Union of Concerned Scientists

Catalyst

SPRING 2012





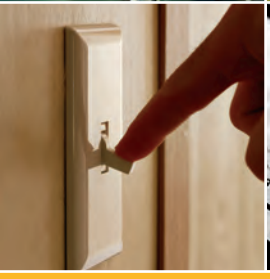

Smarter Ways to Keep the Planet Cool

A new UCS book shows the best climate solutions for every lifestyle










Also: Electric-Drive Vehicles • The Energy-Water Connection

Union of Concerned Scientists

Catalyst, ISSN 1539-3410, is published three times a year by the Union of Concerned Scientists. Text of articles from *Catalyst*, duly acknowledged, may be reprinted free of charge. Artwork may not be reproduced.

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COVER PHOTOS
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Catalyst is printed on chlorine-free recycled paper with 100% post-consumer content.

The Union of Concerned Scientists is the leading science-based nonprofit working for a healthy environment and a safer world.

This publication is financed by contributions from individual members; you can join UCS by sending a tax-deductible contribution of $25 or more to UCS Development, Two Brattle Square, Cambridge, MA 02138-3780.

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LETTERS

Please email your questions or comments to catalyst@ucsusa.org. *Your submission implies permission to publish your letter and name in* Catalyst. *We reserve the right to edit letters for length.*

Forecasting Ozone Pollution

Your recent article in *Catalyst* on global warming ["Climate Change May Be Hazardous to Your Health," Fall 2011] is incomplete. Temperature is only one of several variables in ozone formation. One of the most critical is local weather.

Most high pollution occurs when air is trapped in the lower part of the atmosphere (the "mixed layer"). We cannot predict changes in local meteorology due to global warming. The concