episodes of Bipolar I Disorder in adults or pediatric patients (10 to 17 years).

What is Bipolar I Disorder?

Bipolar I Disorder is an illness with symptoms thought to be caused by an imbalance of brain chemicals. People who have Bipolar I Disorder tend to experience extreme mood swings, along with other specific symptoms and behaviors. These mood swings, or "episodes," can take three forms: manic, depressive, or mixed episodes. Common symptoms of a manic episode are: feeling extremely happy, being very irritable and anxious, talking too fast and too much, and having more energy and needing less sleep than usual. Common symptoms of a depressive episode include: feelings of overwhelming sadness or emptiness, low energy, a loss of interest in things, trouble concentrating, changes in sleep or appetite, and thoughts of dying or suicide. A mixed episode includes symptoms that are both manic and depressive.

Who should NOT take ABILIFY?

People who are allergic to ABILIFY or to any substance that is in it. Allergic reactions have ranged from rash, hives and itching to difficulty breathing and swelling of the face, lips, or tongue. Please talk with your healthcare professional.

What is the most important information that I should know about ABILIFY?

Elderly patients, diagnosed with psychosis as a result of dementia (for example, an inability to perform daily activities as a result of increased memory loss), and who are treated with antipsychotic medicines including ABILIFY, are at an increased risk of death when compared to patients who are treated with a placebo (sugar pill). ABILIFY is not approved for the treatment of patients with dementia-related psychosis.

Some medicines can increase suicidal thoughts and behaviors in children, teens, and young adults. Serious mental illnesses are themselves associated with an increase in the risk of suicide. When taking ABILIFY call your doctor right away if you have new or worsening mood symptoms, unusual changes in behavior, or thoughts of suicide. Patients and their caregivers should be especially observant within the first few months of treatment or after a change in dose.

Serious side effects can occur with any antipsychotic medicine, including ABILIFY. Tell your healthcare professional right away if you have any conditions or side effects, including the following:

Stroke or ministroke in elderly patients with dementia: An increased risk of stroke and ministroke has been reported in clinical studies of elderly patients with dementia (for example, increased memory loss and inability to perform daily activities). ABILIFY is not approved for treating patients with dementia.

Neuroleptic malignant syndrome (NMS): Very high fever, rigid muscles, shaking, confusion, sweating, or increased heart rate and blood pressure may be signs of NMS, a rare but serious side effect that could be fatal.

Tardive dyskinesia (TD): Abnormal or uncontrollable movements of face, tongue, or other parts of body may be signs of a serious condition known as TD, which may be permanent.

High blood sugar and diabetes: Patients with diabetes and those having risk factors for diabetes (for example, obesity, family history of diabetes), as well as those with symptoms such as unexpected increases in thirst, urination, or hunger should have their blood sugar levels checked before and during treatment. Increases in blood sugar levels (hyperglycemia), in some cases serious and associated with coma or death, have been reported in patients taking ABILIFY, and medicines like it.

Orthostatic hypotension: Lightheadedness or faintness caused by a sudden change in heart rate and blood pressure when rising too quickly from a sitting or lying position (orthostatic hypotension) has been reported with ABILIFY.

Leukopenia, Neutropenia, and Agranulocytosis: Decreases in white blood cells (infection fighting cells) have been reported in some patients taking antipsychotic agents, including ABILIFY. Patients with a history of a significant decrease in white blood cell (WBC) count or who have experienced a low WBC due to drug therapy should have their blood tested and monitored during the first few months of therapy.

Suicidal thoughts: If you have suicidal thoughts, you should tell your healthcare professional right away.

Dysphagia: Medicines like ABILIFY have been associated with swallowing problems (dysphagia). If you had or have swallowing problems, you should tell your healthcare professional.

What should I talk to my healthcare provider about?

Patients and their families or caregivers should watch for new or worsening mood symptoms, unusual changes in behavior and thoughts of suicide, as well as for anxiety, agitation, panic attacks, difficulty sleeping, irritability, hostility, aggressiveness, impulsivity, restlessness, or extreme hyperactivity. Call your healthcare provider right away if you have thoughts of suicide or if any of these symptoms are severe or occur suddenly. Be especially observant within the first few months of antidepressant treatment or whenever there is a change in dose.

Be sure to tell your healthcare provider:

- About any medical conditions you may have
- Whether you're taking any other prescription or over-the-counter medicines, vitamins, or herbal products
- Whether you're pregnant, plan to become pregnant, or are breast-feeding
- If you have or have had a low white blood cell count (WBC)
- If you or anyone in your family has had seizures
- If you or anyone in your family has had high blood sugar or diabetes

What should I avoid when taking ABILIFY (aripiprazole)?

- Avoid overheating and dehydration
- Avoid driving or operating hazardous machinery until you know how ABILIFY affects you
- Avoid drinking alcohol
- Avoid breast-feeding an infant

What are the possible side effects of ABILIFY?

Common side effects in adults include: nausea, vomiting, constipation, headache, dizziness, an inner sense of restlessness or need to move (akathisia), anxiety and insomnia. Common side effects in pediatric patients (10 to 17 years) include: extrapyramidal disorder (for example, uncontrolled movement disorders or muscle disturbances such as restlessness, tremors and muscle stiffness), headache, sleepiness, and nausea.

It is important to contact your healthcare professional if you experience prolonged, abnormal muscle spasm or contraction which may be signs of a condition called dystonia.

This is not a complete list of side effects. For full patient information, visit www.abilify.com. Talk to your healthcare professional if you have questions or develop any side effects.

What percentage of people stopped taking ABILIFY (aripiprazole) due to side effects?

In clinical trials, the percentage of adults who discontinued taking ABILIFY due to side effects was 11% and 9% for patients treated with sugar pill.

In clinical trials, the percentage of pediatric patients (10 to 17 years) who discontinued taking ABILIFY due to side effects was 7% and 2% for patients treated with sugar pill.

Can I safely take ABILIFY while I'm taking other medications?

ABILIFY can be taken with most drugs; however, taking ABILIFY with some medicines may require your healthcare professional to adjust the dosage of ABILIFY.

Some medicines* include:

- ketoconazole (NIZORAL®)
- quinidine (QUINIDEX®)
- fluoxetine (PROZAC®)
- paroxetine (PAXIL®)
- carbamazepine (TEGRETOL®)

It is important to tell your healthcare professional about all the medicines you're taking, just to be sure.

How should I take ABILIFY?

- Take ABILIFY exactly as directed by your healthcare professional
- ABILIFY is usually taken once a day and can be taken with or without food
- If you miss a dose, take it as soon as you remember. However, if it is time for your next dose, skip the missed dose and take only your regularly scheduled dose
- Talk to your healthcare professional before stopping ABILIFY or changing your dose

General advice about ABILIFY:

- ABILIFY should be kept out of the reach of children and pets
- Store ABILIFY Tablets and the Oral Solution at room temperature
- For patients who must limit their sugar intake, be aware that ABILIFY Oral Solution contains sugar
- For patients who cannot metabolize phenylalanine (those with phenylketonuria or PKU), ABILIFY DISCMELT® contains phenylalanine
- If you have additional questions, talk to your healthcare professional

Find out more about ABILIFY:

Additional information can be found at www.abilify.com/bipolardisorder

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Based on Full Prescribing Information as of 07/09 1239550A5.

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News Flash....**Government Gets Something Right****Super Light Titanium Timepiece Loses Only One Second Every 20 Million Years.**

BOULDER, Colorado The U.S. government has engineered the most ingenious, most accurate clock in the world: the F-1 U.S. Atomic Clock in Boulder, Colorado. Our extraordinary new Stauer Titanium Atomic Watch utilizes the transmissions directly from that remarkable cesium fission atomic clock to report the most precise time. This scientifically advanced timepiece will gain or lose only one second over a 20 million-year period. It is that accurate! This perfectly tuned technological invention with the super light strength of titanium is now available for UNDER \$200.

Super Light Titanium has two big advantages over steel. One is corrosion resistance and the other is that titanium has the highest strength-to-weight ratio of any metal, which means that titanium is approximately 45% lighter than steel. But every other titanium watch that we can find is

priced at over \$400, and none of those are nearly as accurate as our atomic movement. Stauer has decided to bring these resources together in a timepiece that has the most accurate movement available today. You'll never have to set this watch. Just push one of the buttons and you are synchronized with the atomic clock in Colorado, and the hands of the watch move to the exact time position. The sleek black textured dial has luminous hands and markers plus the timepiece is water resistant to 3 ATM.

A Titanium-clad offer. This Titanium Atomic Watch exceeds the accuracy of any Swiss luxury automatic so you can be more punctual and keep most of your money in your wallet, not on your wrist. Look at your watch and we guarantee that the time is incorrect, unless you are wearing the advanced atomic technology.

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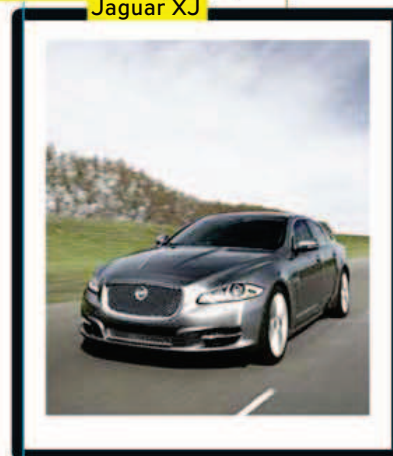
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First Look 2010 Jaguar XJ



Rising Star

Watch out, Honda. Kia is an emerging threat, and the \$14,390 Forte is proof. This compact replaces the Spectra, packs a striking visual presence and has plenty of standard safety features. Two four-cylinder engines are offered, a 156-hp 2.0-liter and a 173-hp 2.4-liter. An efficiency model with that smaller engine will return an estimated 33 mpg highway. The Forte has a real sense of solidity afforded by the structure, and the artful rendering of the interior could be the best ever for a Kia. Power from the 2.4-liter engine is adequate, and we were impressed by the Sportshift manual-override system on the smooth-shifting automatic. The 2.0-liter does need vigorous spurring to keep the pace up, but it's sweet-sounding in normal operation. However, we were not thrilled with the abrupt clutch engagement—manual transmissions are not this Kia's forte. —BARRY WINFIELD

Forbidden Fruit

Ford will bring some of its most successful European designs to the U.S., starting with the 2010 Fiesta. For now, Ford's hottest car this side of the Mustang, the Focus RS, will remain an American fantasy. The RS has a lusty 2.5-liter 300-hp five-cylinder turbo with 325 lb-ft of torque paired to a six-speed. Toggle the key; the engine spins and settles into a nervous, slightly uneven idle. The gear lever slots quickly and cleanly. Even at low speeds, the engine has sufficient torque to pull from low revs. Speed up and ... pow! The kick in the back starts at just above 2000 rpm and hits hard all the way to 7000. The hard-edged growl mixes with wastegate chatter off throttle and a distant "pop" as unburnt fuel ignites in the exhaust. The steering is uncannily accurate. It tells you of impending front-wheel slides before they happen, road-surface changes the second you've crossed them and which side of a coin the tires have just run over. This car is worth a trip to Europe. —ANDREW ENGLISH

first look

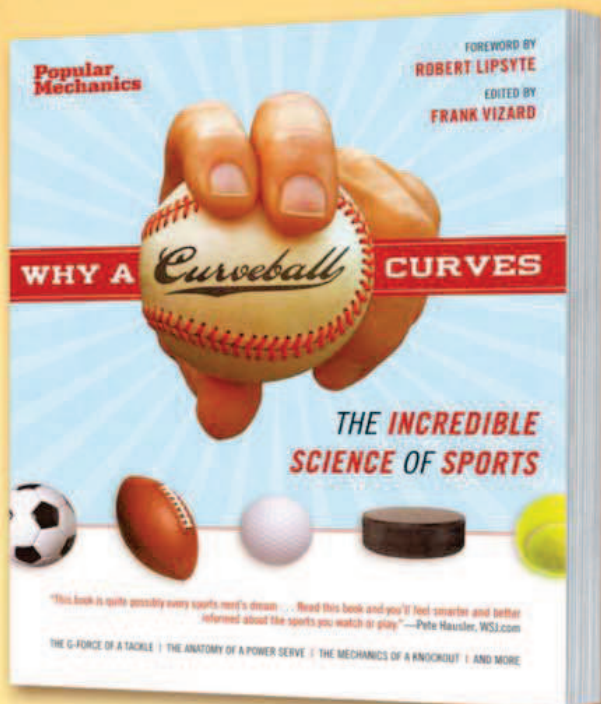
Future Tense

Jaguar's sleek flagship XJ sedan is infused with class-leading technology like the cool 12.3-inch LCD instrument panel. The nav system continues with current touchscreen tech, though the company expects eventually to migrate to an iPhone-like system. Speaking of gestures, you activate the glove compartment and front-seat reading lights with just a wave of the hand. The XJ is powered by a 5.0-liter V8 or two optional supercharged versions, one rated up to 510 hp. We can't wait for a drive. —DAN CARNEY

TOYOTA TUNDRA | WORK TRUCK | DUCATI STREETFIGHTER S
SUBARU LEGACY | CADILLAC SRX vs. LEXUS RX 350
Porsche Panamera S | Chevy Equinox | KIA FORTE
FORD FOCUS RS | first look: JAGUAR XJ



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A GALAXIE FAR, FAR AWAY

> BY JAY LENO
> PHOTOGRAPHS BY JOHN LAMM



M

Most of us have a special affinity for the cars our parents owned when we were growing up. I was brought home from the hospital in a '49 Plymouth sedan. At age 7, I was with my dad when we went to Crabtree Motors in New Rochelle, N.Y., and bought a black and white Plymouth Belvedere—the one with the big fins.

In 1966 we walked into the dealership to buy another car—a Ford Galaxie. By this time, I was 16 and could drive. Usually my dad would just buy whatever they had on the showroom floor.

But there were no full-size Galaxies. There were only Fairlanes and Falcons. “I don’t want a little car,” my father said. “I want a full-size car.” So the salesman asked if we wanted to order a car. And I piped up, “Can I pick the engine? I want to pick the engine.” So my mother said,

JAY IS RESTORING A 1966 FORD GALAXIE 7 LITRE—JUST LIKE THE CAR HIS DAD ONCE OWNED.

“Oh, let the boy pick the engine. What difference does it make?”

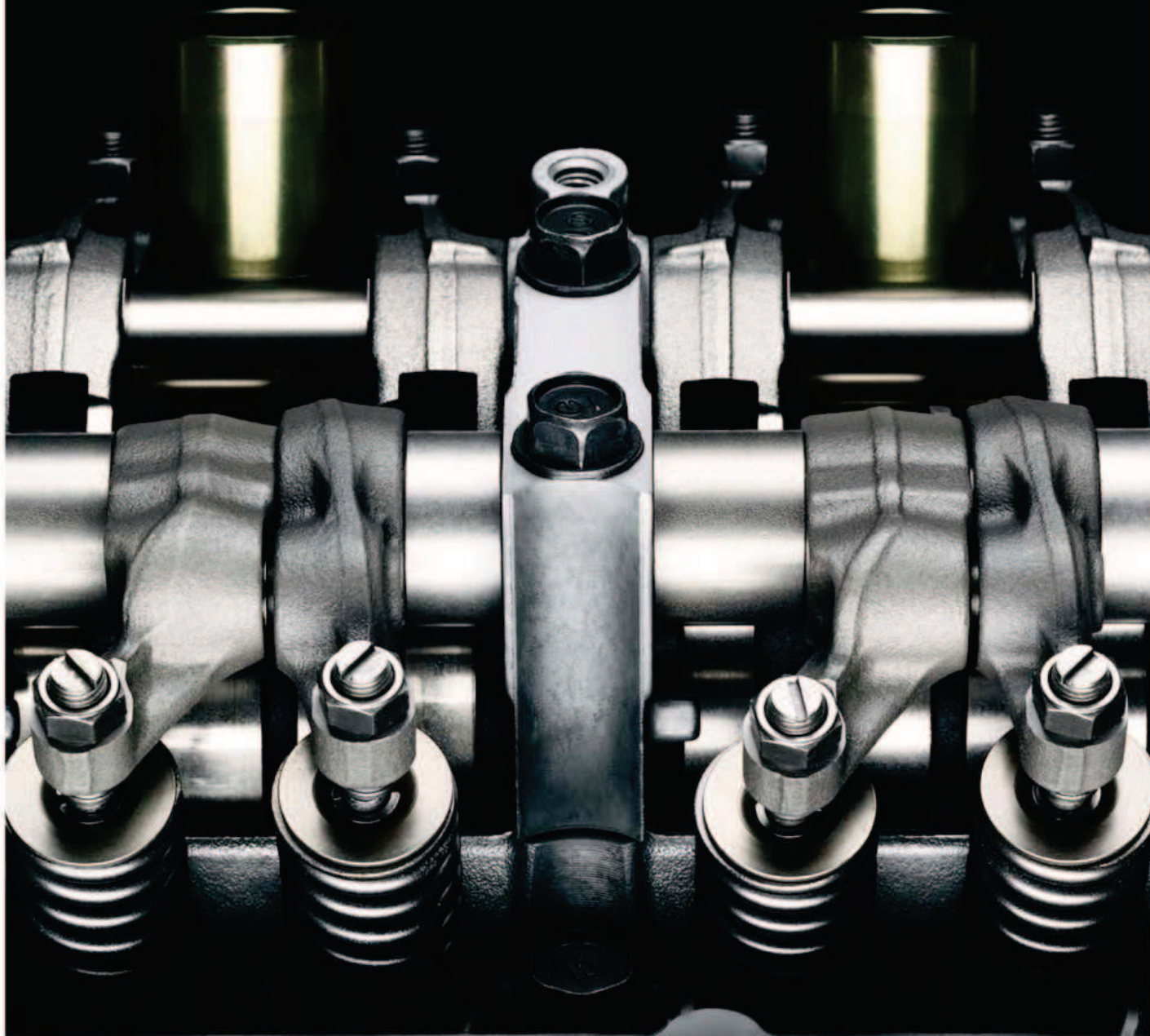
So my dad agreed.

I even remember the salesman’s name. It was Tom Lawrence. I pulled him aside and said, “Tom, here’s what we need: We want the full-size Galaxie with the 7 Litre package.” In 1966, for just one year, the 7 Litre was a separate model. It was the top-of-the-line Galaxie, and it came standard with a 428-cubic-inch V8.

I couldn’t convince my dad to get the four-speed manual, so we ordered our

1

What if the last 75,000 miles never happened to your engine?



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**JAY LENO'S GARAGE///
CLASSIC CARS**

7 Litre with the heavy-duty Cruise-o-Matic. I remember saying to the salesman, "Can we get the muffler delete, and just go with the straight glasspacks?"

“Are you sure you want that?”

"Yup," I told him. "That's what we want."

Four weeks went by, and my whole family headed down to pick up the Galaxie. It was maroon, and, of course, it wore those 7 Litre hubcaps that looked like imitation custom wheels. They were wrapped with those skinny little whitewalls too. It was a two-door pillarless coupe with a black interior—a beautiful car.



Jay bought this 1966 Ford Galaxie 7 Litre in Canada a year ago; it's the same model his dad once owned. It's now under restoration at Jay's garage and will be sprayed the very same Vintage Burgundy as his father's 7 Litre.

I'll never forget what happened next. My father got in the car—we were back in the service area—and he turned the key. The car let out a thunderous *rrrraaaaggggg-rrrrrraaaahhhh*. And my father said, "There's a hole in the muffler. It's a brand-new car, and there's a hole in the muffler!" The salesman explained, "No, Mr. Leno. That's the way it sounds."

“Whaddya mean that’s the way it sounds?” my dad said. “What new car sounds like that?” The salesman made it clear that we had checked muffler delete on the order, which specified glasspacks. My father looked at the order sheet, then looked at me. “What did you make me buy here?”

Frustrated, he said, “Oh fachsrisakes, let’s get out of here.” He put it in drive and just nailed it. The car went eeeeeerrrrrrrrrrreeeeeerrrkkk! spinning the tires on the cement floor. My father said, “I bought a rocket ship; you made me buy a rocket ship!” He was yelling about “the stupid car” all the way home.

A couple of months went by, and I was in my parents' bedroom looking for something. I opened my father's top dresser drawer, and I saw a ticket.



He got a ticket for going 110 mph. So I knew he really enjoyed the car.

Unfortunately, like most cars of that time, it was brand new in '66, but it didn't look that way for long. By '68, rust bubbles were appearing on the top of the fenders. By 1973, the car was pretty much rusted out. But that didn't matter too much because I wrapped the Galaxie around a tree and broke it in half.

I always loved that 7 Litre. And I wanted to relive the experience. Last year, I finally found a 7 Litre in Canada, a four-speed car—the one I always wanted my dad to get. I contacted the guy, bought it and brought it home. Just going for a cruise down the highway, it makes me smile, remembering those days. And it still seems pretty quick.

We've stripped down the car and started the restoration process. As we began to take the car apart, we ripped up the carpet where the four-speed was, and there was a big hacked-out hole around the transmission. I thought maybe it wasn't a four-speed car after all. I checked the data plate and called my friend Vince Panicola, at the Galaxie 7 Litre website 7litre.org, who confirmed it was a real four-speed. In those days, most people

bought the automatics, so the cars came with the C6 floor pan. If a car was marked "four-speed," the line workers took a Sawzall or a torch and just cut a bigger hole so they could stick in the manual transmission. That just shows you the way they did things back in the day.

Speaking of which, after our family had bought that 7 Litre Galaxie, I started working at my local Ford dealership as the lot boy. Every day I'd go out with a rubber hammer and put on 50 or 60 sets of hubcaps. And every night I'd have to take them off, because kids would steal them. One day, I was carrying a big pile of hubcaps. As I came around the corner, I bumped into my boss and dropped all the hubcaps. He yelled and fired me on the spot. I was so upset I didn't even tell my parents. I pretended to go to work every day for two weeks. Then I wrote a letter to Henry Ford II. I told him about the Fords our family owned and mentioned that this was my first job. After 10 days, my boss, Ben Ristuccia, called me and said, "I don't know who you know in Detroit, but you can have your old job back." So you can see, I have a lot of history with Ford.

A man in a plaid shirt is leaning over the open hood of a car, working on the engine. He is looking directly at the camera with a serious expression. On the engine, there is a yellow Purolator PureONE oil filter box and a yellow Purolator PureONE oil can. The background shows a workshop with a red tool chest.

I NEVER LIKED THE IDEA OF OTHER MEN TOUCHING HER.

Here's a call-out to the purists. Guys who choose Purolator PureONE oil and air filters because they know what you get out of something is directly related to what you put into it. PureONE is the most efficient oil filter on the market—99.9% efficient—to trap microscopic contaminants that can harm your engine. It's also 100% covered in textured grip for easy installation. We invented the oil filter. And we continue to perfect it. Save up to \$6 by logging on to www.purolatorautofilters.net/Pages/PromoA.aspx

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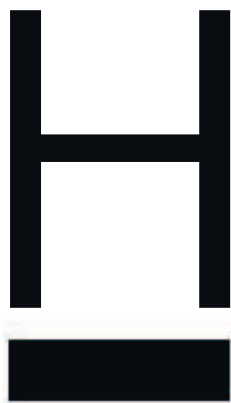
Resilience engineering as an academic idea was born in response to the 2003 space shuttle *Columbia* disaster. The spacecraft disintegrated on re-entry because thermal panels had been damaged by a piece of foam that broke off during the launch. But investigators identified a larger issue: NASA had responded to budget cuts in the 1990s by adopting a “faster, better, cheaper” approach, launching more missions with fewer resources. Safety margins gradually narrowed, information sharing withered and overconfidence ballooned without anyone really noticing. The organization had become brittle and prone to disaster.

When a system looks solid year after year, it’s easy to become complacent, like the generals behind France’s old Maginot Line—which, after all, was pretty good at keeping the Germans out, though useless once they found another way in. It’s just a short step from complacency to pure arrogance: Why worry about lifeboats when the *Titanic* is unsinkable? Resilience is about having enough lifeboats anyway.

NASA’s not the only institution where financial pressures can lead to brittle operations. When you squeeze the slack out to cut costs, you’re left with systems that have no real margin for error. Modern, “just-in-time” manufacturing methods allow factories to save money by eliminating stockpiles of parts and materials—

READY FOR ANYTHING

> BY GLENN HARLAN REYNOLDS
> ILLUSTRATION BY PAUL BLOW



Here’s a simple truth: It’s better to bend than to break, and it’s best to be prepared for the worst. This age-old wisdom is going by a new name in slide-rule circles: “Resilience engineering” starts with the insight that it’s smart to design and maintain systems so they have some give. That means building technologies that offer extra capacity to handle sudden loads, plenty of warning when normal operations are beginning to break down, backup systems in case things do go wrong, diverse digital architectures so that a single bug doesn’t produce widespread failure, and decentralization so that when (not “if”) communication breaks down things don’t grind to a halt.



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✓Yes



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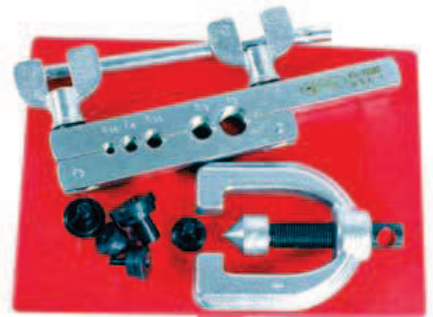
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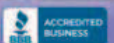
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THINKING AHEAD/// DISASTER RESPONSE

but if transportation is interrupted, those superefficient assembly lines shut down in a hurry. This doesn't mean that just-in-time delivery should go away, but the people in charge had better have a backup plan: early-warning systems and a plan to temporarily switch manufacturing sites, perhaps, or a short-term supply of parts always kept in reserve in case of emergencies.

Often, technologies become so tightly coupled that when one piece goes down, it produces a cascade of failures. In his 1988 book, *The Collapse of Complex Societies*, anthropologist Joseph Tainter suggested that it was increasing complexity that really toppled the Mayan and Roman empires. The northeastern blackout

OFTEN, OFFICIALS WORRY ABOUT THE PUBLIC PANICKING IN A DISASTER. BUT THAT'S BACKWARDS. IN FACT, PEOPLE CONSISTENTLY JUMP IN TO HELP.

of 2003 didn't bring about the end of our civilization—but it was serious. The problem started when a single power line brushed against some overgrown trees, then quickly spread to affect 50 million people. One proposal for adding resilience to the electrical grid is called “distributed energy,” with homes, businesses and municipalities producing at least a portion of their own electricity.

Resilience engineering is a specialized field, but it simply takes some common sense to apply its principles to the ordinary world. For instance, when the power goes out, traffic signals go down. This causes accidents and traffic jams—often exacerbated by people who decide to leave work or home in favor of finding someplace where there might

be lights and a/c. During the 2003 blackout, New York City streets were gridlocked by traffic-signal failure, causing some to abandon their cars and walk, which, of course, made the congestion even worse.

Happily, there's a simple solution to that one: Battery backups for traffic signals. The batteries may only last a few hours, but that's a huge improvement. Most blackouts are over by then, and even if the backup power does run out, there's enough time for traffic to disperse and police officers to arrive. The system fails gracefully rather than catastrophically. California's Sacramento County, New York City and many smaller communities have started installing battery backups. And when New York experienced outages in 2006, many traffic lights continued working.

Backup power for cellphone systems can be equally important, but here things aren't going as well. After studying the aftermath of Hurricane Katrina, the Federal Communications Commission ordered mobile providers to install backup power for all cell towers, but the industry resisted and the requirement was dropped. This means that cellphones, which many rely on in emergencies, aren't as reliable in a crisis as they should be.

The Public Option

When it comes to large-scale emergencies, the country has a hidden weapon—and we can do more with this resource. I'm talking about a populace filled with self-reliant, community-minded individuals. During a major crisis, on the order of Katrina or a serious California earthquake, relief services can be overwhelmed. When individuals are prepared to look after themselves for a while, with food, water and medicine on hand, and alternative sources of heat or power, it makes a big difference. The government can't take care of everybody at once. If disaster-relief

staffs don't have to worry about you, they can take care of others—which means that being self-reliant can actually help your community.

Often, government officials worry about the public panicking in a widespread disaster. But they have that backwards. In studies of more than 500 emergencies, the University of Delaware's Disaster Research Center found that panic rarely occurred. In fact, people consistently jump in to help themselves and their neighbors. Research by scholars like Kathleen Tierney, who directs the Natural Hazards Center at the University of Colorado at Boulder, shows that the true first responders are often the people on the scene when a disaster strikes. They save lives by administering first aid, getting people out of hazardous areas and spreading warnings. Volunteers improvised the water-based evacuation of lower Manhattan on Sept. 11, called an American Dunkirk by some, that moved masses of people out of the danger zone.

A self-reliant attitude is good, but skills help mightily, too. Citizen training is available through the Red Cross, Community Emergency Response Teams and Neighborhood Emergency Response Teams. One underappreciated resource is the amateur radio community. Acquire a ham radio license (American Radio Relay League site, arrl.org) and you can become a major resource if a disaster strikes. It's fun, too.

In the meantime, architects, engineers, regulators and government officials should take heed, and think about creating systems that don't leave us hanging when things go wrong. Because, inevitably, they will. **PM**

*PM contributing editor
Glenn Harlan Reynolds discusses
civilian first responders in his book
An Army of Davids.*



ON THE WEB > To see how Americans coped with the worst disasters of the past 100 years, visit popularmechanics.com/10disasters.

"I never thought
it could happen
to me.
A heart attack at 53."

~Steve A.
New York, NY
Heart attack: 1/9/2008



"I had been feeling fine. But turns out my cholesterol and other risk factors* increased my chance of a heart attack. Now I trust my heart to Lipitor.
Talk to your doctor about your risk and about Lipitor."

- Adding Lipitor may help, when diet and exercise are not enough. Unlike some other cholesterol-lowering medications, Lipitor is FDA-approved to reduce the risk of heart attack and stroke in patients with several common risk factors, including family history, high blood pressure, low good cholesterol, age and smoking.
- Lipitor has been extensively studied with over 16 years of research. And Lipitor is backed by 400 ongoing or completed clinical studies.

*Patient's risk factors include age, gender, smoking, and high blood pressure.

IMPORTANT INFORMATION: LIPITOR is a prescription drug. It is used in patients with multiple risk factors for heart disease such as family history, high blood pressure, age, low HDL ('good' cholesterol) or smoking to reduce the risk of heart attack, stroke and certain kinds of heart surgeries. When diet and exercise alone are not enough, LIPITOR is used along with a low-fat diet and exercise to lower cholesterol.

LIPITOR is not for everyone. It is not for those with liver problems. And it is not for women who are nursing, pregnant or may become pregnant. If you take LIPITOR, tell your doctor if you feel any new muscle pain or weakness. This could be a sign of rare but serious muscle side effects. Tell your doctor about all medications you

take. This may help avoid serious drug interactions. Your doctor should do blood tests to check your liver function before and during treatment and may adjust your dose. The most common side effects are gas, constipation, stomach pain and heartburn. They tend to be mild and often go away.

LIPITOR is one of many cholesterol-lowering treatment options that you and your doctor can consider.

Please see additional important information on next page.



LIPITOR
atorvastatin calcium
tablets



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Call 1-888-LIPITOR (1-888-547-4867) or visit www.lipitor.com/steve

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Visit www.fda.gov/medwatch or call 1-800-FDA-1088.

IMPORTANT FACTS



LIPITOR
atorvastatin calcium
tablets

(LIP-ih-tore)

LOWERING YOUR HIGH CHOLESTEROL

High cholesterol is more than just a number, it's a risk factor that should not be ignored. If your doctor said you have high cholesterol, you may be at an increased risk for heart attack. But the good news is, you can take steps to lower your cholesterol.

With the help of your doctor and a cholesterol-lowering medicine like LIPITOR, along with diet and exercise, you could be on your way to lowering your cholesterol.

Ready to start eating right and exercising more? Talk to your doctor and visit the American Heart Association at www.americanheart.org.

WHO IS LIPITOR FOR?

Who can take LIPITOR:

- People who cannot lower their cholesterol enough with diet and exercise
- Adults and children over 10

Who should NOT take LIPITOR:

- Women who are pregnant, may be pregnant, or may become pregnant. LIPITOR may harm your unborn baby. If you become pregnant, stop LIPITOR and call your doctor right away.
- Women who are breast-feeding. LIPITOR can pass into your breast milk and may harm your baby.
- People with liver problems
- People allergic to anything in LIPITOR

BEFORE YOU START LIPITOR

Tell your doctor:

- About all medications you take, including prescriptions, over-the-counter medications, vitamins, and herbal supplements
- If you have muscle aches or weakness
- If you drink more than 2 alcoholic drinks a day
- If you have diabetes or kidney problems
- If you have a thyroid problem

ABOUT LIPITOR

LIPITOR is a prescription medicine. Along with diet and exercise, it lowers "bad" cholesterol in your blood. It can also raise "good" cholesterol (HDL-C).

LIPITOR can lower the risk of heart attack or stroke in patients who have risk factors for heart disease such as:

- age, smoking, high blood pressure, low HDL-C, heart disease in the family, *or*
- diabetes with risk factor such as eye problems, kidney problems, smoking, or high blood pressure

POSSIBLE SIDE EFFECTS OF LIPITOR

Serious side effects in a small number of people:

- **Muscle problems** that can lead to kidney problems, including kidney failure. Your chance for muscle problems is higher if you take certain other medicines with LIPITOR.
- **Liver problems.** Your doctor may do blood tests to check your liver before you start LIPITOR and while you are taking it.

Symptoms of muscle or liver problems include:

- Unexplained muscle weakness or pain, especially if you have a fever or feel very tired
 - Nausea, vomiting, or stomach pain
 - Brown or dark-colored urine
 - Feeling more tired than usual
 - Your skin and the whites of your eyes turn yellow
- If you have these symptoms, call your doctor right away.

The most common side effects of LIPITOR are:

- Headache
- Constipation
- Diarrhea, gas
- Upset stomach and stomach pain
- Rash
- Muscle and joint pain

Side effects are usually mild and may go away by themselves. Fewer than 3 people out of 100 stopped taking LIPITOR because of side effects.

HOW TO TAKE LIPITOR

Do:

- Take LIPITOR as prescribed by your doctor.
- Try to eat heart-healthy foods while you take LIPITOR.
- Take LIPITOR at any time of day, with or without food.
- If you miss a dose, take it as soon as you remember. But if it has been more than 12 hours since your missed dose, wait. Take the next dose at your regular time.

Don't:

- Do not change or stop your dose before talking to your doctor.
- Do not start new medicines before talking to your doctor.
- Do not give your LIPITOR to other people. It may harm them even if your problems are the same.
- Do not break the tablet.

NEED MORE INFORMATION?

- Ask your doctor or health care provider.
- Talk to your pharmacist.
- Go to www.lipitor.com or call 1-888-LIPITOR.

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By James B. Meigs

Photograph by Tina Tyrell

Turn on a light, drive a car, visit a store, and you are instantly connected to thousands of people you've never met: coal miners, autoworkers, engineers, farmers, truck drivers—all the people who extract, invent, build, grow and deliver the myriad products we use each day.

That interdependence is one of the hallmarks of the modern world—no single person could make a pencil from scratch today, much less manufacture a microchip—but it also makes us nervous. What happens when the power goes out? What if the global supply chain that brings us raspberries in January breaks down? Disasters such as Hurricane Katrina remind us that the networks supplying power, food, water and communications are all fragile. And we can't always

PM EDITOR'S NOTE

The Self-Reliance Issue

Americans are rediscovering the virtues of independence. Surviving, and thriving, in an uncertain world means having the right tools—and the confidence to use them.

1

rely on the government to save us when those systems go down. We are, to some extent, on our own. Then there are the slow-motion disasters: global epidemics, energy shortages, environmental degradation.

Whether they're concerned with short-term threats or long-term challenges, more Americans are deciding to get their own homes in order. Having a good stock of food, water and survival basics is a start. But many of us are going further, installing wind and solar power, planting modern versions of the victory garden and lovingly restoring (rather than discarding) broken appliances around our homes. We are discovering that, in an age of plenty, it can be satisfying to do things for ourselves—and that many of the same steps needed to make a lifestyle more disaster-resistant also make it more sustainable.

The notion of self-reliance is hardly new. Henry David Thoreau advocated it; America's western pioneers exem-

plified it; and institutions like the Boy Scouts inculcated it into generations of young people. In this special issue, PM explores how the concept is gaining new currency today. We visit some of the modern pioneers who are finding new frontiers of independence—people living off the grid, building the next generation of solar homes and challenging our throwaway culture. And in our Home, Auto and Tech columns this month we offer some advice on how to embrace the off-the-grid approach in your own life, from making your own biodiesel to rigging an emergency cell-phone charger. Of course, being self-reliant doesn't mean giving up the tools and technologies of the modern world. Even the most hardcore DIYer wouldn't be able to replicate a simple tool like the wrench pictured above (which my father purchased in the late 1930s and used to help maintain the Panama Canal). But it does mean using those tools to build a smarter, safer, more sustainable life.



THE SELF-RELIANCE ISSUE

The New Homesteaders

More people are choosing to cut their dependence on the power grid, the grocery store and the fuel pump. But are seeds and solar panels enough to lead us into a new, sustainable future?

By James Vlahos
Photographs by Rob Howard

Similar birthing scenes have unfolded countless times in America's agrarian past, but none, I suspected, had the soundtrack of the Ghost Town neighborhood in Oakland, Calif. As Bébé's cries reached an apex they were matched by the caterwauling of a police car siren on Martin Luther King Jr. Way. Then came the intestine-undulating bass of hip-hop from a passing car. Residents disagree on how Ghost Town got its name—for the isolation created when freeways cleft the neighborhood from the rest of the city in the 1950s? For the appallingly high murder rate? For the casket companies that used to be located here? More unanimously accepted is that Ghost Town is a singularly odd location for a homestead that hosts pigs, goats, geese, peaches, potatoes, spinach and bees. Carpenter is living a version of the Laura Ingalls Wilder fantasy all right, but hers is Little House in the 'Hood.

New Farmer's Almanac

*In a 4500-square-foot lot in Oakland, Calif., Novella Carpenter grows broccoli and lettuce right next to fig trees and passion fruit vines. Included in her annual crop: **1095 eggs, 200 pounds of tomatoes, 16 quarts of honey, 40 rabbits and 210 quarts of goat's milk.** In the U.S., more than **4800 farmers markets** and **2500 Community Supported Agriculture farms** supply locally grown food. Studies have shown that organic methods, like those Carpenter uses, can help soil store **1000-plus pounds of carbon** per acre. Other approaches can cause carbon loss.*

THE PHONE RANG WHEN I WAS shoeless and only a couple of sips into my morning coffee. "Hi, it's Novella Carpenter," the caller said. "My goat is giving birth."

Twenty minutes later I was crouched in the hay at Ghost Town Farm, pushing away chickens and peering into the pen that housed the expectant mother, Bébé. Her udder was so swollen she couldn't get her hindquarters down. Bleating, she clawed at the dirt with her right front hoof as if searching for a stash of Vicodin. "Pass me the iodine," Carpenter said. "We better wash up."

Carpenter, the author of *Farm City: The Education of an Urban Farmer*, is, by her own admission, "a bit nuts." If so, she has company—similar farms have sprung up on city blocks in Los Angeles, New York, Pittsburgh and Detroit. And food is hardly the only commodity that people are producing for themselves these days. A small but growing number of American households generate all of their electricity using wind, solar or micro-hydro. But off-the-grid living has come to mean something more nuanced than cutting all ties with utilities and society; for many, it's about finding creative ways to produce and conserve resources at home. Hundreds of thousands of Americans capture rainwater in barrels, can food from their gardens, heat water with solar collectors and commute by bicycle. We may be nearly a decade into the 21st century, but the self-reliant spirit of an earlier era—that of homesteading pioneers—has returned with gusto.

At Ghost Town Farm, Carpenter cleared the head-high weeds from a 4500-square-foot lot and started planting. She didn't ask permission. When the lot's owner discovered the squat garden he warned that he would soon develop the real estate—that was five years ago. Now the lot is verdant with lavender, sage and thyme; lime, rhubarb and raspberries; artichoke, collard greens and avocado.

Strolling through the garden, I became overwhelmed by a feeling that could only be described as vegetable lust. But something deeper than my appetite had been stimulated, too. My grandfather once worked a small mountain farm in

THE SELF-RELIANCE ISSUE / **New Homesteaders**

Greece. He immigrated to California's Central Valley in his 20s, opening a produce stand and then a grocery store, but he never totally severed his connection to the land. I remember strolling through fruit-laden trees in his backyard as a boy. Now, I was gearing up for major changes myself—the arrival of my first child, the purchase of my own home—and I had been thinking about what sort of sanctuary I could create for my own family. The house I envisioned was solar-powered and garden-ringed, a little safer, smarter and more productive than the wasteful world around it. I was deeply curious about the experiments of modern homesteaders because I wondered just how self-sufficient I could be, too.

In the pen Bébé continued to push and, with a little gentle guidance from Carpenter, the newborn's head crowned. Then the front legs were out. Bébé gave a final, anguished cry and the kid was born, a female, soon to be named Hedwig. Twenty minutes later, she had a brother, Eeyore. The two Nigerian dwarf goats wobbled about on untested legs and, undistracted by a car alarm that had started to blare, tried to find their mother's teats.

America is dotted with remote, off-the-grid homesteads. Certain regions—including western Texas around Big Bend National Park; the mesas outside of Taos, N.M.; and pockets of the Sierra Nevada northeast of Lake Tahoe—host whole mini communities. The Surprise Valley of northeasternmost California supports another. There, where skyscrapers of light slant from the heavens to the mirror-flat floor of the desert, I was crouched on a mattress attached to a rope.

The other end of the rope was hitched to a Ford F-350. The tires spun and soon I was hooky bobbing—surfing at 30 mph, a roostertail of dust in my wake. I felt as gleeful as the Road Runner with Wile E. Coyote giving futile chase. The truck stopped after a few minutes and, as I spat dirt clods from my mouth, a pretty young woman in a red plaid shirt and a white cowboy hat emerged from the cab. “You’re lucky you’re just visiting,” Tierra Hodge said. “If you lived here we would have set the mattress on fire.”

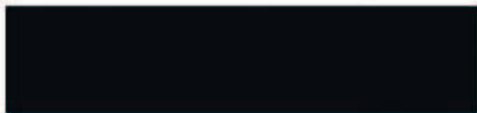
I’d been introduced to Tierra through a tortured chain of connections—my wife’s cousin’s father’s friend’s daughter, or something like that. She grew up off the grid on land near here, and had agreed to guide me around a place I never knew existed and introduce me to people who didn’t necessarily want to be found.

The first stop was welcoming enough: a mountain homestead replete with mud, solar panels, semi-clothed children, and chickens. Then we had lunch in the town of Eagleville with Ed and Wendi Lutz, trompe l’oeil painters who’d retired to build an off-the-grid retreat. Tierra said the place was beautiful—circular, with deep wooden sills and colorful





Tina and Bill Hodge with their daughter Tierra (center) in the kitchen of their earth-berm home in California's Surprise Valley. "I've been building houses all my life and can say for sure that ferro-cement is much more forgiving," Bill says. "If it looks right, it is right. It's more like building a sculpture."

THE SELF-RELIANCE ISSUE / **New Homesteaders**

bottles embedded in the walls—but the Lutzes refused to disclose its exact location. I'd told them I was a journalist and might as well have said One World Government Spy. "We have come to value our privacy," Wendi said, eyeing me warily. That afternoon we drove past a doomsday retreat, complete with its own private airstrip, belonging to a wealthy Bay Area businessman. "He's preparing for the end of the world as we know it," Tierra said with an enigmatic smile. I couldn't tell if she was mocking him or applauding his foresight.

The specters of financial crisis, climate change, uncertain energy reserves and a fragile food supply loom large for the new generation of survivalists—and though I don't share their apocalyptic mind-set, I find myself relating to the urge to run for cover. In April, the top-selling action and adventure book on Amazon.com was *Patriots: Surviving the Coming Collapse*, a work described to me by its author, James Wesley Rawles, as a "survival manual dressed as fiction." Its plot appeals to those on the political right, who fear a too-powerful government—and the anarchy to come in the wake of its inevitable collapse. Leftie off-the-gridders gravitate more to the "grow-local" approach championed by author Michael Pollan. "We're using up the world's resources more quickly than you could imagine," says Ruby Blume of the Institute of Urban Homesteading. "I think we need to be prepared."

Lately, homesteaders of all political stripes have settled upon a common concern: globalization. The shock waves of any crisis—for instance, the subprime meltdown—now spread far, fast and wide. Many doubt that major institutions can be counted upon to save the day. "You're on your own, your job is at risk, and a lot of the commodities you rely upon are vulnerable to disruption," says John Robb, author of *Brave New War*, which describes how terrorists could exploit global systems. To my ear, such statements straddle the line between reasonable advice and hyperventilated threat. One day you're sipping a frappuccino. The next you're using a pitchfork to fend off rioting mobs. But even if I don't fully agree with the dystopian diagnosis, I like Robb's proposed cure: "You're going to have to start doing more for yourself." The beauty of the DIY solution is that the exact problem doesn't matter; greater self-sufficiency makes sense to survivalists and eco-utopians alike.

In the early 1970s, Tierra's parents established their own fully off-the-grid homestead in Mendocino, and later in Surprise Valley, with the thought that "when society crumbles, we'll be

able to raise our children in a safe environment," Tierra says. She and her sister, Celesta, grew up in a tepee; her mom, Tina, and dad, Bill, supported the family by breeding llamas and selling medicinal herbs. Instead of sitting in a classroom the Hodge girls were home-schooled, usually outdoors. Instead of playing video games, they explored the mountains on horseback.

Growing up in the wild was idyllic but not always easy. When Tierra was 15 a boy braved the long dirt road to the homestead to pick her up for a date to the county fair. He emerged from the car looking spiffy in an all-white outfit only to have the Hodges' pet raccoon pounce with muddy paws. Then one of the llamas pegged him with a wad of saliva. Tina, always on the lookout for free meals for wildlife she rehabilitates, shouted after the couple, "Goodbye, honey, have fun, and don't forget to look for roadkill!" "I just about died," Tierra recalls. But in spite of their upbringing—or because of it—the girls turned out fine. Tierra went to college. And Celesta moved almost directly from the tepee to a penthouse in New York, gracing the cover of *Cosmopolitan* as a fashion model.

The day after hooky bobbing, I found myself standing ankle deep in llama poop with a shovel. My job was to ferry wheelbarrows of the stuff up a hill to a garden, dump the smelly payload and then do it again. And again, ad infinitum, until it got dark or my blisters burst. It was raining, so I was damp, and the sodden manure was getting heavy. Then the clouds broke, and the sun beamed down on the Hodges' secluded mountain—160 acres surrounded by protected wildlands. The air was pine-scented and pulsing with the sound of a creek.

Just as my back began to give out, Bill mercifully invited me to tour the family's airy, three-bedroom house. It was built earth-berm style, dug into the mountainside and covered by a living roof of soil and vegetation. The ground temperature stays close to 57 F year round, which makes the house extremely energy efficient. A small solar array provides enough electricity for lights, a refrigerator and a stereo.

Efficiency From the Land

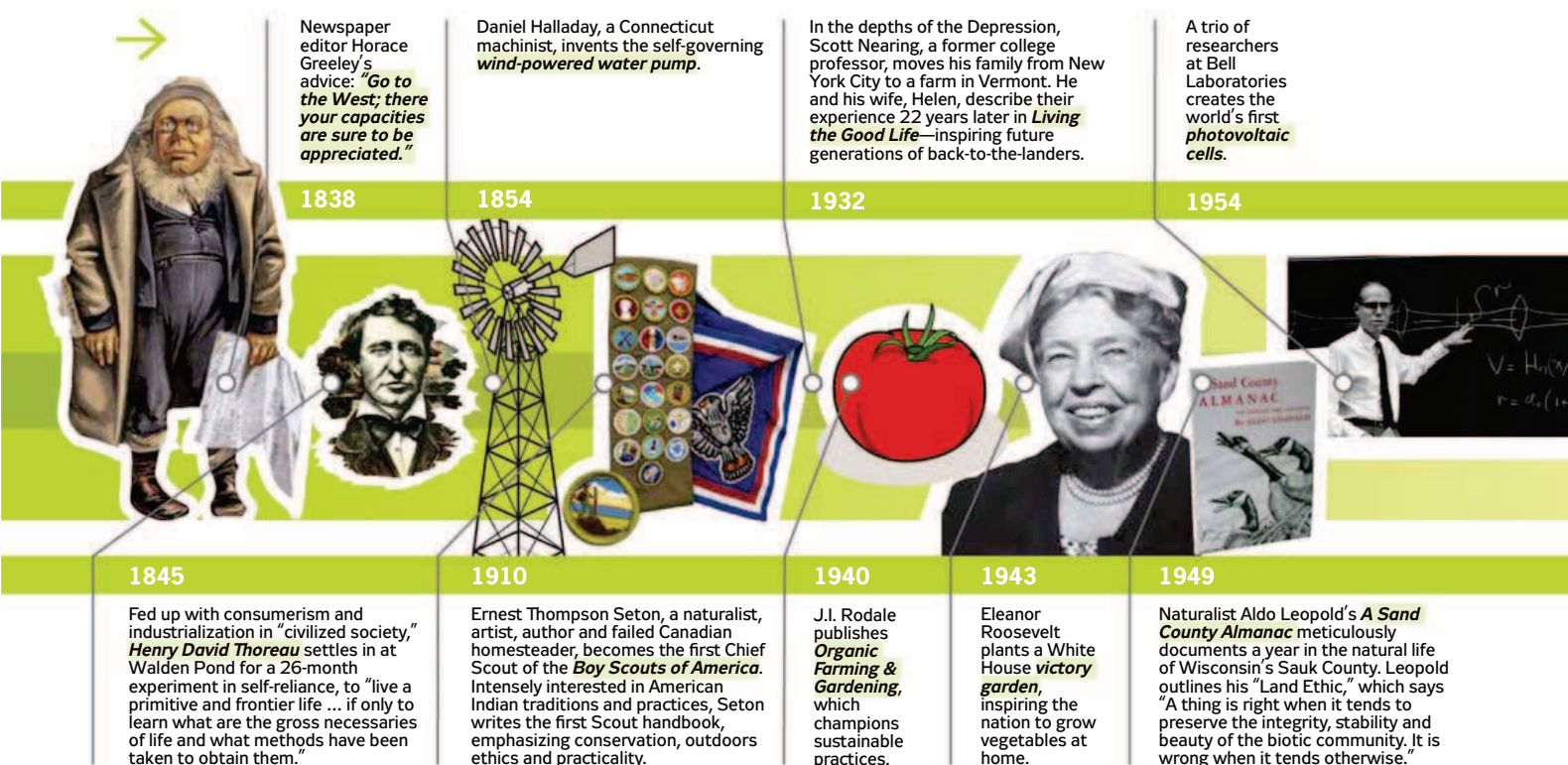


Tina and Bill Hodge built their home right into the Warner Mountains of California. The curving **1 1/4-inch-thick walls**—made of **3/8-inch rebar** covered with **six layers of 1/2-inch steel mesh** and cement—are roughly as strong as an inch of steel. As a result, the roof can support **2 feet of wet earth**—plus a tractor. There are now **3.18 million square feet of green roofs** in the United States. Research has shown that such roofs can reduce heat gain by **95 percent**, heat loss by **26 percent** and stormwater runoff by **54 percent**.



A History of Self-Reliance

Though organic food and solar power may seem like the products of today's



Bill crouched beside an unfinished section of wall, where he pointed out a grid of $\frac{3}{8}$ -inch rebar layered with steel mesh. He had painstakingly covered the rest of the grid with a mixture of sand, cement and water—ferro-cement construction that was affordable, fire- and pest-resistant and exceptionally tough. Bill bent the rebar before applying the mortar, which resulted in strong, gracefully curving walls. The house had taken him more than two decades to complete—and should be there for a thousand more, he says.

That kind of work—the kind that results in dirt under fingernails—is back in vogue. Not everybody builds his own home, of course, but people with office jobs are raising hens, bees and wind turbines, learning to weld and taking up quilting. My blistered palms reminded me that manual work is still work, and tasks like shoveling manure can be just as mind-numbing as data entry. But I couldn't deny the appeal of creating something tangible and unique.

After the tour, Bill and I plopped chairs down outside and popped tops off of a couple of beers. Purplish mesas flanked the horizon to the east. To the west rose the snow-topped Warner Mountains. He admitted that living off the grid on 160 acres was "a utopian thing" not many people could emulate.

As for Tierra, she moved back to Surprise Valley after several years away. She started a fencing company and has built a small off-the-grid place of her own. It has three tiny rooms that she shares with Sienna, her 4-year-old daughter from a

recent marriage. The house has only enough solar power for a refrigerator, a few light bulbs and a boom box, but the desert view surpasses that of most million-dollar vacation homes.

Tierra is conflicted about her future and considering a move to the Bay Area. After getting a taste of her life for the past few days, I had more than an inkling why: It is lonely to live this far out of the mainstream. I couldn't do it myself, no matter how dazzling the mountain scenery. And yet Tierra is proud of what she has achieved. "There's a resourcefulness to living this way," she says. "You know that if all else fails in the world, you'll still be okay."

Power generation doesn't have to be a DIY enterprise. Witness Oregon's Three Rivers community, a subdivision with 250 solar- and wind-powered homes, or the Villages at Heritage Springs, 500 solar homes planned for Southern California. Other all-solar real estate developments are in the works in Florida, Iowa and Colorado. Clayton Homes, the country's



largest maker of mobile and prefabricated houses, has introduced the i-House, which includes solar panels and energy-efficient appliances, for little more than \$100,000.

Satellite Internet services have enabled people to stay connected even in remote areas. Nick Rosen, who runs the website Off-grid.net, spends several months each year living off the grid in the mountains of Majorca, Spain, but seamlessly continues his work as a writer and technology consultant. The notion that painful sacrifices are mandatory has been toppled, he says. Modern energy technologies, well-insulated homes and power-sipping appliances mean "you can live a fantastic, comfortable time off-grid."

Curious to see how much luxury is possible, I arranged to visit the home of Thomas Beck, an architect in Estes Park, Colo. Beck got his start in residential work before he hit puberty, building multistory treehouses complete with trapdoors and fireman's poles. He began studying environmental design in 1973, just as the OPEC oil embargo hit, and attended the National Solar Energy Conference the following spring. "I realized

then that oil was a finite resource, but the sun's going to be around for, what, 96 billion more years?" Beck says.

Yet it wasn't until recently that he built his magnum opus: a 5800-square-foot spread with a 270-degree view of Rocky Mountain National Park. "When most people think about an off-the-grid house I don't think they'd picture this," Beck said when I arrived. Inspired by the Arts and Crafts style of architecture, Beck used wood beams, stone and stucco to create multiple wings fanning out under long diagonal rooflines. We passed through the front door, elaborately carved from standing dead hardwoods, and proceeded to the Great Room—a cavernous space with a flat-screen television, a dining table long enough for 16 and a baby grand piano. Beams recycled from a century-old railroad trestle support the lofty ceiling. In the kitchen, granite countertops could land a small plane.

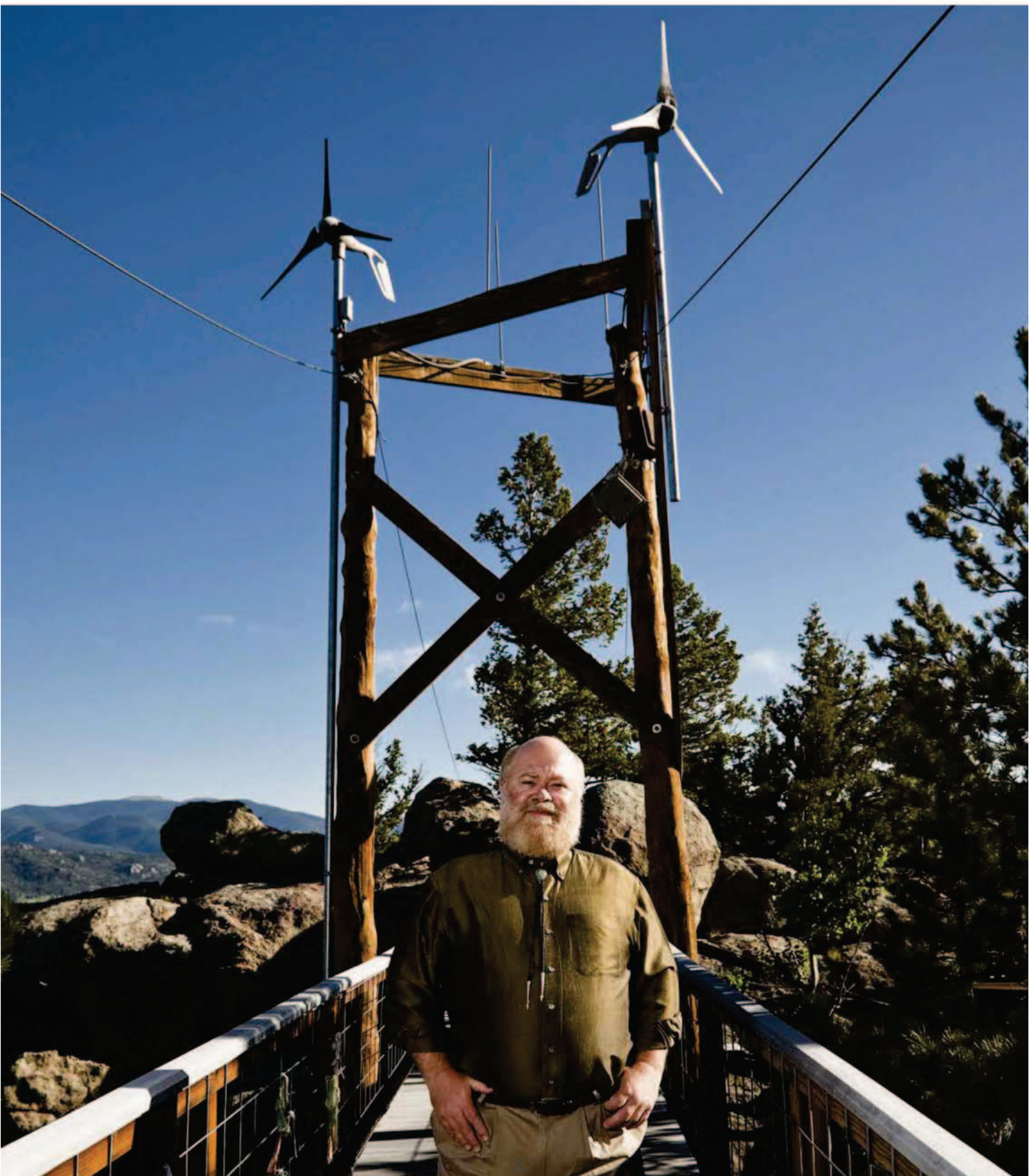
Yet Beck's only utility bill is for propane. Outdoors, above a wood-fired hot tub, rise two wind turbines that can produce 800 watts of electricity. Integrated photovoltaic cells on the roof contribute another kilowatt. A few dozen yards from the front door stands the power house: An array of solar panels on top generates 1.44 kilowatts and, inside, three inverters charge lead-acid batteries—32 in all. Three banks of evacuated-tube solar thermal collectors heat water for both domestic use and the 3.5 miles of radiant floor tubing that warms the house.

Beck stepped out to meet with a client and encouraged me to explore the house on my own. I went downstairs,



Reading the Meter

The two turbines towering over a footbridge at Thomas Beck's home in Estes Park, Colo., each generate **400 watts of electricity**. Last year, **3521 residential wind turbines** were sold in the United States. Photovoltaic cells on the roof of Beck's home and power house produce another **2440 watts**. Across the country, **115,000 households** now have photovoltaics; **61,000** of those feed energy into the grid.



where a lap pool with 10,000 gallons of solar-heated water acts as a thermal reservoir to help stabilize the home's temperature. I was tempted to go for a quick swim—but then chickened out. The whole place, in fact, screamed “look but don't touch,” and I wondered what it might say about the broader movement for sustainability. This eco-mansion took copious amounts of natural resources to construct. I would love to live here. But, environmentally, it seemed a bit like a biodiesel-powered Hummer. While an impressive showcase for off-the-grid tech, Beck's luxurious spread appeared no more realistic—for me anyway—than the Hodges' bare-bones retreat.

The dream of living more independently from civilization is almost as old as civilization itself. When Rome fell 1500 years ago, city dwellers fled to the countryside, becoming some of the world's first back-to-the-landers. The Diggers of 17th-century England and Depression-era Americans similarly tried to provide for themselves locally. By the late 1960s and early 70s, as many as 1 million Americans, decrying consumerism and Vietnam, set out for what they thought would be a purer life in the countryside. For inspiration they read Aldo Leopold and Henry David Thoreau; for practical advice on everything from carpentry to compost they clutched issues of the *Whole Earth Catalog*. However well-armed with information, though, most of the would-be pioneers lacked practical experience and abandoned small-farm living after learning that it was—as Novella Carpenter indelicately put it to me—“a s---ton of work.”

Carpenter knows firsthand about the travails of the back-to-the-landers. She spent her early childhood on a rural retreat in Idaho. Directly emulating her parents horrified her, but the apple fell only so far from the tree. “I recognized that if my parents were Utopia 8.5 with their hippie farm in Idaho, I was merely Utopia version 9.0 with my urban farm in the ghetto,” she wrote in *Farm City*.

A few weeks after the goats were born, Carpenter and I strolled past a graffitied warehouse across from the farm, then turned left on Martin Luther King Jr. Way. Carpenter said that instead of tumbleweeds she sometimes spotted “tumbleweaves,” the lost hairpieces of prostitutes, blowing down the block. When we stopped in a small park to pick pellitory, a nettle-like plant that the chickens love, Carpenter recounted a shooting she'd witnessed there. I really

THE SELF-RELIANCE ISSUE / **New Homesteaders**



admired Carpenter, but I thought she was more than a little crazy. What made her urban version of utopia any better than the rural approach of her parents?

“I find the country incredibly lonely,” Carpenter said as we headed back. Ghost Town was diverse and intriguing; the menace of thugs was tempered by the support of the community. We strolled past a bodega whose owner, a goatherd in Yemen before he emigrated to the U.S., had taught her how to slaughter livestock. And Carpenter pointed out a monastery occupied by Vietnamese monks, one of whom had helped her chase down a runaway pig.

Carpenter's urban farm is doubtless an extreme case study. But it also seems to me the most tenable future for self-sufficient, environmentally sustainable living. Homesteading, to be sure, needs the sense of hardy independence that I'd found in Surprise Valley. And I certainly appreciated the appeal of some eco-luxury à la Beck. But for homesteading to truly transcend niche status—for it to have any appreciable impact on the world—it must embrace the community spirit of Carpenter's urban experiment. Maybe I'd drunk too much organic goat milk. But after seeing everybody else, I knew that it is Carpenter's city setup I want to draw from to create my own family's future home—minus the gun-toting teens and the tumbleweaves, of course.

“People are always like, ‘I know where I'm going to go when the s--- hits the fan, Novella—to your house!’” Carpenter says. “And my response to that is, if it hits the fan, it's going to hit the fan for all of us.” We left the street and walked behind her house, where she scattered sawdust on the ground to cloak the livestock odors. We tossed out the pellitory, and the chickens scrambled to gobble it down. **PM**

Architect Thomas Beck designed and built his home in the Rocky Mountains. It melds the Arts and Crafts style of the early 20th century with energy-generation and storage technologies honed in the 21st.

THE SELF-RELIANCE ISSUE

The Rules of Survival

3

Life-threatening situations can hit with no warning and push the limits of human endurance. How do you face down disaster when there's every reason to panic? Here's how to wire your brain for survival.

By John Galvin
Illustrations by Andres Rivera

burning down your neighborhood, you shouldn't stick around. And, for most homeowners, evacuation was certainly the smartest option. But Vaplon stayed and fought back against the fire. What did he know that everyone who followed the conventional wisdom didn't?

Some disasters are simply not survivable. But most are, and research on human behavior suggests that the difference between life and death often comes down to the simple—yet surprisingly difficult—task of recognizing threats before they overwhelm you, then working through them as discrete challenges. The people who survive disasters are not necessarily braver or luckier than those who perish. They do, however, tend to be better prepared and more capable of making smart decisions under pressure. Not everyone is born with these traits, but almost anyone can learn them.

Rule 1: Prepare for the Worst

"The last thing I want from my story is for people to risk their lives," Vaplon says. "But I'd thought about protecting my home, and I felt comfortable with my decision to stay."

The day before the fire swept through his 2.5-acre spread, he woke up early to the distant smell of smoke. He immediately broke out 500 feet of fire hose and attached it to a standpipe hooked up to a 10,000-gallon water tank. "I started watering

IT WAS EARLY, 9:00 AM, AND EERILY dark in Poway, Calif., as 75-mph winds drove chaparral embers through the air and shook the bones of Frank Vaplon's house. One ember lodged in his woodpile and set it ablaze. Most of his neighbors had evacuated, but Vaplon had decided to stay and fight the wildfire that was closing in on his property.

Geared up in a mail-order firefighter's outfit—helmet, bunker coat, respirator, the whole thing—Vaplon began his assault by shooting a high-pressure stream of water at the flames, but it just blew back against him in a hot mist. "It was like pissing into the wind," Vaplon says. "So I turned around and started spraying down the house."


The Witch Creek fire was the fourth largest on record in California. A reported 1800 firefighters battled the blaze and several others nearby; more than 250,000 people in San Diego County were evacuated. Conventional wisdom says that when a wildfire is

down everything that I could," Vaplon says. "The roof, my lawn, everything."

The former Hewlett-Packard engineer didn't stop there. He raked up all the loose debris around his house, and then boarded up the attic vents where embers might get in. He checked the fuel for his three backup generators. And he put important papers in a steel box, which he loaded into his RV. He parked the vehicle facing out just in case he needed to bolt. "I had a plan to go if I had to go," he says. "If for one minute I started to get scared, I would have left."


The gear and setup were just part of Vaplon's extensive preparation. Whether deliberately or not, he had organized his brain to deal with disaster by planning a detailed fire strategy.

"The brain is an engineering system," says John Leach, a former Royal Air Force



Frank Vaplon saved his home from a California wildfire with mail-order firefighting equipment and plenty of preparation.

THE SELF-RELIANCE ISSUE / Rules of Survival



combat survival instructor who now works with the Norwegian military on survival training and research. "Like any engineering system, it has limits in terms of what it can process and how fast it can do so. We cope by taking in information about our environment, and then building a model of that environment. We don't respond to our environment, but to the model of our environment." If there's no model, the brain tries to create one, but there's not enough time for that during an emergency. Operating on an inadequate mental model, disaster victims often fail to take the actions needed to save their own lives.

Not Vaplon. As the firestorm approached, he stayed calm and clearheaded. He had done so much advance work that he had created a model for his brain to act on when disaster came. All his equipment would have been useless if he hadn't thought through how to use it.

The Witch Creek blaze swept past in less than 2 minutes. Vaplon quickly put out the small fires on his property, then doused his neighbors' fires. He saved one house, but another burned after embers set the garage on fire. "There was nothing I could do about that one," he says. "When I got back to my house I heard these two loud thumps. Those were the gas tanks exploding."



Rule 2: Keep Cool in a Crisis

The tornado siren sounded at the Little Sioux Scout Ranch in western Iowa just before the power went out on June 11, 2008. Scout Leader Fred Ullrich, an IT manager at the University of Nebraska Medical Center, opened the door of the building where he and 65 Boy Scouts had taken shelter. "I was looking for lightning and listening for that freight train sound you're supposed to hear with tornadoes, but there was nothing like that," Ullrich says. "But something

told me we were in deep trouble—I don't know what it was. I yelled for the boys to get under the tables." As the scouts dove for cover, the wind came up. Ullrich leaned into the door from the outside, trying to push it shut, but instead he was picked up and thrown from the building. Then the 150-mph wind simply blew the Boy Scout shelter apart. "I can only describe my actions in that moment as being totally futile," Ullrich says. "There was absolutely nothing I could do."

Once the tornado passed, Ullrich noticed he couldn't hear out of one ear. He felt around and fished out a stone. All around him was chaos. Some scouts were pinned under a collapsed brick chimney; others were trapped by the debris of the wrecked structure. For a brief moment Ullrich was dazed. Then he went into autopilot rescue mode. "I don't know how to describe it," he says. "It was like my brain went away, and I went to a very businesslike place." He circled what was left of the disintegrated shelter, directing the able-bodied to take care of the injured. And the scouts did just that—applying pressure to wounds, turning T-shirts into bandages and elevating the legs of those who were in shock. Ullrich used a 6-foot iron bar to pry up a wooden board and bricks that had fallen on one boy.

In a disaster roughly 10 percent of people panic, while 80 percent essentially do nothing. Unable to come to terms with what's happening, they freeze. The remaining 10 percent jump into action. Ullrich was trained in CPR and first aid, skills that doubtless helped the scouts that day, but before any of that formal training would even matter, Ullrich needed a separate and equally important skill: to get hold of himself and get people organized.

According to Chris Hart, a former Navy psychologist and now professor at Texas



Woman's University, being able to set aside fear is what separates people like Ullrich from others. "Fear is a good thing," Hart says. "You want to have it because it can motivate you to action. But if you become overwhelmed by it, then it's debilitating."

What's worse, research shows that the greater the number of people who are involved in an emergency situation, the less likely it is that anyone will intervene—a phenomenon known as the Bystander Effect. Ervin Staub, professor emeritus of psychology at the University of Massachusetts, who has done extensive research on the subject, says that in group situations, there is a diffusion of responsibility; people look for cues from others before deciding how to act. "Just being aware of this tendency and saying 'I am responsible' can make a difference. People who believe that they are responsible for other people's welfare help more."

Ullrich didn't know what he and his scouts were in for that day, but mental preparedness and responsibility are central to the Boy Scout philosophy. The night before the tornado, Ullrich had put the boys through a first-aid drill. When emergency responders arrived after the tornado, what they saw was devastating—four scouts were dead or mortally wounded. Scores were suffering from broken pelvises, dislocated shoulders, lacerations and punctured lungs. Yet, amazingly, the rescue crew also saw that Ullrich and the uninjured scouts were putting their training to work. They had organized an on-the-spot triage center, helping to prepare the most seriously injured for their journey to the hospital.

By teaching his scouts to leap into action, Ullrich skewed the 10-80-10 math of disaster. He saw the drill as part of his responsibility to care for the troop. "The point of it is to get these scouts to be the people who don't sit around when something bad happens," he says, "but to be the type of people who do something."

Rule 3: Hang in There

On Saturday, Nov. 18, 2007, Daryl Jané left his cottage on Bainbridge Island in Washington State to head for an overnight sky-watching event 190 miles southeast at Trout Lake. He had planned to be back the next day to watch a Seattle Seahawks game. Jané never made it to Trout Lake. Instead he became the prisoner of a tremendous late



Daryl Jané

Snowbound in a Jeep for 14 days in Washington State's Cascade Range, Daryl Jané did not let panic force him into a bad decision. He stayed with his vehicle, and every day he cleared fresh-fallen snow surrounding it and ran the engine to charge the battery.

autumn snowstorm. Jané was driving on a widely used—at least in good conditions—forest service road as the snow began to pile up. He became stuck 35 miles from his destination when the tires of his '93 Jeep Cherokee sank into deep snow.

In the car, Jané had a near-full gallon of water, some food for the evening, a Wal-Mart sleeping bag and a Seahawks jacket with a fleece liner. He was certain he'd be rescued the next day, but no one came. He knew he shouldn't leave the shelter of his vehicle to look for help, so he stayed with the Jeep and, as the days passed, settled into a survival routine. He slept in fits and starts so he could keep brushing the snow off his door and the roof in case a search helicopter came looking for him. (In fact, the local sheriff had called off the search after the fifth day, convinced Jané was not in the area.)

After eight days, Jané was seriously dehydrated. He was literally buried in frozen water, but he knew that it would do him more harm than good. "I had read somewhere not to eat snow if you were stuck," he says. He was correct: It lowers the core temperature of the body, which then must expend precious energy to keep warm. Yet his head ached, his teeth felt fuzzy, and his tongue and lips were cracked—he had to find water or die. Eventually, he wrote a goodbye note to his family and friends and set out with his empty gallon jug to search for water.

Jané struggled through the 5-foot-deep snow until he noticed a depression. He dug through it with a cup, and



THE SELF-RELIANCE ISSUE / Rules of Survival

Not Your Ordinary Survival Checklist

Gallon jugs of water, fire extinguishers and first-aid supplies are the essentials of any good survival kit, but our survey of those who outlasted disasters suggests a few more unexpected items.

**1 BEER**

"Buy a lot of it," says Trey Click, a magazine publisher who rode out last year's Hurricane Ike in Galveston, Texas. "It's one of the only things you can use for money in the aftermath." Need your neighbor to help you clear trees out of your yard? A case of Bud is a better motivator than a \$20 bill when all the stores are boarded up.

2**HANDHELD CB RADIO**

Think no one uses CB radios anymore? Think again. These things can be a direct line to emergency crews and tow trucks, exactly the folks you might want to get in touch with after a disaster. Plus, they work when cell towers don't. Look for one that also tunes into NOAA weather channels.

4**GLOW BRACELETS**

When the electricity is out, you may not feel like celebrating, but these party favors can come in handy. "Houses get dark really quickly with no power," says Mark Vorderbruggen, who went five days without electricity after Ike hit Texas. "I used them to mark the location of radios, flashlights, batteries and door handles."

3**CONTRACTOR BAGS**

Thick, sturdy 3-mil contractor bags are the multitool of the disaster world. They're tough enough to stuff with sharp debris, they work as an impromptu poncho or water barrier for leaky structures, and you can use them to drag heavy objects.

5**A GOOD BOOK**

When stuck in his Jeep for two weeks, Daryl Jané would have killed for a good book. "I had water and a sleeping bag, and that's all you really need to survive," he says. "But it gets so boring after a while. If I'd had a book I would have been set."

instructor turned survival psychologist, it shouldn't be. "Unfortunately, people in his situation die all the time, but they don't have to," Leach says. "He didn't have food, but that's not a problem for two weeks—you can live without it. Fluid is the issue, but he found water." What really saved Jané, Leach says, is that he adapted to his environment; he understood that he was in trouble and changed his behavior. "Being aware of your surroundings and recognizing the threats means your brain is working on solutions," Leach says, "and that gives you an edge." That awareness starts your brain modeling a plan to keep yourself alive and help in your own rescue, instead of remaining in denial about the problem or simply panicking.

Steve Leslie, a 20-year veteran of Washington State-based Olympic Mountain Rescue, has seen countless people get lost or stranded in the woods. He sees long-term wilderness survival as a challenge of maintenance. "Basically it's housekeeping—your chances of survival go way up if you maintain a good shelter, find water and, if you have any food, parcel it out."

Jané created a survival routine and stuck to it: He avoided desperate actions and stayed with his vehicle, kept the roof clear to increase the odds of being found and, most important, never gave up. By facing reality—he was stuck and might be there a long time—and adapting to it, Jané set himself up for the slow, disciplined work of long-term survival.

Rule 4:

Outlast the Aftermath

Last September, a 600-mile-wide hurricane named Ike carved through the Caribbean with wind speeds of up to 145 mph before slamming into Texas near Houston. As a direct result of the storm, 48 people in Texas died.

But, according to a report by the National Hurricane Center, the aftermath proved to be deadlier than the storm itself. As many as 64 post-storm deaths occurred in Texas because of factors such as carbon monoxide poisoning and electrocution. More than 1 million Texans were left without power. Municipal water systems were overwhelmed, and clean water was the next to go. Enormous lines formed at FEMA food centers, grocery stores and gas stations—which had no electricity to

discovered water. He drank an entire gallon. "It was the greatest feeling," he says, still recalling the first sip vividly. "I could feel that water going through my body. It was like I was the Tin Man being oiled." Once he got back to his Jeep he put away his pen and goodbye note. The water he found kept him alive and gave him hope as the snow continued to fall day after day.

In the end, Jané was stuck for 14 days before a local snowmobile club found him. He had lost 10 pounds but had suffered from neither frostbite nor hypothermia.

Jané's survival story is, of course, amazing. But is it miraculous? According to John Leach, the former RAF

Did your little storm knock out the power?

excuse me
for not noticing.



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Mark Vorderbruggen

After Hurricane Ike struck Texas last September, research chemist Mark Vorderbruggen and others in his Houston suburb organized themselves to clean up the neighborhood with chain saws, rakes and Vorderbruggen's favorite aftermath tool, alligator loppers—"great for taking apart limbs on fallen trees."



pump what little gas was left. That first weekend after Ike, some 37,000 Texans were holed up in shelters that ran short of food and water within 24 hours. The next few weeks brought countless scores of injuries from clearing debris.

While many in the area were awaiting assistance, Mark Vorderbruggen and several of his neighbors in the Houston suburb of Spring were already busy cleaning up their neighborhood. The crew had organized before the storm by gathering all the

two-way Family Radio Service walkie-talkies they could find and then distributing them among 14 occupied houses. They had already taken a quick inventory of residents with generators, chain saws and first-aid skills (one neighbor was a retired Army medic). The day before Ike hit, Vorderbruggen went door to door with four or five guys from the neighborhood, serving as an impromptu pickup crew, clearing yards of furniture, tools and anything else that might turn into a deadly missile in hurricane-force winds.

Thanks to his preparations, Vorderbruggen's house survived largely intact. But there was still plenty of debris to clean up in the neighborhood. "Almost every leaf and every pine needle on every tree was stripped off," he says. "There was an incredible amount of raking to be done." He and his neighbors all pitched in to clean up every yard and sidewalk.

In times of danger, many people can retreat into a defensive crouch, but "every man for himself" is a terrible strategy for post-disaster situations. Psychologists use the term "reciprocal altruism" to describe what happens when people overcome their tendency toward selfishness and work together. "We tend to extend help to others," says psychologist Andrew Shatté, one of the world's leading experts on the psychology of resilience, "on the understanding that some 'other' will expend a few resources to save us." By working together, groups reduce the danger and stress to individuals. "Once their basic survival needs are met," says Shatté, "people like Vorderbruggen instinctively reach out to help the community. They are more resilient and happier with their lives for doing so."

In fact, for Vorderbruggen and his neighbors, the aftermath of Ike was less like a disaster and more like a barbecue. The area was without power for five days, but the neighbors conserved resources by eating meals together at a different house each night to ensure that no food was spoiled. "We cooked on the grill, and I ran a small light off a battery-powered electric inverter," Vorderbruggen says. "I got to walk around in Hawaiian shirts and swim shorts for nearly a week. Cooking outside, clearing debris. It was actually kind of fun—for me."

PM



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The Electric Cold-Beer Gadget Test

A PM editor goes into survival mode—with his favorite tech in tow.

4

By Glenn Derene
Photographs by David Sykes

POTENTIAL
POWER
PRODUCTION



I'M A DIFFERENT SORT OF SURVIVALIST. WHEN THE electricity fails, the floodwaters begin to rise and the orders for evacuation come, everyone will surely be concerned with stockpiles of food, blankets and water, but I'm going to be equally worried about Blu-rays, computers, Wii games and cold drinks. After all, I've got a modern family to provide for. How are we going to maintain our high-tech lifestyle? I recently decided to design and test a plan to keep our gadgetry humming once society collapses.

I created a closed-loop power supply using two Exide Orbital gel-cell deep-cycle batteries, an inverter, →



POWER
CONSUMPTION

01. Coleman PowerChill
Thermoelectric Cooler (\$168)

Since this 12-volt fridge ran all day long, it was a real battery killer, but it kept our beer cold.

02. Verizon MiFi
(\$40-\$60/month)

This Wi-Fi hotspot with 3G broadband connectivity goes wherever you want it—a must-have.

03. Vizio VA220E
Eco HDTV (\$400)

This electricity-sipping 22-inch 720p HDTV used less power than a 40-watt light bulb.

07. Flip Mino
Video Camera (\$180)

If it were truly the end of the world as we know it, wouldn't you want it on video?

08. Coleman LED
Rechargeable Lantern (\$45)

The lone LED in this lantern puts out powerful light; the battery lasts up to 10 hours.

09. Tivoli Audio
iSongBook (\$400)

My 6-month-old rocked out to Sesame Street songs on this portable radio with iPod dock.



Sunforce 60-Watt Solar Charging Kit (\$399)

A half-hour of setup, and we were making electricity—even under light cloud cover.

Southwest Windpower Air Breeze Wind Turbine (\$699) and EZ Tower (\$573)

Capable of making 400 watts in a steady wind, our turbine couldn't exploit light, swirly breezes.

Yamaha EF1000iSC Generator (\$879)

This 1000-watt device has enough power to charge two 12-volt batteries in parallel.

*PRODUCTS NOT TO SCALE

04. Nintendo Wii (\$250)

Minimum electricity input; maximum fun output.

10. Craftsman Nextec Drill, MultiSaw and Worklight Combo (\$150)

Because when society collapses, you're going to have to be your own carpenter.

05. Acer Aspire One Netbook (\$380)

Lightweight, long on battery life and great for post-disaster blogging.

11. LG LX370 Cellphone (\$100 with contract from Sprint)

I charged this phone once, and three days later it still had two bars of battery left.

06. Panasonic Portable Blu-ray Player (\$800)

It's a little awkward to use, but worth taking along for hi-def movies among the ruins.

12. BenQ Joybee GP1 Mini Projector (\$500)

We hooked the Wii up to this projector, and the world became our screen.

THE SELF-RELIANCE ISSUE / Electric Cold-Beer Gadget Test

a small wind turbine, a 60-watt solar array and a portable gasoline generator. Then I assembled a suite of electronic devices and conveniences selected for maximum efficiency. I loaded it all into the back of a pickup and brought the whole operation, along with my wife and 6-month-old son, to my mother's 17-acre farm in upstate New York. Her property seemed well-positioned to harvest power from both wind and sun.



For three and a half days, PM technology editor Glenn Derene and his family powered all their gadgets with a portable energy farm.

DAY 1 Both batteries were fully charged, so on arrival I immediately hooked one up to our 40-quart Coleman thermoelectric fridge and stocked it with beer, water and soda to ensure cold beverages would be available as soon as possible. I also plugged in my battery-powered devices so that everything would be charged up by the time I had my solar and wind generators ready.

I assembled the solar rig in a half-hour, but the wind turbine proved to be a more complicated affair. I'd love to give an estimate of how long it took to erect, but I can't, since the

project was interrupted by three thunderstorms in 4 hours, which threatened to deliver a far higher dose of natural electricity than I had in mind. So we postponed the completion of the turbine until the second morning.

While waiting out storms, I set up a survival base camp in my mother's living room and made my family vow to use only the electronics and power we brought with us. Our Internet access was supplied by Verizon's MiFi 3G wireless hotspot, and we tapped into it for e-mail on an Acer netbook. We put our son to sleep with lullabies played on a Tivoli mini boombox. And when night fell, we watched a Blu-ray of *Wall-E* on a 22-inch HDTV. Since many of the devices were operating on their own battery power, we were able to get through the first evening without having to recharge either of the deep-cycle Orbitals.

DAY 2 By the next morning, however, both batteries were dead, and my beer was getting warm. It was time to break out the fossil fuels: I started the generator and attached one battery. Then my stepfather and I finished raising the 29-foot wind-turbine tower and hooked both that and the solar array up to the second battery.

The Yamaha generator took about 2 hours to charge one of the batteries. (I learned later that it is a far better use of the 1000-watt generator's power to charge both batteries in parallel.) My solar-wind hybrid setup, by contrast, took about 6 hours to charge a battery. Making power this way is a hell of a workout on the arms and shoulders: Our deep-cycle batteries weighed 40 pounds each and had to be hauled from the open field where we were making power to our gadget-stuffed bunker.

DAY 3 and Beyond After the first few days, my family and I settled into a groove, alternating batteries back and forth from the solar-wind station, then topping off the charge with the generator when the sun set. When I wasn't busy hauling batteries, we had plenty of music, movies, Internet access and video games to keep us entertained. But I learned to moderate my usage of the most power-hungry devices. According to my measurements, the TV and projector pulled 35 and 41 watts, respectively, but generally only ran for an hour or two at a time. The fridge, on the other hand, sucked up 50 to 60 watts all day long, so we unplugged it in the evening.

We got lucky with the sunshine—after the initial thunderstorms, we had good weather for several days. The wind, however, was not as reliable. The Air Breeze turbine needs at least an 8-mph wind to spin; for maximum effectiveness, that wind should come from a consistent direction. Unfortunately, the swirling Hudson River Valley breezes spent more time spinning the turbine like a weathervane than rotating its blades.

After three and a half days, the generator ran out of fuel. However, I determined that if I were willing to forgo the fridge and be a bit more judicious in the use of the TV, we could have kept using our electronics as long as the weather held.

So our tech-survival trial run taught us two lessons: First, there is no reason we can't all watch HD movies and play video games in the aftermath of society-crushing disaster. Second, we will have to make some sacrifices—get used to warm beer. **PM**

Designed for Survival

Survive any situation with the **Channellock 6-N-1 Rescue Tool**. Serving as the top choice for firefighters, EMS crews and other first responders, massive side cutting electrician pliers are the starting platform for this tool. Cut into both its jaws is a heavy-duty cross hatching that grips with a vengeance.

Forged into one handle is a gas shut-off wrench and a pry bar. The other handle is equipped with a spanner wrench and a glass punch for breaking through car windows (or insulated glass windows in houses).

To see the 88 Rescue Tool in action, visit www.therescuetool.com/88. While you're there, check out Channellock's new 89 Rescue Tool.

"The Channellock 6-N-1 Rescue Tool is more than a tool—it's an emergency kit that slides into your back pocket. Hang it by the fire extinguisher or stash it in the "go bag" that you keep on hand for disasters. It's a must for homeowners living in areas prone to hurricanes."

BY THE HOME EDITORS

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THE SELF-RELIANCE ISSUE

Apocalypse Chow

By Emily Masamitsu
Photograph by Burcu Avsar

Will prepackaged rations make surviving the aftermath of a disaster more palatable?

MEALS READY-TO-EAT

(MREs) are the military's answer to a long-term, disaster-proof food supply. These vacuum-packed foodstuffs—also available in civilian versions—require little more preparation than activating an included heating pad by adding water, and have all the nutrition necessary to keep you alive. But does the taste inspire the will to survive? To find out, we served up civilian MREs from three different manufacturers to some of PM's hungriest staffers in a flavor face-off. Here's what the end of the world tastes like.



Actual enchilada may look less appealing by the light of your fallout shelter.



APACK

Pasta and vegetables; crackers; peanut butter; fig bar; raisins; shortbread cookie

Price \$6 Calories 1150



SOPAKCO

Beef enchilada; bread and grape jelly; strawberry toaster pastry; mixed fruit

Price \$7 Calories 860



MRESTAR

BBQ chicken with beans; potatoes; dried fruit; nut-raisin mix; vanilla pound cake; sugar cookies

Price \$6.50 Calories 1530

→ Our vegetarian-friendly menu looked the most appetizing of the entrees. It proved to have "a decent tomato sauce, though a touch salty." Unfortunately, it couldn't mask the fact that the noodles were overcooked. The side dishes ranged from "yummy, not overly sweet" (shortbread cookie) to "dry but tasty" (fig bar). The big disappointment: the unnaturally moist raisins, "an insult to grapes everywhere." → **Grade B+**

→ The south-of-the-border option was at least shaped like an enchilada, although it lacked *un sabor delicioso*. The sauce was "too tangy and acidic, completely masking the flavor of the meat." The strawberry pastry was really dry with a "bland but familiar taste." The fruit cocktail proved to be "just as fresh as the canned variety," and the bread, though "a little dense," was nicely complemented by a "smooth and flavorful" jam. → **Grade B-**

→ Smothered in "cheap barbecue sauce," the meat in the poultry entree had a consistency that was "indistinguishable from the vegetables." The pound cake, on the other hand, was a standout, deemed to be "the best of all the desserts" in the test. The dried fruit snack tasted "a bit like soap," with too much sugar. Thankfully, the nut mix had a "great, familiar taste," on par with regular trail mix. → **Grade C**

SPICE UP YOUR STOCKPILE

→ Food isn't just about calories. Your disaster menu may include MREs or canned food, but either

way, a few extra shelf-stable ingredients can go a long way toward civilizing your supper. Don't forget

to stock up on flavor-enhancing items that don't need refrigeration, such as ketchup, mustard, salt,

spices, hot sauce, bouillon, powdered drink mix and chocolate. A few bottles of wine wouldn't hurt either.

MONUMENTAL MOMENTS IN HISTORY

- 1925 ● The automobile radiator is invented
- 1929 ● Antifreeze is patented for use as engine coolant
- 1964 ● BRUT® makes its national debut ensuring men everywhere won't overheat even if their cars do
- TODAY ● BRUT® introduces 24-Hour Protection with Trimax® Anti-Perspirant and Deodorant for extreme protection against odor and wetness, helping you stay dry when you're working on, or going to work in, your car



BRUT® – clinically proven to be most effective at fighting odor and wetness. Maximum strength BRUT® 24-Hour Protection with Trimax® Anti-Perspirant and Deodorant uses the same active ingredient found in expensive prescription strength brands. Now that's power you can count on. Try BRUT® today and experience how well it works!

THE SELF-RELIANCE ISSUE

The Soul of an Old Machine

By Jim Gorman
Photographs by Marcus Nilsson

Yes, we live in a throwaway society. But a growing band of old-school tinkerers and new-school hackers are rediscovering the joy of fixing what's broken.

HOW MANY M.I.T. ENGINEERING Ph.D.s does it take to repair a dishwasher? In the case of a balky Maytag at Eric Wilhelm's house in Oakland, Calif., one doctorate sufficed. After a plastic wheel on the dishwasher's upper rack broke off of its assembly, Wilhelm faced a classic consumer conundrum. The same plastic part had broken and been replaced three times—and now the warranty had ended. Considering this history and Wilhelm's mounting frustration, repairing the 3-year-old appliance seemed marginally less logical than buying a new one.

But discarding the machine didn't feel right to Wilhelm, who is the co-founder and CEO of Instructables.com, a website that details DIY projects, from simple repairs to elaborate, artsy computer mods. Armed with a drill, a vise and a spare stainless-steel bolt, Wilhelm repaired the wheel and got his rack rolling again—and it hasn't broken since. "From a purely monetary standpoint, it probably made no sense for me to spend an hour and a half fixing a plastic wheel on my dishwasher," he says. "But I got an intangible reward—a satisfied feeling that I fixed something and didn't replace it."

Not so many decades ago, Wilhelm's little project wouldn't have seemed noteworthy. Typical American homes were places where socks were darned, lawnmowers rebuilt and bushings, gaskets, nuts and bolts were transfused into a steady stream of machines that needed rehabilitation. By the time I was growing up in the 1970s, though, many people had come to look on tinkering as less a sign of competence than of deprivation and backwardness. My father, who grew up in poverty, probably felt more pride in getting a new washing machine delivered than in keeping an old, outmoded one working for a few more years. Buying new and buying often were American ideals—signs of a modern outlook and success.

POPULAR MECHANICS readers were among those who never stopped building, modifying and fixing the technology in their lives: cars, stereos, garden sheds, computers, the occasional wind turbine or one-man submarine. But today the repair culture is making a broader comeback. Saul Griffith, an MIT-trained physicist and a Bay Area innovator of everything from low-cost eyeglasses to energy

1950s O'Keefe & Merritt 40-inch Gas Stove

OWNER:
"Mister Jalopy," Los Angeles
HANDS-ON CARE:
Maintain the valves

The '59 Cadillac of stoves, O'Keefe & Merritt's four-burner unit is all chrome and shiny porcelain. An L.A.-based artist and entrepreneur who goes by the nom de wrench Mr. Jalopy is





at work restoring the mint green O'Keefe & Merritt from his childhood home. A key task is to clean and lubricate the valves that feed gas to the burners, chrome griddle and broiler.

Step 1: Turn off the gas at the nearest shutoff valve. **Step 2:** "The wonderful thing about gas ranges of this era is that 90 percent of their workings are accessible by just lifting the lid,"

Mr. Jalopy says. Pull off the knobs and unscrew the bolts holding the front panel. The valves are protected by a metal plate held by two screws. "These screws are usually corroded and ready to break," warns Mr. Jalopy. "Soak with a rust buster if necessary, and make sure you use a screwdriver that fits perfectly." **Step 3:** Clean away residual grease with rubbing alcohol, then apply a thin layer of valve cream to the conical valves. Test for leaks using soapy water.

THE SELF-RELIANCE ISSUE / **Soul of an Old Machine**

technology to kite-surfing equipment, credits the digital revolution. "You have 20-year-olds who grew up with Microsoft Windows, accustomed to complete control and personalization," Griffith says. "They want the same control over their physical objects. Repairing and making things does that."

Whatever the cause, diverse data points support the conclusion that a mechanical revival is underway: the ubiquity of home-improvement megastores and even more numerous DIY and man-and-machine shows on TV; the rise of websites such as FixItClub.com and RepairClinic.com; and the healthy traffic at the plans-and-advice section of PopularMechanics.com and at Instructables. Among this summer's most widely reviewed books was *Shop Class as Soulcraft*, a manifesto calling for renewed respect for mechanical skills, written by a



1971 John Deere 140 Lawn and Garden Tractor

OWNER:
John Fernandez, Brick, N.J.
HANDS-ON CARE:
Rebuild the carburetor



When computer systems analyst John Fernandez saw this old tractor for sale on the side of the road seven years ago, he fell in love. "I knew I had to restore it," he says. One simple task on such machines is rebuilding the carburetor, a job made easier by advice from enthusiasts at

WeekendFreedomMachines.com. **Step 1:** Get the service manual and a carburetor rebuild kit. Yep, Kohler still sells them. **Step 2:** Remove the carburetor and unscrew the bowl assembly. Place the parts in Sea Foam gas treatment overnight to clean out any gunk. **Step 3:** Replace everything from the kit. "Use all of the new gaskets and you're good for another decade," Fernandez says.

one-time philosophy post-doc turned motorcycle mechanic. (Hipsters in Brooklyn carry their copies in Crumpler messenger bags as they pedal restored Schwinn bikes to welding class.) The Internet has fostered communities of guitarists fixing old Fender amps, shade-tree mechanics endlessly rebuilding Volvos and steampunk show-offs grafting motherboards into antique-looking brass and steel contraptions.

Premature Demise

Mr. Jalopy is annoyed. An artist, business consultant and used-bike store owner in Los Angeles, the self-named tinkerer has become an outspoken advocate for keeping old machines running. "Repair culture is right in line with the rise of sewing, crafting and the slow-food movement," he says. "All of these are about engagement with the stuff around us." And he is troubled by the hands-off message that many modern products convey. Take the Apple iPhone. The battery is sealed into the phone, so when the battery goes the whole unit is supposed to be returned to Apple for an expensive and time-consuming replacement. For an indispensable digital tool, that's a death sentence.

"When a product can't even be opened, it takes away a fundamental aspect of ownership," Mr. Jalopy says. "If I can't repair it, then who owns it? What I'm buying is temporary use of an object that will soon [meet its] demise." In a world designed by Mr. Jalopy, cases would be easy to open and ease of repair would be a primary engineering goal.

There are products made that way—they're just not sold in electronics stores. Industrial mainstays such as jet airplanes and diesel locomotives can stay in service for decades, thanks to robust construction and maintenance-friendly design. Modular architecture in Xerox's commercial-grade copiers allows the machines to remain state of the art through multiple innovation cycles. Such "product life extension" strategies could be extended to more consumer products, says industrial ecologist and operations management specialist V. Daniel Guide Jr., of Penn State's Smeal College of Business. But whether people want them is uncertain—such items often cost more, and people tend to choose cheap, disposable goods over expensive, long-lasting ones. (For a sampling of durable, repairable products, see "Tomorrow's Classics," page 85.)

Complexities also arise with the question of what environmental benefits come from fixing, rather than replacing, broken items. As the heralds of the DIY resurgence point



1970s Millers Falls Dyno-Mite Electric Saw

OWNER:

Eric J. Wilhelm,
Oakland, Calif.

HANDS-ON CARE:

Swap in a new power cord

Everything about the sturdy circular saw Eric Wilhelm inherited from his grandfather is built for the ages, right down to the steel carrying case. With one key exception: The rubber power

cord had disintegrated with time. Wilhelm rewired the saw with a power cord filched from an old computer. Here's how it's done. **Step 1:** Disassemble the saw's casing by removing a few

screws. **Step 2:** Unscrew the positive, neutral and ground wires of the old power cord.

Step 3: Strip the three wires on the computer cord and secure them to the contacts. In Wilhelm's case, this work yielded a saw that cut strong and true. "I hope some of my tools are high-enough quality that they'll still be around for me to hand down," he says.





1968 Fender Princeton Reverb Amplifier

OWNER:
Steve Dube
Tolland, Conn.
HANDS-ON CARE:
Replace the tubes

Musician Steve Dube has a thing for using (and fixing) old tube amps. "They always sound warmer than solid-states," he says. When Dube came across a Fender Princeton Reverb identical to the first amp he ever plugged into, it looked "like it'd

been through a hurricane." But he couldn't resist. Replacing the tubes is always the most delicate operation. **Step 1:** Search out the right parts. Dube buys tubes from KCA NOS Tubes (kcanostubes.com) and sources schematics from SchematicHeaven.com or

Gerald Weber's *A Desktop Reference of Hip Vintage Guitar Amps*. **Step 2:** Avoid injury. "Drain all filter capacitors using a cap discharge cable," Dube cautions. "They can hold high voltages for days, and contact with them might kill you." **Step 3:** Clean the socket and pins on each replacement tube with Big Bath (tubesandmore.com) to ensure good contact.

out, it takes a lot of energy to mine raw materials, transform them into useful goods and ship those items from warehouses to stores to living rooms. "Repair is a small act to save money, but it's also small action to save the planet," Griffith says.

Broadly speaking, that's true. But it's difficult to determine the total environmental impact of a product—or just about any aspect of modern life. (It once took Griffith, who has multiple advanced degrees and won a MacArthur genius grant in 2007, several *days* to calculate his own carbon footprint.) Researchers who study the issue have identified a distinction between faddish electronics and the longer-lasting workhorses of domestic life. A paper in the journal *Environmental Science & Technology* reported that it takes 8 gallons of water and 3 pounds of fossil fuels and chemicals to build a microchip weighing just 2 grams. But the chips aren't used for long. "Consumer electronics are designed with six-month life cycles," Guide says. "All the energy embodied in them is consumed during the production phase—very little while they're being used—but we get rid of them quickly." If mobile phones could be upgraded rather than replaced, there would be a solid environmental payoff.

In contrast, many an ancient appliance could help the environment by retiring from service. "A washing machine is designed for a 20-year life cycle," Guide says, "and very little energy is consumed in its production. Almost all of it is used during the life cycle." New models of such appliances tend to be far more efficient than their predecessors—so if Wilhelm's dishwasher breaks again when it's 10 years old, he might want to dump it.

Machine Code

Malcolm Frazier, 35, of Stratford, Conn., learned small-engine repair and a mending mind-set from his father. For him, life-cycle analyses don't matter when the wheels come off a machine. Fixing the problem just feels right—it fulfills a personal code that combines self-reliance with thrift. "I don't throw anything out without trying to fix it first," he

CHANNELLOCK 421
PLIERS



Tomorrow's Classics

Buy them now, leave them to your kids.

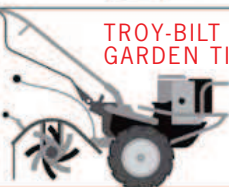
A pair of Channellock 421 pliers begins life as two pieces of high-carbon steel. Drop-forged and heat-treated, they are wedged together with a nut and bolt. Thereafter, the halves are joined for life. The jaws grip tenaciously without slipping. Maintenance? Practically none. Use an awl to clean gunk from between the teeth.

STANLEY POWERLOCK
TAPE MEASURE



Every tool reaches a point of perfection—any development thereafter is detrimental. Stanley's PowerLock tape measure resides at that pinnacle of engineering, with its slim chrome-plated plastic body and a spring-steel blade coated in Mylar. Keep it clean and reasonably dry, and it will last for decades.

TROY-BILT
GARDEN TILLER



Cast iron, and plenty of it, is the key to the Troy-Bilt tiller's success. The material dampens vibration, absorbs impact and acts as the perfect housing for the transmission's smooth-running bronze gears. Tune the machine's Briggs & Stratton engine, change the gear oil occasionally and if somehow you manage to bend a tine, bang it back into shape on an anvil. That's it.

REMINGTON 870
SHOTGUN



Harry S. Truman was president when the 870 was born. Since then, millions of the no-fuss pump guns have been purchased to hunt everything from doves to deer. A little light oil on the breech bolt and a good scrubbing with a bore brush and No. 9 solvent are all it takes to make this smooth slider last for generations.

says. Nothing is too humble—Frazier will replace the broken handle on a Swiffer sweeper—but he gets a bigger payoff with products like the stereo receiver he fixed not long ago. "I think I can usually do a better job than paying someone else to do it, and it makes me feel good knowing that receiver would have cost \$400 to replace. In my mind, I'm ahead \$400."

For Talbot Hack, 47, of Ann Arbor, Mich., diagnosing a leaky coffee maker or replacing the hard drive on a laptop is a welcome change from his work as a marketing executive. And, he uses repair as a way to connect with his teenagers. "I try to instill in my kids that they can feel confident taking on certain tasks," he says. Recently, he and his son solved an engine compression problem on a 20-year-old moped. "The lessons my kids learn are: Do a little research beforehand, break the problem down, go step by step and don't give up at the first sign of trouble," Hack says.

In the end, no accounting of monetary savings and carbon balances can outweigh the psychic rewards of taking charge of a concrete problem and resolving it. Old-school repair hobbyists and new-school garage hackers seem to agree that reanimating a machine or tool bound for the trash heap can yield outsize paybacks. "When you repair, there's satisfaction in understanding your world and having power over it," Griffith says. "You think, I know this machine. I brought it back from the grave. It's a part of me, and I'm a part of it." **PM**



THE SELF-RELIANCE ISSUE

The Race to Zero

For the Solar Decathlon, 20 teams of college students strive to build the most technologically savvy sun-powered house. This October their homes go head to head in a contest to consume the least energy.

By Harry Sawyers
Photographs by
Christopher LaMarca

7

Students juggle homework and hard hats at Santa Clara University, where they're out to prove that smart design and solar technology can power a net-zero house today.

ON A HOT AND BRIGHT CALIFORNIA DAY, THE red steel frame of a half-built house, its footprint a jagged stamp on the landscape, glints in the sunshine beaming down on Santa Clara University. Crawling around the crescent-shaped structure, workers holler measurements, fasten sheathing and snap chalk lines. They're wearing hard hats and tool belts, and the noise of steel swatting plywood sounds unmistakably like a job site. But this is hardly a construction crew out of central casting. Swinging a sledgehammer in this gravel lot somewhere between the quad and the cafeteria, a student volunteer with arms as skinny as the tool's handle tries in vain to pound a steel spike into the ground. He swings, misses and repeats, while the crew snickers. Each stroke gets more and more desperate, until, finally, a cartwheel swing sends the kid headlong. His oversized hard hat flies off and the crowd cracks up, prompting structural and construction manager Dan Ruffoni, a 22-year-old senior at Santa Clara, to intervene. Ruffoni sinks the spike in a few clean blows and progress resumes, but the sledgehammer slapstick has cost the rookie contractors 7 precious minutes. They really don't have 7 minutes to spare.

The students have been working 100-hour weeks all semester, running to the job site after class and doffing hard hats to take midterms. So far, they've managed to finance the project and file 138 pages of engineering drawings on deadline—not to mention pass their exams. But the big deadline, though still months away,



THE SELF-RELIANCE ISSUE / **Race to Zero**

is approaching fast. That's when the half-clad structure now rising from the campus will have to function as a super-efficient, sun-powered home of the future at the Solar Decathlon, in Washington, D.C. Sponsored by the U.S. Department of Energy this fall, the competition will pit 20 teams of college students against each other in an international showdown of innovative engineering. Team California's young roster tops out at age 23, whereas some schools attract Ph.D. candidates, or students Ruffoni describes as "old enough to look like they're already in the homebuilding business." As team project manager Allison Kopf puts it: "We don't have a construction background. We're undergrads—we have no background, period." But the students don't see that as a serious impediment; if anything, it has increased their drive to win.

Like many of his teammates, 21-year-old Preet Anand says

he "works on the project full-time and does school on the side." While workers whistle to "Layla" from a dusty boombox, Anand, the team's water systems leader, gestures to a rectangle of blue sky visible through the ceiling beams in the asymmetrical structure. "We're putting solar photovoltaics and flat-plate solar thermal collectors on the roof," he says, "and clerestory windows will provide simple daylighting. Our architecture is not only performance-driven, we want the house to look good." He describes his team's strategy as a "young, daring Silicon Valley approach"—and it's not without its challenges. Window shutters with thin-film solar collectors along the louvers had to be axed because of safety concerns. Certain products have proven to be so obscure that it was unclear whether they could be shipped to the U.S. For other prototypes, students have had to prove that new materials are up to code.

All this before crossing the last major hurdle: simply showing up at the competition. The members of Team California (which also includes students from California College



Preet Anand, far left, dismantles a mockup of the house framing. He says Team California's project can prove that renewable energy and efficient design are "a necessity, not a luxury." Above right, sophomore Allison Kopf makes cuts after class while freshman Victoria Watson holds the sawhorses steady.

of the Arts) must dismantle the house once they finally complete it and transport the pieces in three wide loads on a meticulously planned, 2848-mile journey across the country, only to reassemble the structure in just six days upon arrival at the National Mall. Then, they must move into their house for the duration of the competition. In the end, they're not just building a solar-powered home—they're proving that people can live in solar-powered homes, comfortably and without sacrifice. Teams have to shower in their houses, watch TV, do laundry and even host other teams for two dinner parties and a movie night.

During the competition, the DOE will open the solar village's 20 homes for public tours from Oct. 9 to 13 and Oct. 15 to 18. On Oct. 14, expert judges in 10 categories—including architecture, engineering and market viability—will comb through each home, scrutinizing details down to the placement of the lighting. This year, there's an added twist: The houses will be plugged into the Potomac Electric Power Company's grid,

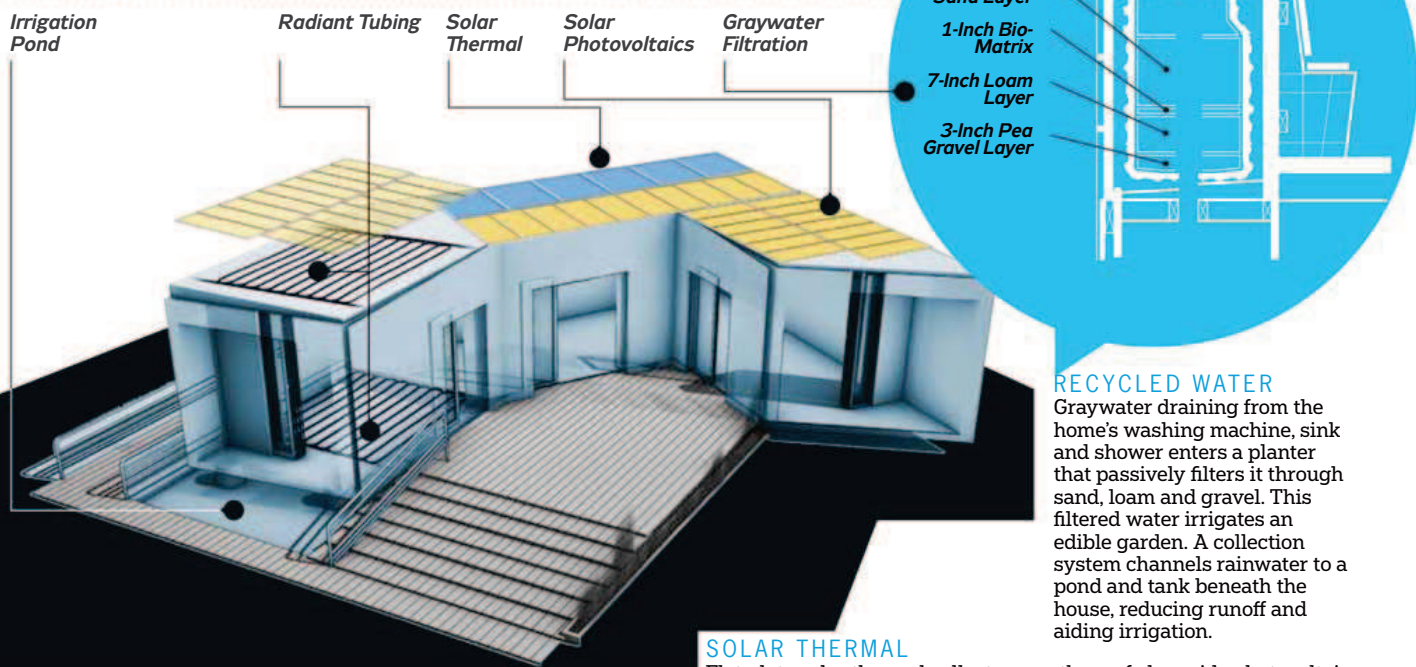
where real-time meters will monitor both the amount of energy consumed and the power each home feeds back into the system. Nationally, meters like these could help utilities respond more quickly to power outages or prevent rolling brownouts. At the Solar Decathlon, they will keep score—50 additional points go to houses that generate more energy than they consume.

Team California's heating and cooling system may help the house hover near that perfect zero. "Doing all the heating and cooling with electricity would take a lot of power from our solar panels," 23-year-old thermal design leader Tim Sennott says. So the students drew up an elaborate system in which solar thermal collectors heat and cool the house through radiant tubing in the floor and ceiling. An energy-recovery ventilator maintains a constant indoor temperature and humidity, further reducing HVAC demands. "What we designed is a whole ton more complicated than something we would ever put in a residential home," Sennott says. "We're trying to do stuff with technology that's not mainstream yet." The tactic can be risky. In July, the supplier of the cooling system's solar-powered absorption chiller pulled out, leaving students scrambling for an alternative.

The Solar Decathlon has a precedent of such edgy approaches, according to its director, Richard King. Students in years past have adopted solar technologies that were

How It Works

Team California's systems harness both the sun and rain—to keep the house's consumption at net-zero, nothing can go to waste.



RADIANT TUBING

Hot fluid from the rooftop solar thermal system transfers heat to water in PEX tubing in the floor panels, warming rooms. A second array of tubing in the ceiling can provide radiant cooling—an unusual twist. Cold water routed from a heat pump flows overhead, absorbing heat from the rooms and lowering the indoor temperature.

Solar Scholars

Remarkable ingenuity defines every Solar Decathlon house. But these three standouts employ fresh technology and radical architecture to solve specific challenges.



BOSTON

Team Boston, comprising Boston Architectural College and Tufts University, wanted to keep its house's market price below \$300,000. So students opted for a modular \$200 Enphase micro-inverter—which converts DC into AC power—rather than a \$3000 converter that typically handles the whole photovoltaic array. Ross Trethewey, the team's solar thermal engineer, also specified flat-panel thermal collectors at a third of the price of comparable evacuated tubes. "This isn't as flashy, but it's going to be affordable," Trethewey says, "and that's sustainable."

VIRGINIA

Sensors on the concrete floor inside Virginia Tech's house and a weather station on the roof detect temperature changes inside and out; a series of sliding panels, inspired by functional shutters, move across the front of the structure to adjust the interior climate accordingly. "The 'responsive architecture' strategy allows the user to easily manipulate shade and insulation screens to block harsh weather conditions, as well as open the house up when the weather is good," team leader Alden Haley says.

ARIZONA

The sun doesn't hit the top of a house at quite the same angle in Duluth, Minn., as it does in, say, Tucson, Ariz. So the University of Arizona's house has a pivoting hinge that can adjust the one-piece southern wall and roof assembly to catch rays at the optimal angle. An airflow channel and a layer of insulation beneath the panels lowers their temperature. "Rooftop surface temperatures around here can get up to 150 F or 160 F," project manager Matt Gindlesparger says. "PV panels are rated to tolerate even higher temperatures. But they're a lot happier when they're cooler."

"hardly even heard of at the time," King says. The competition gives the public a chance to see these new technologies work together as a system—some, like California's radiant cooling, for the first time.

Santa Clara's 2007 Solar Decathlon house, its boxy frame crowned with solar panels, stands a short walk from the current job site. In its sunny living room, sitting in a chair made from reclaimed wine-barrel staves, Anand pulls a tape measure from his back pocket and points to handsome bamboo joists along the ceiling. The 2007 team wanted to develop bamboo-based structural materials, he says. That idea caught the eye of the company Teragren, which sent unfinished bamboo for the students to test in a Tinius Olsen machine—a massive contraption that stresses I-beams to evaluate tensile strength and shear-load capacities. That year, underdog Santa Clara took third place. The students' joists, now certified under multiple international building codes, will soon be on the market.

"It's one thing to manufacture a product, but it's another to have it installed in a building that meets code," says Tom Goodham, Teragren's vice president of opera-

tions. "The beauty of putting products into an actual building is that it helps people understand it's not just conceptual. This is a material that's ready to be used, that can be integrated into design today." Working with Santa Clara on this year's house, Teragren revised the joist to create open-web floor trusses. The elegant, trestle-shaped bamboo beams have openings to run conduit, simplifying installation.

But really, all the cutting-edge technology eclipses the core challenge—building a house isn't easy. Try doing it on top of a full college course load. Despite the occasional decision Ruffoni describes as "so embarrassingly wrong that only students would do it," his teammate Anand credits their team's inexperience as a major asset. Unfamiliar with the sobering constraints of actual construction, he says, "The only thing we had to apply was creativity." **PM**

Clauss® SpeedPak® Utility Knife Instructions

STEP-1

Insert 10 Blade
Titanium Cartridge

STEP-2

Back to work



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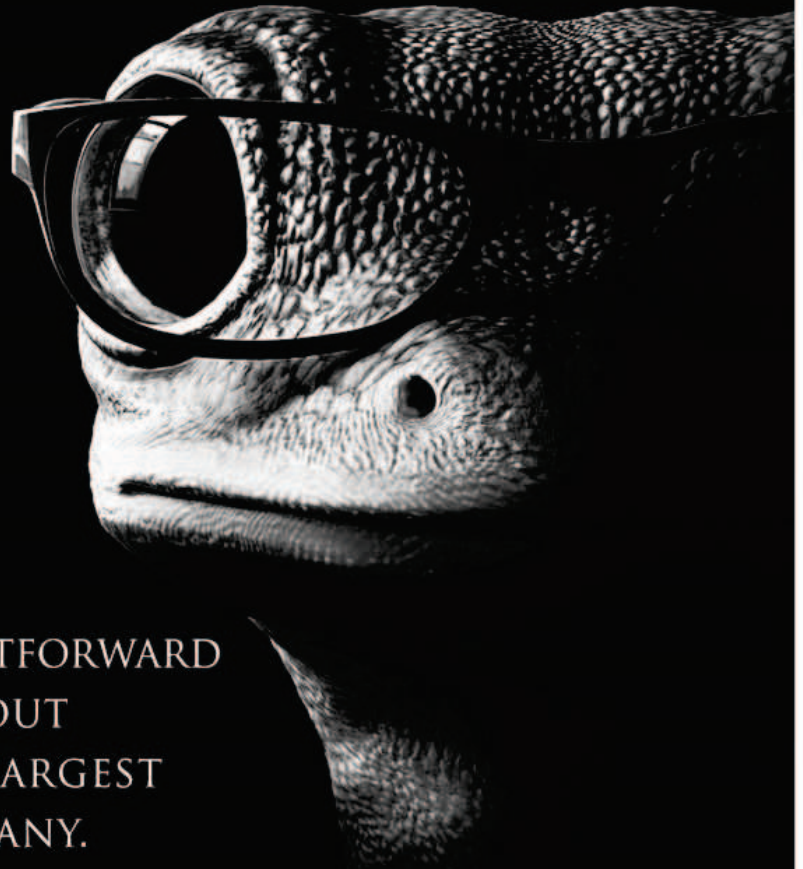
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Quite frankly, there's nothing I enjoy more than rolling up my sleeves and getting to work (though it should be noted I'm not in the habit of wearing shirts, either). After all, GEICO has been around for over 70 years — and that isn't simply a matter of luck. It takes dedication and skill to help people save hundreds of dollars on their car insurance. Of course, it also helps to be owned by Warren Buffett's Berkshire Hathaway Inc. So it should come as no surprise that when it comes to financial security, GEICO is consistently rated "excellent" or better by independent experts. Or that over 3 million drivers switched to GEICO last year. Clearly, when it comes to car insurance, I mean business. Even if the same can't be said of my attire.

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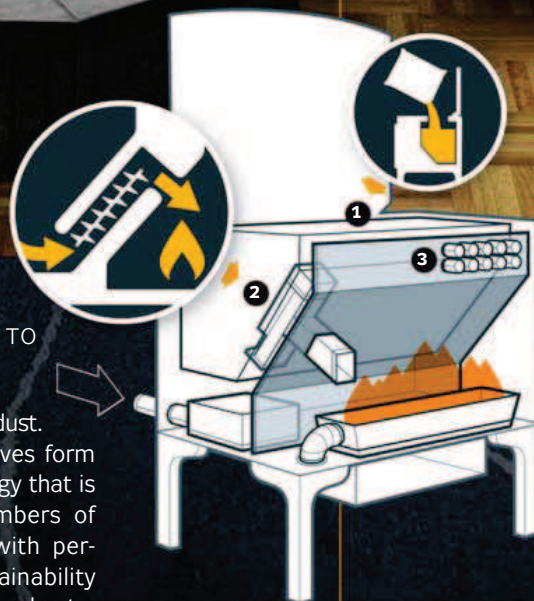
RAISING CHICKENS + GEOTHERMAL
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DIY Home



Pellets In, Heat Out

Wood pellets are loaded into the stove's hopper (1) and are fed by auger (2) to a fire pot. The pellets are ignited and the hot combustion gas swirls upward. A blower drives indoor air through heat-exchanger pipes (3), and the air discharges into the room.



Sawdust Melodies

PELLET STOVES OFFER A MORE SOPHISTICATED ALTERNATIVE TO THE TRADITIONAL WOOD STOVE. *BY JOE TRUINI*

Last winter, Connecticut homeowners Keith Goodrow and Jody Willis began looking into ways to cut their fuel bills. Goodrow, a civil engineer, and Willis, a veterinarian, were spending about \$3000 a year on fuel oil to heat their ranch home and to produce hot water. Looking for a way to trim that number, they decided to follow the lead of a neighbor who had installed a stove that burns pellets made from

wood, or, to be precise, sawdust.

These clean-burning stoves form one leg of a dual-fuel strategy that is appealing to growing numbers of homeowners concerned with personal independence, sustainability and cost savings. Unlike oil and natural gas, wood pellets typically are produced close to where they're used—reducing the energy used in transportation—and they come from

ILLUSTRATION BY GABRIEL SILVEIRA

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a renewable resource. Most compellingly, the pellets are made from a saw-mill waste product—no trees are cut just to manufacture them.

Then there's the cost advantage: Oil and natural gas are tightly tied to a global system that's sensitive to political disruptions and refinery-damaging hurricanes in the Gulf of Mexico, both of which can cause prices to spike. (An online calculator maintained by Penn State helps homeowners compare the costs of various fuels: energy.cas.psu.edu/costcomparator.html.) Federal tax credits are helping to make such stoves more attractive as well. Taxpayers can receive a credit of 30 percent, up to \$1500, for the purchase and installation of a 75 percent efficient biomass-burning stove in 2009 or 2010. By leaving a conventional system in place, homeowners can hedge their bets—at times, fossil fuels may well be less expensive than pellets. "What drove our decision was the economics," Goodrow says. He expects the \$6000 investment in the stove, including its installation and a large bulk fuel purchase, will pay for itself in less than three years.

In the Hopper

A pellet stove is simpler to operate than a classic wood-burning stove, but it's certainly not as hands-off as a conventional furnace. "Our whole culture is built around giving the consumer products that you can plug in and forget," says Dan Freihofer, vice president of operations for PelletSales.com, a pellet provider. "But the pellet stove takes a little more involvement. You've got to fill it every day, and clean the ash out every few days. The archetypal owner is someone who isn't daunted by a little technology—an engineer or someone who likes to tinker." There are two basic stove types: inserts that fit into a fireplace and freestanding models, like the Lopi Leyden that Goodrow and Willis bought. This stove produces 45,100 Btu per hour, roughly matching the output of a small residential boiler or furnace—enough to

heat 2250 square feet of living space.

The homeowner pours pellets into the hopper and tinkers with settings to determine how fast the fuel will burn, and thus how much heat it will throw off. Some stoves can even be connected to a wall thermostat, allowing you to turn the heat up or down as though it were a furnace. When the stove is in operation, an electrically driven auger meters fuel into the fire pot. The fuel is ignited and hot combustion gases wind their way through a tubular heat exchanger at the top of the burn chamber. The gases transfer their heat to the exchanger and are then pulled outside by an exhaust blower. Air from

the room is pulled through the heat exchanger and warmed before discharging into the room.

Depending on the burn rate, a stove will run anywhere from several hours to all day before its hopper needs another load of fuel. Each pellet is an energy-dense sawdust extrusion that measures about 1/4 inch in diameter and 3/4 inch long. The average household uses between 2 and 3 tons per heating season. Last winter a ton of pellets (50 40-pound bags) cost about \$200 to \$275—providing, that is, you could find



THE PARTS

- 1. Warm Air Blower** circulates air from the room through the heat exchanger and back into the room.
- 2. Auger** moves wood pellets from the hopper to the fuel chute.
- 3. Fuel Chute** guides the pellets off the hopper and into the fire pot.
- 4. Pellets** are energy dense extrusions formed from hardwood and softwood sawdust.
- 5. Igniter** starts the pellets burning electrically, no matches needed.
- 6. Fire Pot** holds about a handful of burning pellets. It's set against a refractory firewall and cast-iron floor.

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PM DIY HOME /// PELLET STOVE



1



2

THE INSTALLATION

1. A hooded vent supplies outdoor air for combustion. This prevents the creation of negative pressure in the house (caused by combustion) and the risk of drawing CO into living areas.
2. Exhaust joints are sealed with high-temperature silicone caulk.

them. The pellet industry got a sooty black eye over the last few seasons in regions where demand outstripped supply. The producers and retailers say they have fixed the problem for this year with better production methods and logistics. Just to be sure, many stove owners started placing orders in the spring. Some groups of owners started pooling their orders to buy a whole tractor-trailer load of fuel at a time—bringing down the price while ensuring they'd have pellets once the temperature drops. "Supply looks dramatically better this year," Freihofer says. "Supply will exceed demand."

Hole in the Wall

To see how these heaters go in, I visited Goodrow and Willis to help the dealer install their Leyden stove—and tried not to get in the way. The process turned out to be straightforward. First, the two-man crew from Dean's Stove and Spa, in Plantsville, Conn., set down a UL-listed hearth pad with a pedestal base that would raise the 400-pound stove about 7½ inches above the floor. Next, we located wall studs, and temporarily set the stove in place to decide where to run the vents through the wall without hitting any studs.

With the vent locations determined, we moved the stove and

bored a pilot hole as the center mark for the exhaust vent. Next, we cut the interior wall surface with a dry-wall saw. Outside, we used a reciprocating saw to remove wood siding and sheathing and fitted the wall thimbles into their holes. This hardware provides a noncombustible surface to pass the exhaust pipes through. We used essentially the same method to install a fresh-air intake vent, which would supply outdoor air for combustion. Then we fastened all the exterior vent surfaces to the siding and caulked with high-temperature sealant.

Back inside, we set the stove on the hearth pad and connected the vents. The fresh-air vent connects to the stove bottom with a flexible corrugated vent pipe, while rigid metal pipe runs from stove to exhaust. Finally, we attached the hard-wired thermostat, which comes with the stove. (For added convenience, wireless remote thermostats are also available for about \$150.)

The installation done, we plugged in the stove and filled its hopper. The auger delivered pellets to the fire pot, and the automatic igniter lit the fuel. In no time, the room was glowing with warmth.

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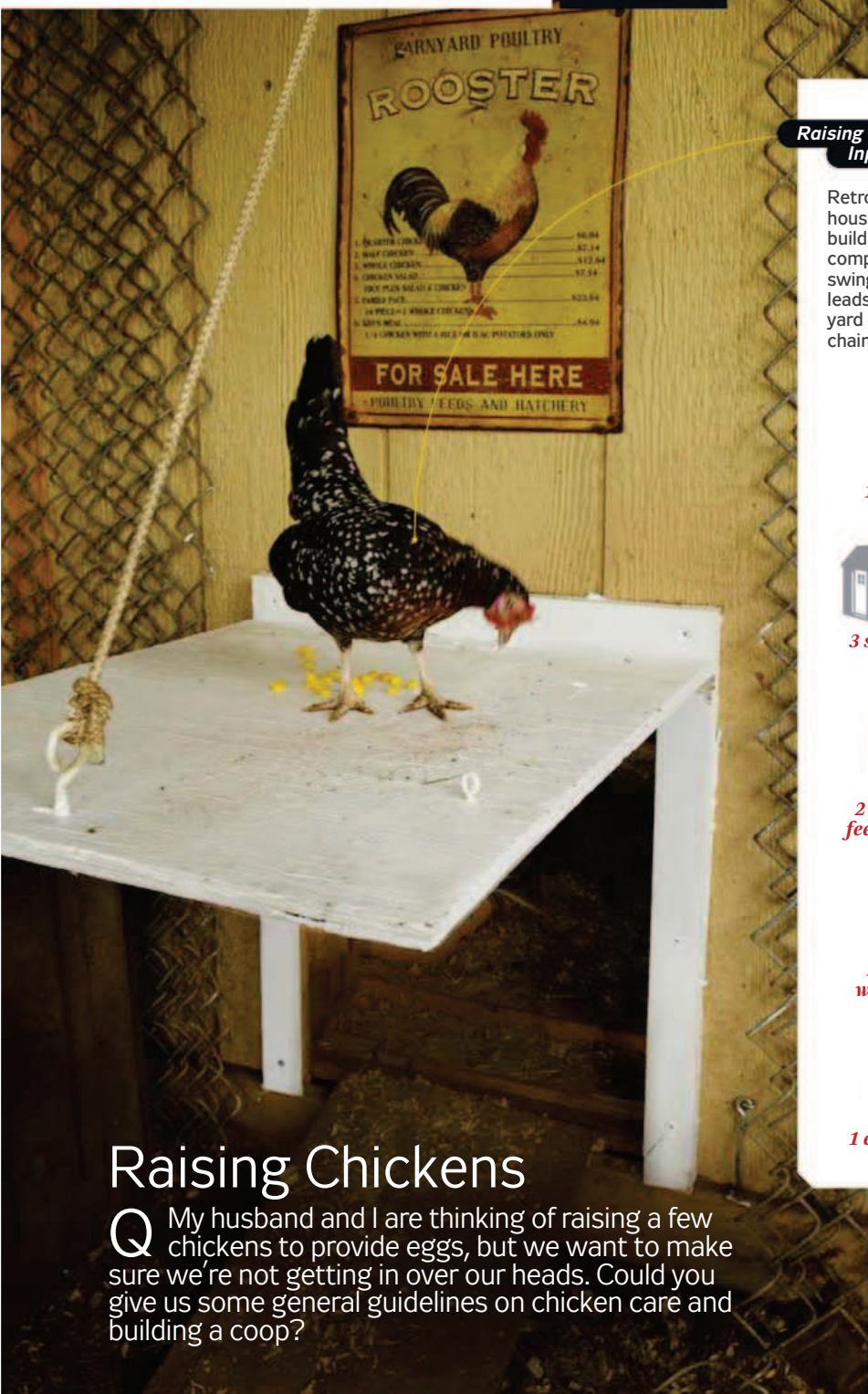


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Homeowners Clinic

by Roy Berendsohn

Q + A



Raising Chickens Input / Output

Retrofit a shed to house chickens, or build a small coop, complete with a swing-up hatch that leads to a chicken yard enclosed by a chain-link fence.



1 chicken

+



3 square feet

+



2 pounds of
feed per week

+



2 cups of
water daily

=



1 egg per day

A Lots of people with no farming background have started raising chickens in the past few years, mainly to add a satisfying dose of self-reliance to their daily diet. You can raise chickens anywhere that zoning laws don't prohibit it, from a small yard in a rural township to the heart of many big cities—the project doesn't take much space. My first piece of advice is to start slow. "One of the most common mistakes made by novice chicken owners is getting too many birds too fast," says Gail Damerow, who has raised countless chickens and written several books on farm-animal care, including *Storey's Guide to Raising Chickens*. A laying hen produces an egg a day, so it doesn't take more than a couple of birds to put breakfast on the table. That's your output. As for input, count on providing each bird with 2 pounds of feed per week and 1 to 2 cups of clean water a day. (But your chicken mileage may vary—as Damerow points out, "Chickens haven't read the books.")

The size of your flock determines the size of the coop you build. If anything, err on the side of making the structure a little larger than you think you'll need. Damerow advises 3 square feet of floor area per laying hen. "The coop size requirements I follow are often criticized as being too spacious," Damerow says, "yet my chickens rarely experience the health problems I hear about from

ILLUSTRATIONS BY GABRIEL SILVEIRA

Raising Chickens

Q My husband and I are thinking of raising a few chickens to provide eggs, but we want to make sure we're not getting in over our heads. Could you give us some general guidelines on chicken care and building a coop?

other chicken keepers."

When it comes to building the structure, a chicken coop is much like any small outbuilding. It's wise to keep it simple and inexpensive, yet sturdy enough to safely house animals. The gold standard of coop construction is to pour a slab of concrete and erect the building on that. This design is suitable even to meet organic poultry standards. If you're not concerned about these stringent requirements, build the base and floor out of pressure-treated lumber.

Finally, check with your local agricultural extension office or other amateur poultry raisers to find out about carnivorous varmints that live in your area. They range from raccoons, skunks and weasels to coyotes. When I was a kid, local farmers dealt harshly with these critters, usually with a shotgun blast. I'm not embarrassed to say that as a young guy who hunted on those farms, I had no qualms about assisting them.

The times have changed, though. Before you pull the trigger on a pest, know what your responsibilities are. Laws regarding varmint control vary by state. The firearm method aside, take sensible precautions against animal intruders. Those Yankee farmers kept a tidy coop. They knew that local predators were stealthy and needed cover, so they removed piles of brush or rocks from anywhere near the coop, and they mowed nearby to keep grass short.

We haven't dealt with aesthetics here, not a topic normally associated with these buildings. Still, I don't see why a coop has to be ugly. The poultry plans offered by North Dakota State University Extension Service on its website (some going back to the 1930s) are particularly attractive exam-

ples. Even if the architectural niceties are lost on the birds themselves, they won't be overlooked by your neighbors. And if you decide some day to leave chicken-raising behind, at least you'll be left with an attractive structure. Sanitized and repainted, the coop could go on to a second life as a garden shed or to enclose firewood.

Flood Control

I live in an old house with a sump pump that sits in a murky, muddy pit. The pump failed recently after the pit partially caved in. I need to upgrade the whole setup.

Where do I start?

It's a long shot, but buy a plastic sump liner and lid and see if it will simply fit in the hole. If it does, fill the space between the liner and pit wall with clean gravel and declare victory.

Assuming that doesn't work, dig a new sump pit. This is a tough and muddy job that will require a stout shovel, a wrecking bar and perhaps a posthole digger. You may even need to rent a wet-cutting pavement saw or an electric jackhammer to remove some of the existing basement floor.

Make the hole large enough to surround the plastic sump liner with a layer of gravel about 2 to 3 inches thick. In addition to the plastic sump liner and lid, you'll need a new pump. If the old pump discharged using a makeshift setup, then install new PVC pipe and a back-flow valve. (Search for "Installing a Sump Pump" at *popularmechanics.com*.)

If the outlet supplying the pump is not GFCI-protected, complete the installation with an electrical upgrade. Install a GFCI receptacle in the pump's outlet box. Uncomfortable with this work? Call in an electrician.

PM

? **Got a home-maintenance or repair problem?** Ask **Roy** about it. Send your questions to pmhomeclinic@hearst.com or to Homeowners Clinic, Popular Mechanics, 300 W. 57th St., New York, NY 10019-5899. While we cannot answer questions individually, problems of general interest will be discussed in the column.

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Free armored safes being doled out to public

Armored Safe giveaway ends public worry for those who rush to buy up hoards of brilliant, never-circulated U.S. Gov't issued coins that will never lose their cash value



■ **HELP IS ON THE WAY:** This never-before-seen photo captures the rapid shipment of free Presidential Armored Safes (left) that are now being shipped to U.S. citizens all across the country. The World Reserve is also making available the larger Grand Presidential Armored Safes (right) free to the general public who beat today's published deadline to buy up the newly released Collection of never-circulated U.S. Gov't issued coins and currency. Those who get through by calling the National Delivery Hotline at 1-866-964-2951 and beat the 7 day order deadline will get the Armored Safes for free.

By Shawn Oyler

UMS - Imagine finally getting something that will never lose its value.

Sounds too good to be true?

Well, it's true and word is quickly spreading about the free handout of Armored Safes that are being stocked full of never-circulated U.S. Gov't issued coins and currency that by law will never be minted again.

These free Armored Safes are being turned over to the general public who make it in time to beat the order deadline for their share of the hoard of brilliant, never-circulated U.S. Gov't coins and currency before the 7 day shutdown.

"The frantic demand for U.S. Gov't coins has caused the U.S. Mint® to officially halt the sale of many of its most valuable coins," said lead consultant for the World Reserve Thomas C. Harris, Retired Deputy Director of the U.S. Treasury Bureau of

Engraving and Printing.

"Today, the World Reserve began to release this hoard of U.S. Gov't coins and currency in a free Armored Safe to the general public. Having valuable U.S. Gov't coins serves as an economic life raft. This valuable Collection will never, never, never lose its face value. You will always have something worth a lot of money," said Harris.

Here's the best part, among the U.S. Gov't issued coins and currency that everyone gets is the highly sought after American Eagle 1-ounce silver bullion coin made from solid .999 fine silver, 250 of the first liberty engraved Westward Journey Nickels, a banker's stack of historic \$2 bills and a full vault tube of the Presidential Golden Dollar Coins.

Here's why that is so important. Just think if you would have saved the same number of never-circulated Eisenhower Dollar coins from 1974. Remarkably, they would

now be worth 500% more in collector value.

This gives you a hint that these are not the same grade as the coins found in loose change, or from the local bank. In fact, these coins remain in brilliant, never-circulated condition if left sealed and untouched.

U.S. Gov't Savings Bonds used to be a favorite way to keep money safe and popular to give as gifts. But no one can take a Savings Bond and go buy something with it.

That's why this hoard of valuable coins gives everyone the comfort of having full control of their money. No matter what, they will never lose their U.S. cash value.

If times ever get really tough any coin in the hoard could be used to buy anything. But unless it is a good reason, only a fool would do that because this personal hoard of money is already worth so much more in

collector value.

"So many people are buying up these coins. Even for those people who give away some of their collection as gifts, they are keeping the Armored Safe for themselves," said Robert Anthony, Director of the private World Reserve Monetary Exchange.

"This Safe is one of the absolute best places to keep valuables and important papers. People will now have a safe place to store their wills, guns, jewelry, antiques, keys, coins and even cash," Anthony said.

"The only problem the Safe creates is when it's time to read your Will. You need to make sure everyone knows who you want to leave it to," he said.

"When Americans get their hands on this Safe and their very own personal hoard of U.S. Gov't Coins, they'll really do a double take. Everyone will feel like they just won the lottery," he said. ■

How to get the free Armored Safes

All those who beat the 7 day order deadline for each personal hoard of U.S. Gov't issued coins and currency from the World Reserve Collection will actually be awarded the Presidential Armored Safes absolutely free.

Eligibility: Certain restrictions apply: Open to the public only, sorry no dealers. Those who miss the 7 day deadline will be turned away from this free offer and required to wait for future announcements, in this or other publications. The entire World Reserve Collection must be obtained to get the safe free. For more information about the larger Grand Presidential Armored Safes please call.

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■ **LIKE WINNING THE LOTTERY:** Everyone gets the personal hoard consisting of 267 never-circulated U.S. Gov't coins and currency including 12 Presidential Golden Dollar Coins in a sealed Vault Roll, a heavy vault brick containing 250 of the first liberty engraved Westward Journey Nickels and, best of all, a solid .999 fine silver American Silver Eagle and a banker's stack of 4 historic \$2 bills. If times ever get really tough, any coin in this collection could be used to buy anything. Keep it as long as you can because this hoard is already worth so much more than face value.



■ **NO MORE WORRIES:** Carolyn Ford of Perry Town, OH thought she hit the jackpot when her free Grand Presidential Safe was delivered. "I already have some old coins, but I wanted this whole hoard of U.S. coins as a nice nest egg. I'll also set aside some of my hoard for my Grandchildren. Now I don't have to worry where to keep my important papers and my Grandfather's gun since I have my new safe," she said.



7 Smart places to stash your cash

By Aaron Robinson

So you're still hiding money under the mattress or in the bread box?

Well, you're not alone. Ever since financial institutions have been dropping like flies, millions of Americans have stopped relying solely on their banks.

1. Be sure your bank is insured. If you're not sure if your bank is FDIC insured find out or get your money out. They only have enough cash on hand to cover about 2% of nationwide deposits. So it's not always wise to keep all your eggs in one basket.

2. Start and grow a coin collection. Coin collections are tangible assets that will always keep their face value, instead of just owning stocks that could depreciate or lose you money.

3. Keep cash safe at home. Cash is King. Believe it, but remember not to keep it in a thief's favorite spot; like in the bread box or the mattress. These will never have the protection that a quality home safe can provide.

4. Savings Bonds, an old favorite. Savings Bonds are an easy way for your money to stay safe in the future. However, if lost or stolen they could be difficult to replace unless the serial number was kept in a safe place.

5. Gold and silver still shine. If you own gold or silver, great, hold on to it. But if you don't, one of your best bets is to try to get as many U.S. Gov't issued gold and silver coins as you can.

6. Hold on to real estate. With interest rates at historic all-time lows the market is sure to recover and property values will once again bounce back. So those who hold on to their homes for the long term will likely reap the benefits of these investments.

7. Buy a good safe. Home safes become an absolute necessity during economic turmoil. But, because of the huge spike in recent sales, safes may be hard to come by.

With all this you'll be much safer, just in case your bank is the next to fail. ■

How Your House Works

DRILL AND FILL
Installers thread pipe into a hole a few inches wide and over 100 feet deep. As wind and solar hog the alt-energy spotlight, this technology has remained underground.

Geothermal: Dig It

EFFICIENT AND ECONOMICAL, GEOTHERMAL HEATS, COOLS AND CUTS FOSSIL-FUEL USE—WITH A HEALTHY RETURN ON INVESTMENT.

efficient shortcut to the target temperature. Imagine a 100-degree Florida day or a 0-degree Michigan night: Spot the system 50 degrees, and it doesn't work so hard to get the house comfortable.

Unlike wind and solar, geothermal's power source never varies. Bob Brown, vice president of engineering with equipment maker WaterFurnace, says, "The ground's there all the time. It's great for heating and it's great for cooling. All I've got to do is bury a plastic pipe, put fluid in and, lo and behold, I've got a great system."

"You're not making heat, you're moving heat," Colorado geothermal installer Jim Lynch says. Installations like Lynch's tap into the earth below the frost line—which always stays around 50 degrees Fahrenheit—to reduce a home's heating and cooling loads. All HVAC systems require energy-intensive heat movement, a task responsible for over half of the average house's total energy demand. Geothermal works more efficiently because the system's mild starting point creates an

by HARRY SAWYERS



GATEFOLD
PULL OUT

pm do it yourself

PHOTOGRAPH BY MERLE HENKENIUS

HOW GEOTHERMAL HAPPENS

→ **IN THE GROUND:** A water-filled, closed loop of 1-inch high-density polyethylene (HDPE) pipe ferries heat between the earth and the house. Pipes descend 4- to 6-inch-diameter vertical wells—the number and depth depend on the house's site and size—before ganging together in a header and bringing lukewarm water in through the

basement walls. Drillers backfill each hole with bentonite grout (or new enhanced grouts, engineered with fly ash) to maximize thermal conductivity.

→ **IN THE HOUSE:** Pumps cycle water through the pipe loop to the heart of the system: the geothermal unit, which acts as furnace and air conditioner. This

The Installation



THE BIT

This mud-drilling bit grinds soft earth and funnels it back into hollow, 20-foot drill-shank sections. Corkscrew auger bits, in contrast, pound through solid rock. A new mud bit spinning at 1000 rpm, pushing downward with between 300 and 500 pounds of pressure, is good for five 150-foot holes.



THE PIPE

Water-filled HDPE pipes absorb heat through their walls. This sawed-off cross-section shows two pipes fused in a butt joint made by pressing the molten edges together at over 500 F. The joint, stronger than the walls of the pipe itself, resists rust, rot and leaks for a purported 200-year life span.

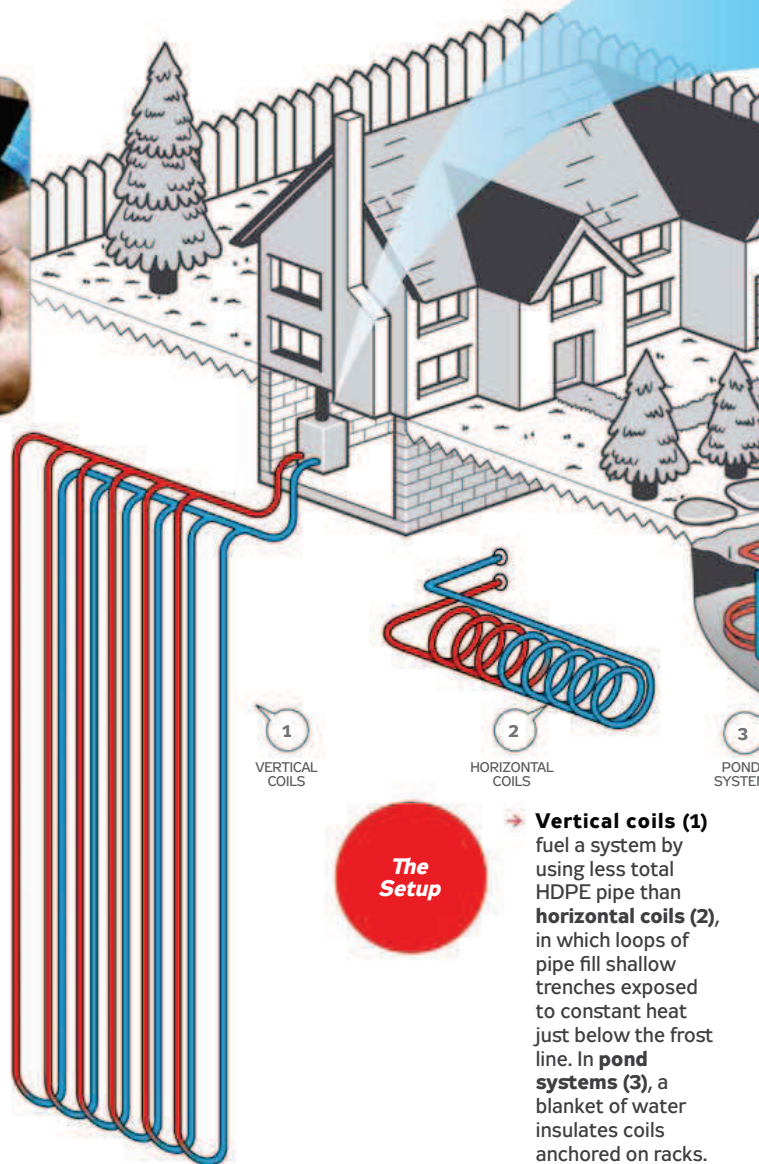


THE UNIT

A combined furnace and air conditioner, the geothermal unit manages all-season



climate control from the basement. Using the same principles as a refrigerator, which removes heat from food, this machine and the buried pipe remove heat from the earth or from the house. Wired to a 50-amp circuit, it works without venting, combustion or risk of carbon-monoxide poisoning.



The Setup

→ **Vertical coils (1)** fuel a system by using less total HDPE pipe than **horizontal coils (2)**, in which loops of pipe fill shallow trenches exposed to constant heat just below the frost line. In **pond systems (3)**, a blanket of water insulates coils anchored on racks.

Geothermal Misconceptions

1

IT'S A GEYSER.

Hot springs and other steamy subterranean liquids are not related to residential geothermal. Those are unusual local seismic circumstances. Home systems work everywhere.

machine uses refrigerant and the temperate water from the underground pipes to heat or cool air. The air is then circulated through standard ductwork. With a device called a desuperheater, the unit uses excess heat to warm up domestic hot water at no added cost. The results feel the same as those from any standard forced-air HVAC system.

CASE STUDY A typical 2000-square-foot home in Commack, N.Y., was recently retrofitted with a geothermal system. Tax credits, the inefficiency of the existing system and a low-interest loan combined to create immediate savings. The monthly payment is now \$24 lower than the old monthly HVAC expense.

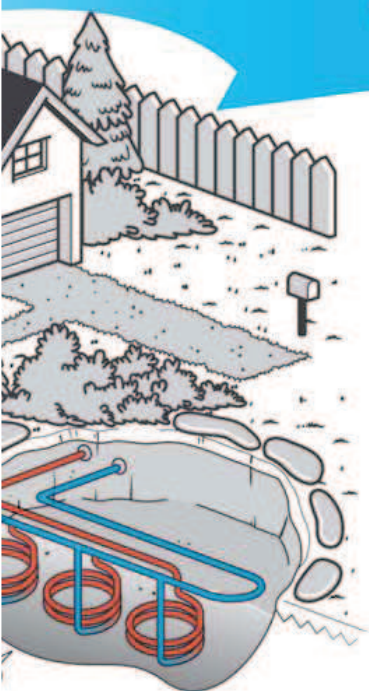
Installation cost: \$30,000 - \$11,000 (tax credit) = **\$19,000**
Annual costs: \$3945 (old system) - \$2076 (geo) = **\$1869 saved**
Payback period: \$19,000 / \$1869 = **10.17 years**
Monthly fuel costs for old system: **\$329**
Monthly geothermal costs: \$173 (power) + \$132 (loan) = **\$305**

The Flow

→ **Air in the ducts (1),** refrigerant in the geothermal unit (2), and water in pipes (3) flow past each other like interlocking gears. Water brought from underground transfers heat to

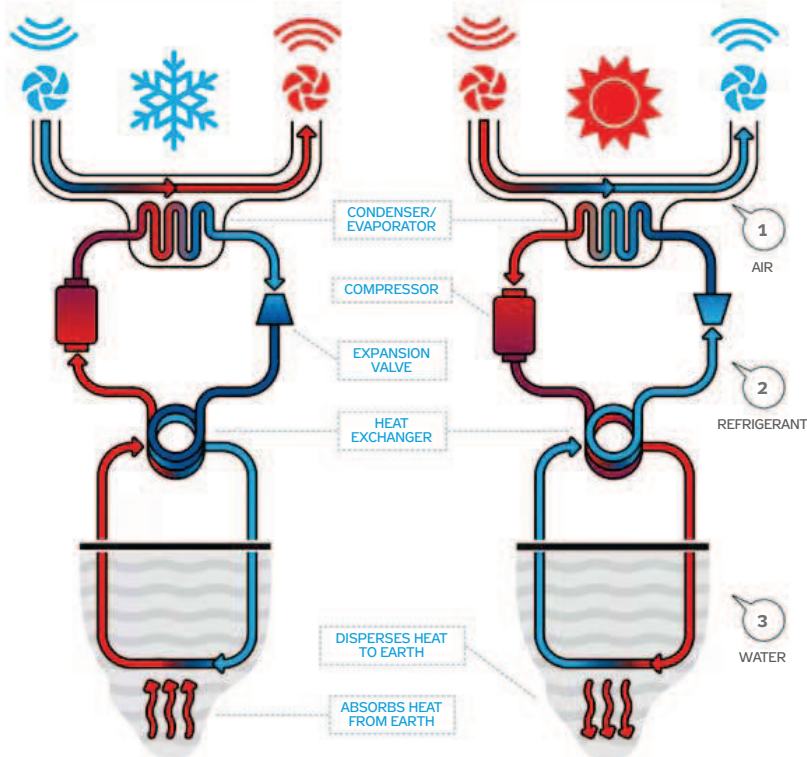
the refrigerant, or absorbs heat from it, depending on the season. Like an air conditioner, the unit compresses or expands the refrigerant to raise or lower its temperature. Finally,

the refrigerant, now heated to 180 F or chilled to 40 F, fills condenser/evaporator coils. Air in the ducts blows across the coils to be cooled or warmed, then flows through the house.



WINTER HEATING

SUMMER COOLING



Hard ground can inhibit deep digging, stopping Colorado installers like Jim Lynch from doing simple vertical work: "Texas, Nebraska—that's some easy drilling down there," Lynch says. His clients receive options 2 and 3. If an existing system gets a geothermal

upgrade, it may operate as geothermal 90 percent of the time, while the old boiler or furnace fires up only on the coldest days of the year. The payback period on retrofits averages 12 to 15 years; on new installations, it can get as low as three to six.

2

THE WATER TABLE IS IN THE WAY. Installers drill straight through it. On Long Island, where the water table is just a few feet below the surface, saturated sand makes for some of the best drilling and most efficient heat transfer possible.

3

IT GENERATES ELECTRICITY. Industrial-scale geothermal power plants can generate electricity. Home systems don't—but they do save electricity (or fuel) by replacing conventional home heating and cooling with more efficient equipment.



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The New Moonshiners

HOME-BREW BIODIESEL WILL LET YOU TURN USED FRY-OIL WASTE INTO HIGH-QUALITY DIESEL FUEL. IT'S SIMPLE, BUT NOT NECESSARILY EASY. BY JOHN DECKER

"Make your own diesel for 70 cents a gallon," the Internet ad claimed. I was tired of paying for 30 gallons of regular diesel each week to fill my pickup, so I downloaded the instructions. It wasn't long before I was sucking used



Senior editor Mike Allen (who used to teach organic chemistry in a previous career) gloves up to pump methanol into the processor.

pm do-it-yourself

Do you have constant **RINGING** in your ear?



Finally, new discovery for quiet relief!

A breakthrough by a rock drummer finds combination of scientifically advanced ingredients combined with homeopathy to silence the ringing, which could save thousands from risky and expensive treatments.

Every night for almost 18 years, if I couldn't find a fan, turn on a tv or find loud static from a vacant radio station, then sleeping was impossible. The high-pitched ringing, buzzing and humming kept me up at night. Sluggishness, tiredness and lost energy would be my nemesis the next day. Gathering the energy for my next gig was my goal everyday - a routine of coffee, then aspirin, which made it worse. I couldn't take it - it was a major problem. I couldn't sleep. I couldn't concentrate. I heard it constantly, I couldn't hide from it. Everywhere I went, it wouldn't go away...It drove me nuts! Headaches, depressive mood swings, testiness, constant state of anxiety. Due to the tenacity of Tinnitus (the ringing in the ears from exposure to loud noises, or in my case, pounding on drums and loud distorted guitar amps behind my head for years), I was determined to find real, pure, silent relief and I did with Quietus™...

Tinnitus - Who's at RISK?

Outdoor Workers

- Carpentry & Construction
- Mining, Drilling & Farming
- Airport Workers

Indoor Workers

- Machine Operators
- Night Club Workers
- Musicians

The symptoms of Tinnitus are real. I had what 1 out of 6 Americans get: the symptoms associated with Tinnitus (*ti-nahy-tuh s*) from loud noises that worsen as you age, and in many cases lead to hearing loss.

Silence is now music to my ears.

I tried everything from hearing aid sound generators to ginkgo biloba, zinc and magnesium mineral doses to bio feedback. Some of these things helped reduce the ringing, but nothing worked short of expensive, risky surgery. Not until I discovered the active all-natural ingredients of my new product Quietus, the ringing in my ear for years was finally silenced.

**"STOP the ringing, CALM the hissing.
Peace & mental clarity begin."**

Just one small tab twice a day unleashes an exclusive proprietary blend of ingredients, including the same select herbs FDA approved as Homeopathic Pharmacopoeia of the US. Quietus uses scientifically advanced technology that supports the body's own healing mechanism that cancels out symptoms such as roaring, buzzing, whizzing and swelling of the parotids...**safely & naturally.**

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No other treatment that I know of matches the relief that Quietus provides with effectiveness, speed and convenience. With Quietus, the ringing stops and the comfortable silence will peacefully lull you to sleep. Remembering people's names becomes easier. Mental clarity becomes your calling card. Intense focus becomes your edge...

Bernard
BERNARD - CREATOR, DRUMMER.

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Quietus is not available in stores. Quietus is for personal use only. To protect it's proprietary formula, as well as your risk free trial, Quietus is by special request directly from our lab. I am so confident in the advanced technology of Quietus and I want you to experience the same life-altering relief I did when first taking Quietus that you receive a special **30-day RISK-FREE trial** by calling us direct! Ask how to receive a **FREE Supply** with your order.



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*Shipping and handling non-refundable. www.QuietRelief.com

fry oil out of tanks behind a restaurant, and mixing it with lye and methanol in a 5-gallon bottle before pouring it into an old water heater.

Two hours later, I opened the valve at the bottom of the heater and black goo oozed from the hose, a biodegradable substance called glycerin. Before long the glycerin drained and gave way to a thin, clear, amber liquid: I had my first batch of biodiesel.

Young and Fuelish

I made that first batch of fuel five years ago. If you factor in all the time I spent making the homebuilt biodiesel processor (a converted electric water heater) and experimenting with the design (some batches went, umm, less than perfectly—I had to replace two injection pumps on my truck), my experience with DIY fuels was often a frustrating and, occasionally, very expensive process.

Since then, the biodiesel industry and the technology have evolved. With the professionally engineered biodiesel systems available today, the process is simpler, safer, takes less time and yields more consistent results. So I decided to try one of the commercially available processors—it came boxed with all of the equipment and reagents needed to turn out consistent, high-quality biodiesel fuel. The FuelMeister processor used here has five fewer valves than the eight in my old home-made one. It also mixes the lye and methanol inside the tank to prevent the chance of dangerous spills.



1

1. Start by filtering your waste vegetable oil to remove chunks of food left over from the fryer. We used a paint filter. The filtrate is mostly breeding, with the occasional chunk of ... something. Mix all your oil from different sources to achieve a uniform sample.

2. Next we need to titrate to see how acidic the oil is. Add a small amount of phenolphthalein indicator dye to a carefully prepared mixture of methanol and sodium hydroxide. Add a sample of the acidic waste oil to the mix with a calibrated pipette.

3. Trickle in a prepared basic reagent until the mixture stays purple for 10 seconds of swirling. The quantity of reagent you add here determines the amount of methoxide (methyl alcohol/sodium hydroxide mixture) to add to the oil to complete the transesterification process. It takes some simple math or a look-up table to calculate the amount.



2



3

RISKY
BUSINESS
**Biodiesel
Safety First**

Yes, you can make biodiesel in a plastic bucket with little more than some drain cleaner, gas-line de-icer and a wooden spoon, *if you know what you're doing*. But it can be dangerous. Splashing lye and/or methanol into your eyes can blind you. And electrical pumps unattended in the presence of hundreds of gallons of flammables will make your local fire marshall understandably nervous. In addition, poor-quality product will damage your very expensive diesel-injection pump. Our advice? Research biodiesel production properly before doing the mad-scientist routine. — MIKE ALLEN

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A Little Theory

There's quite a bit of chemistry involved in transforming vegetable oil into biodiesel, in a process known as transesterification. Vegetable oil (VO) is made up of chains of fatty acids held together by glycerol molecules. Methanol breaks those chains of fatty acids apart. The corrosive, alkaline lye (sodium hydroxide, although you can also use potassium hydroxide) breaks the glycerol (a heavy alcohol) off those chains and the methanol (a light alcohol) in turn takes the place of the glycerol, leaving shorter, lighter, more combustible molecules. The result is an oil that burns well as a direct replacement for petroleum-based diesel fuel, with 12 to 15 percent glycerin left over at the bottom of the tank. The lye acts only as a catalyst in this case, and isn't consumed in the process.

On the other hand, waste vegetable oil (WVO), like we get out the back door of restaurants, is somewhat acidic because it has free fatty acids, which are produced during heating and cooking. Fortunately, that acidity is neutralized by the extremely alkaline lye essential to the transesterification. Adding lye converts free fatty acids to a form of soap, most of which will drain out with the glycerin. The remaining soap is removed in the wash. Of course, we have to be sure that the amount of alkaline lye is just enough to counterbalance the acidity, or we wind up with poor-quality fuel.

Biodiesel in Practice

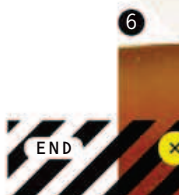
You can't make biodiesel if you don't have a couple of high-quality restaurants in your area. Greasy spoons need



4



5



6

4. Heat your oil to 120 F, then add the calculated amount of methanol/ hydroxide mixture. The FuelMeister processor we used conveniently lets you do the methanol/lye mixing inside a tank mounted to the lid. Agitate for an hour by running the transfer-pump hose back into the vessel. At this point the oil will have been converted into biodiesel. Allow the heavier glycerin to settle out for a few hours.

5. Drain the glycerin from the bottom until you get lighter-colored, thinner biodiesel pouring from the valve. Then use water to wash the excess methanol, lye and soapy residue from the biodiesel. The water will settle to the

bottom of the vessel in a few hours, where you can drain it out.

6. Allow the fuel to air out for a day or two with the top off to let any cloudiness (caused by a small amount of remaining water) dissipate.

not apply. That's because the more pure the WVO is, the better the biodiesel. Restaurants that overcook their food, don't change their oil frequently or cook lots of frozen food will have oil with high free-fatty-acid content.

As for water, less is better. As little as 5 percent in the WVO can leave you with a batch of soapy glop instead of biodiesel in your processor.

You don't want to deal with the mess of cleaning up, so care in selecting feedstock will pay off in the long run. Heat a couple of ounces of the WVO in a frying pan. If it sizzles, there's too much water. This water can be removed by heating the oil to above 220 degrees in an open container, and then letting it cool down. But that consumes a lot of energy, and you'll need to baby-sit the whole business because of the danger of fire. Best just to find higher-quality WVO.

Busy restaurants are like food-cooking assembly-lines. They heat their oil at the same time, at the correct temperature, and fry about the same amount of food every day. They also change their cooking oil at the same time and in the same way every week.

Other places aren't as careful, and their oil gives me less, and poorer quality, biodiesel per batch. I get almost all my WVO from two local restaurants, and I've never had water in the oil. Biodiesel processing has become popular. Restaurants used to be thrilled when I took the old oil away without charging them. Now WVO is a commodity not unlike crude oil. When regular diesel is about \$2.50 a gallon, I pay \$0.30 per gallon. When diesel was \$4.85 a gallon, I paid \$0.60 a gallon.

Doing the Math

The 40-gallon processor we used here costs nearly three grand. We saved about \$1.20 a gallon over the current price of petro-diesel, if you don't count the \$2995 price tag for the processor. That means we'd have to make 62 *or more* batches to pay back the investment, or one batch every six days—for a year. A couple of batches can be fun, but spending every Saturday with greasy hands can get to be a chore. You'll also need to set up a place

to store the WVO, the methanol and the biodiesel, all of which are flammable, and a place to work. Don't forget you'll also need to dispose of leftover poor-quality WVO, a fair amount of glycerin and the occasional batch of glop. There's an excess of methanol and alkali remaining after the transesterification, and commercial biodiesel producers recover the methanol and use it for the next batch. Your local authorities may have an opinion as to the proper, legal disposal of glycerin.

You'll still need to run a fair amount of conventional mineral diesel in your tank along with your home-brew fuel, especially in the winter when low temperatures turn even the best-quality biodiesel into jello.

Also, the current crop of direct-injection diesels don't fare well on concentrations of bio higher than 10 percent. Why? To thermally purge the diesel particulate filter (DPF), the injection system periodically injects fuel into the cylinder during the exhaust stroke to raise exhaust temperatures high

enough to ignite the carbon inside the DPF. The carbon simply burns off, leaving the DPF ready to filter out more particles. Biodiesel, more viscous than mineral diesel, sticks to the cylinder walls and washes past the rings into the crankcase. This can dilute the engine oil, potentially causing engine damage. Most car manufacturers prohibit the use of more than 10 percent biodiesel if you expect any warranty protection. Biodiesel works best in older diesel vehicles with precombustion-chamber mechanical injection.

Caveats aside, you can make diesel fuel sustainably while also reducing pollution. Getting a good supplier of WVO when fuel prices are low should ensure an adequate supply when demand rises. Biodiesel stores very well in a cool, dry place if you squirt a little nitrogen from a welding supply shop into the top of the barrel. Making a lot of the stuff now might be one way to have your own little investment in home-brew biodiesel futures as regular diesel prices climb.

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Car Clinic

by Mike Allen

Q + A

Get-Home-at-Any-Cost Tweaks

Got a leak in your radiator?

Crack a raw egg into the radiator filler cap (not the overflow tank, if you have one). The egg white will plug the hole—for a while.



Now that you've fixed the hole in the radiator, you don't have enough water to refill it. **Top off with diet soda** (no sugar to gum up the water pump). Other liquids will work too, like recycled beer and that leftover iced tea.



Punched a hole in the oil pan with a stone?

Whittle a plug from a twig and hammer it into the hole. Trim off the excess so the plug doesn't catch on the next rock.



But now you don't have enough oil to refill the crankcase. **Add a quart of water.** Really. The oil-pump pickup is not on the exact bottom—the remaining oil will float on top of the water.



Poked a hole in your gas tank on a rock?

Stuff a wedge from a bar of soap into the hole. It'll last long enough to get into town. Or a few hundred yards past that stream you need to ford.



Fix It or Walk Home

Q My 4x4 quit suddenly, on the side of a mountain. My wife and I were looking at a potential 20-mile hike, until a guy on an ATV came by and fixed it in 5 minutes—without any parts. How did he know, and what did he do? He moved this little box-shaped thing in the fuse box underhood from one place to another.

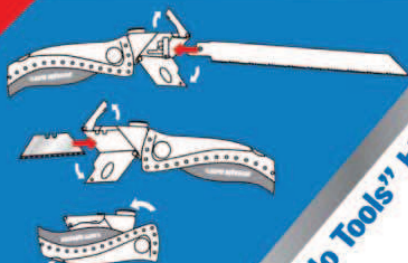
A Here's a little-known secret—many of the relays used on most cars are identical, whether they are used for the fuel pump, the headlights, the fans or the rear-window defroster. It's a standard 30-amp SPDT relay. He probably repurposed a relay from some other circuit on your car, like the foglamps or the rear defroster, and plugged it into the fuel-pump relay socket. I'm just impressed that he fig-

ured out it was the relay in such a short time. (Sounds like the voice of experience.) It's easy to tell which relay is which. Relay positions, as well as fuse positions and values, are listed in the owner's manual—and, almost always, on a decal inside the fuse/relay panel to boot. Actually, the schematic of the relay, telling you which pins are which, is usually printed on the side of the relay's outer case.

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I'm Melting

I've had to replace the radiator in my truck twice and the heater core three times in the last five years because of corrosion. I use fresh antifreeze, but it doesn't seem to help. What's happening here?

If fresh coolant, changed every other year, isn't holding the corrosion at bay, look for one of two problems. First, the combustion gases could be leaking into the cooling system through a bad intake manifold gasket, head gasket or a cracked head or block. You can chase that by sniffing the radiator neck with the probe of an exhaust-gas analyzer. If you can detect any carbon monoxide in the radiator, it's a sure sign there's exhaust leaking in.

Second, the corrosion problem could be electrical. Measure the voltage between the battery ground and the liquid in the radiator. Just dip the voltmeter probe into the coolant without touching the side of the filler neck. If the meter indicates any more than a few hundred millivolts—bad news, dude. I'd start by replacing all of the ground wires and clamps connecting the battery to the engine block as well as to the frame and body of the vehicle. Remember, you've got a cooling system with sev-

eral dissimilar metals (iron, copper and aluminum are all common in engines, radiators and heater cores) wetted with an electrolyte. That essentially creates a big battery, and the electrolysis can eat through thin radiator tubes in short order.

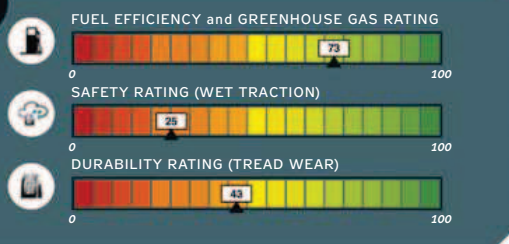
Clutching Techniques

I had to replace the clutch slave unit on my 2003 Ford F-150. The mechanic wanted to know how I drove the truck. I said that when I stop for traffic lights, I usually leave it in gear with my foot on the clutch pedal. He said that this practice might have caused the slave unit to fail. I've been driving manual transmission cars and trucks for some 30 years and have never had a problem with the clutch before. What is the right way to drive a manual truck or car? Leave it in gear with my foot on the clutch pedal or take it out of gear and keep my foot off of the clutch pedal when I am stopped?

I dare say most of the vehicles you've driven, unless they were either a tiddlywink-size sports car or a big rig, didn't have a hydraulic clutch like your late-model F-150. So you may not have seen this problem in the past. Most American iron uses a pure

NEWS FLASH

Read the Label



Starting next year it should be simpler to comparison shop for tires. The NHTSA is proposing a new label be affixed to the sidewall of every new tire. The label (which hasn't been finalized yet) will show a tire's rolling resistance (rolling

resistance has a direct effect on fuel economy), wet traction and wear resistance in an easy-to-assimilate form. Since 1976, tread-wear ratings have been listed on tire sidewalls, in tiny raised print. Unfortunately, the current ratings are not

consistent among tire manufacturers, making it impossible to compare the relative tread-wear of tires from different companies. The new ratings are industry standard, and the easy-to-digest label should make it easier to compare and shop. —M.A.

mechanical linkage, or maybe a cable. Regardless, keeping your foot on the pedal while stopped, or in motion for that matter, is poor practice.

First, there's a safety issue: Leaving the truck in gear might make it easier to lurch into traffic if you sneeze or lose your concentration and release the clutch pedal. On a more mechanical level, the practice keeps hydraulic pressure on the slave cylinder, shortening the life of the seals. It also keeps the throw-out bearing spinning. Unlike any other bearing in the drivetrain, this bearing doesn't have liquid motor oil, ATF or gear lube constantly circulating past it. The throw-out bearing is lubed by a scant spoonful of grease sealed inside. When this bearing fails, the first step in repairing it is to remove the transmission from the car, which isn't easy or cheap.

Outmoded

What's the replacement for Type A transmission fluid?

Type A automatic transmission fluid (ATF) was a GM specification for transmission fluid back when they still used buggy whips. Well, not exactly: It was first used in 1947 when GM started selling cars with modern automatic transmissions. Type A ATF was superseded by Dexron in 1967, and then by Dexron II and Dexron III. Some power-steering units, convertible-top hydraulic systems and even outdoor power equipment still specify Type A. You should be able to substitute Dexron III in most applications that specify Type A. If you're really compulsive about an older vehicle's diet, you can find true Type A from some smaller manufacturers if you hunt around.

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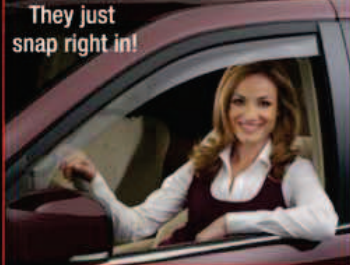
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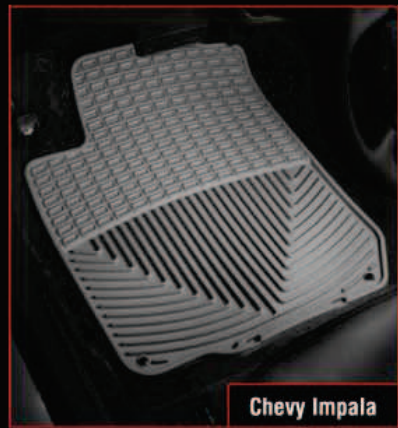
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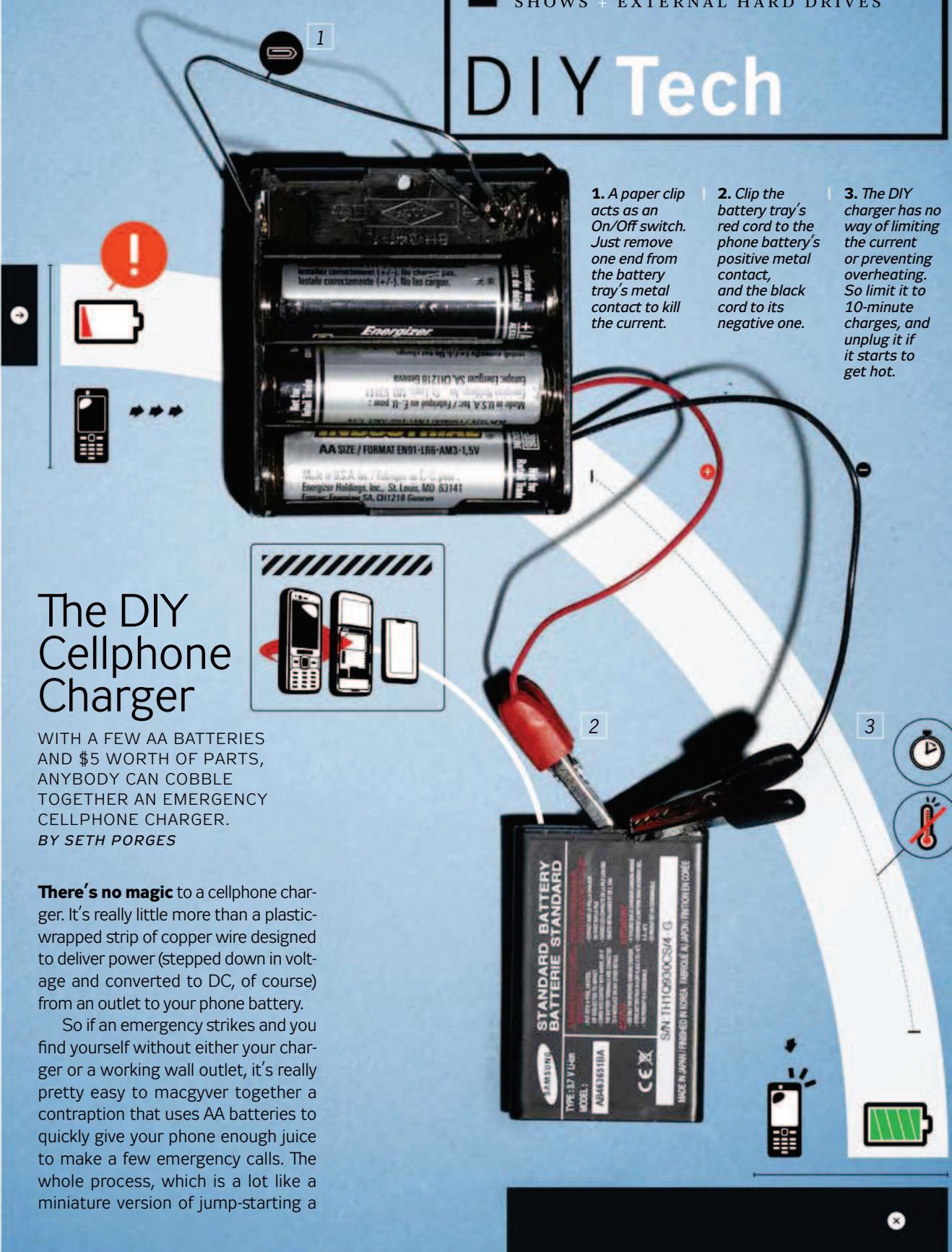
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DIY Tech



The DIY Cellphone Charger

WITH A FEW AA BATTERIES AND \$5 WORTH OF PARTS, ANYBODY CAN COBBLE TOGETHER AN EMERGENCY CELLPHONE CHARGER.

BY SETH PORGES

There's no magic to a cellphone charger. It's really little more than a plastic-wrapped strip of copper wire designed to deliver power (stepped down in voltage and converted to DC, of course) from an outlet to your phone battery.

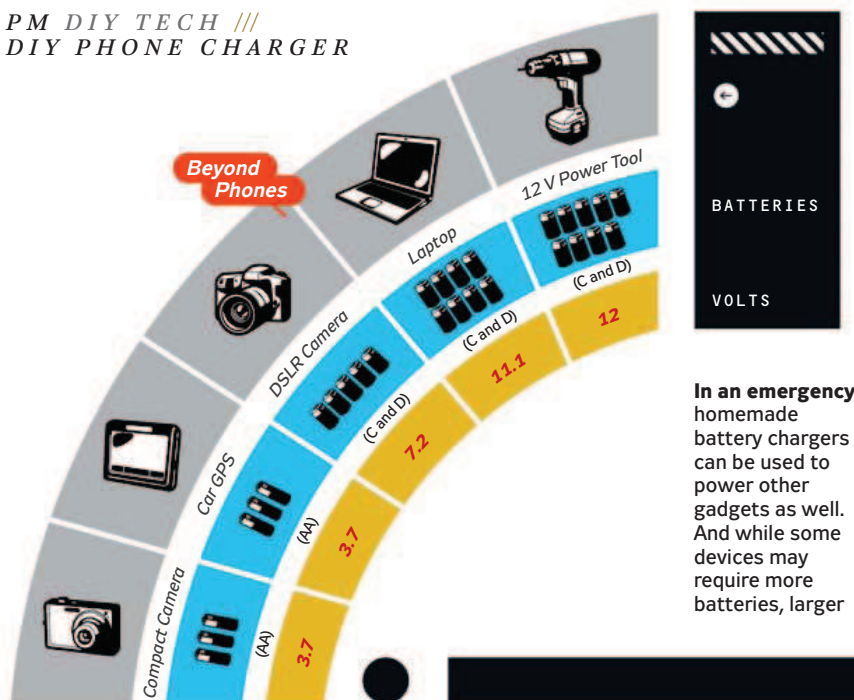
So if an emergency strikes and you find yourself without either your charger or a working wall outlet, it's really pretty easy to macgyver together a contraption that uses AA batteries to quickly give your phone enough juice to make a few emergency calls. The whole process, which is a lot like a miniature version of jump-starting a

1. A paper clip acts as an On/Off switch. Just remove one end from the battery tray's metal contact to kill the current.

2. Clip the battery tray's red cord to the phone battery's positive metal contact, and the black cord to its negative one.

3. The DIY charger has no way of limiting the current or preventing overheating. So limit it to 10-minute charges, and unplug it if it starts to get hot.





In an emergency, homemade battery chargers can be used to power other gadgets as well. And while some devices may require more batteries, larger

C or D cells or a larger battery tray, the process is basically the same as for phones. Here's how many batteries you'll need to charge some other common gadgets.

Just make sure it's an emergency. A desperate need to update your Facebook photo may not be worth the risk the process poses to your laptop or camera.

car, takes minutes and uses parts that can be found at Radio Shack for a total of less than \$5.

To do it yourself, you'll need the following: a few AA batteries, a four-AA-battery tray, a metal paper clip and two alligator clips. That's it, and the finished product should be able to charge just about any phone (with the notable exception of the iPhone, which does not have an easily removable battery) if you find yourself in the wilderness or waiting out a power outage.

Check the Voltage

The first step is to check the voltage on your phone battery. Most clock in at about 3.7 volts, but you should pop it out of the phone and read the fine print to see for sure. This information will let you calculate how many AA batteries you need. The key is to use enough to barely exceed the phone battery's voltage—employ fewer and you won't be producing enough juice to charge the battery, but hook up too many and you could burn out the whole thing. AA batteries are 1.5 volts each, so charging a 3.7-volt battery requires combining three of them for a total of 4.5 volts.

Pop the batteries into the AA tray. It's a four-battery tray, so you'll need to put something else in the last AA slot in order to complete the circuit. This is

where the paper clip comes in handy. Unfold it and hook one end through the metal spring in the negative end of the empty slot. Then take the other end and bend it so it touches the metal contact on the outside of the tray at the positive end of the same slot.

This clip will act as a sort of On/Off switch—as long as it is touching both the spring and the metal contact, power will be flowing and the charger will be on. To turn the charger off, simply move one end of the paper clip away from one of the contacts.

Hook Up the Power

For our contraption to work, you need to connect the tray to the phone battery. The tray will have two wires running from it: A red wire carrying current from the positive battery terminal, and a black one carrying current back to the battery's negative terminal. Crimp or solder a red alligator clip to the red wire, and a black alligator clip to the black wire. If a voltmeter is available, hooking your clips to it can confirm that your batteries are providing the correct voltage.

Now look closely at the phone battery. It will have a series of small metal contacts that it uses to suck up electricity. There should be a positive (+) sign next to one of them, and a nega-

tive (–) next to another. (Note that most phone batteries contain three or more contacts, but you can just ignore the rest of them. And if they don't have positive or negative markings, a voltmeter will tell you which is which.)

Taking care to make sure the two clamps don't come into contact with each other, clasp the red alligator clamp to the side of the battery so that its metal jaws are touching the positive metal contact, and the black clamp to the side of the battery so that it's touching the negative one.

Your battery is now charging. But be warned: Since this makeshift mechanism has no built-in way of limiting the current or guarding against overheating, you'll want to keep an eye (and a finger) on it to make sure it doesn't get too hot. If the phone battery starts to heat up, unplug it immediately, or you could damage it. And there are other reasons why you should only try this if you have no other choice: The process could violate your phone's warranty, and the sharp alligator clips can scratch up a battery's plastic shell. And, to be safe, I wouldn't recommend using this method to charge your battery for more than 10 minutes at a time. When you're done, put the battery back in the phone and start dialing.

PM

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Q I have my television hooked up through my surround-sound system. It's great for movies, but the rest of the time it feels like I'm just wasting energy. Is there any way to get the best of both worlds?

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A Multichannel surround-sound systems can bring a stunning theater-like soundscape to your living room. Great if you're getting your Michael Bay fix, but overkill if you're just watching the morning weather report—especially when you consider how much power these sound systems suck up. We hooked up a wattmeter (everybody should have one) to a typical 37-inch LCD HDTV and cable box, and found that

the combo used a total of 172 watts. When we added a 5.1-channel home theater with a powered subwoofer, it kicked our consumption up to 244 watts. Watch a movie through a Blu-ray-playing PlayStation 3, and the total goes up to a whopping 444 watts. That's two and a half times the electricity usage of the TV and cable box alone.

The problem is exacerbated by the fact that modern home theater receivers

ILLUSTRATION BY DAVID M. BUSAN

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are often used as HDMI routers, meaning they take video inputs from multiple sources (cable box, Blu-ray player, game system, etc.), and output them all to your TV using a single HDMI cable. This arrangement keeps things organized, but it also means that the sound system is on whenever the TV is—powering a constellation of speakers and, likely, a subwoofer, even during shows that don't really benefit from multichannel, room-filling surround sound.

Keeping components turned off when they aren't needed can make a noticeable difference in your energy bill. The key is to arrange your home theater system so that it's easy to switch among different input devices and sound systems without having to rewire all of your AV gear whenever it's movie night. The easy way to toggle between sound systems: an HDMI switch that has a digital audio output.

But before you buy an HDMI switch, you'll need to make sure it will work with your speaker system. Some

tech term **AMOLED**

For years, techies have been yearning for a flexible-display technology, which could allow for impossibly compact gadgets—such as portable media players or e-book readers—that are capable of being rolled up when they aren't in use. **Active-Matrix Organic Light-Emitting Diode** displays, which have a matrix of pixels that light up when electrically activated, have presented some of the most promising flexible-display prototypes so far. AMOLEDs also use less power than traditional OLEDs.

AV receivers have optical audio inputs and others have coaxial audio inputs. See which one yours has and get an HDMI switch with the same type of audio connection. Remote-controllable HDMI switches with digital audio outputs are available from companies such as Octava and Kramer Electronics for \$250 to \$350. Hook your cable box, gaming machine and Blu-ray player to the HDMI inputs, link the HDMI output directly to your TV, then plug the digital audio connection into your receiver and turn it on only when you want a surround-sound infusion.

And if you're really serious about minimizing electrical waste, plug all of your nonessential AV gear into a separate power strip and kill its power when its devices aren't in use (this will cut down on the standby, or "vampire" power leakage that occurs when unused devices are left plugged in). Belkin even makes a remote-controllable power strip called the Conserve that allows you to maintain consistent power to devices that you use all the time (DVR, Wi-Fi router), while completely killing power to unused gear.

Circumventing Slide Shows

I read a lot of news online and always get frustrated when I have to click through a slide show 10 times in order to see a full story. Is there any way around this?

News websites love slide shows—they're an easy way to generate mul-

tiplied page-view hits from visitors who may be surfing over to see a single story. But it can be annoying having to click "next" every few seconds just to read a list. The easy way around this: If the site has a "Print" button near the top of the story, click it. The entire story will load as a single page. When your browser asks if you want to commence the print job, just click cancel, and read the story at your leisure.

Powered Drive

I bought an external hard drive that came with a Y-shaped double-ended USB cable. However, I tried connecting it to my laptop with just one of the two USB jacks and it seemed to work fine. Do I really need the Y cable, or can I use any USB cable?

Compared to other USB devices, external hard drives are power hogs—they often require more juice than older laptops are capable of delivering through a single USB jack. When it's connected to a computer through a double-ended Y cable, the hard drive is able to suck up a double dose of power through two USB slots simultaneously.

However, because newer laptops are able to deliver more power through each USB jack, you may not actually need the Y cable. The only way to know for sure: Try plugging it in with a single USB cable. If your hard drive works, you can probably get by with connecting it to that computer using any old USB cable. **PM**

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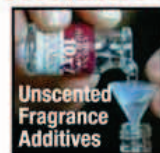
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1. Raceway Pond

This 2000-square-foot, rubber-lined pond produces 25 pounds of dry algae a day. Rather than grow "designer" strains, Sprouse uses native algae. "We get seeding through the air and water," he says. Though his crop has lower energy-rich lipid content than genetically modified algae, it's easier to grow. Sprouse's long-term goal: Scale up to a 25-acre farm that would produce 14,000 pounds of dry algae per day.

2. Centrifuge

The algae solution enters as 99 percent water; it exits as 60 percent algae. Sprouse is designing a filter press that would use less energy.

3. Fertilizer Tanks

Sprouse uses two tanks—one full of diluted pig excrement, high in phosphorus and potassium, and one containing nitrogen-rich urea—to create fertilizer.

4. Algae Coal Oven

Algae paste is cooked for several hours, under pressure, inside this 55-gallon drum—producing granules that are non-water-soluble and can be stored outdoors. "It's a drop-in replacement for coal," he says. Unlike coal ash, algae ash contains no mercury or lead and can be applied to farm fields.

5. Harvester

Positioned at the terminus of the raceway, the harvester houses a pump that pulls water through filters, which extract a diluted algae solution. The water is then recycled to grow more algae. Sprouse invented the device.



When Jes Sprouse was a kid, he used to watch mile-long coal trains rumble across the Wyoming plains, headed for the power plants his ironworker father had helped to build. Now, he is in the energy business himself, but instead of coal he focuses on algae farming. So far, his operation is limited to a single pond in his front yard, but he's got big plans: to fuel America as a tycoon of algae pellets (for home use) and algae coal (for power plants). Both products yield 10,500 Btu per pound—nearly as much energy as bituminous coal. And they're a lot cleaner. "I've known for a long time that our path is unsustainable," he says. "Farming algae is environmentally driven, but I also want to make money." — PAUL TOLMÉ

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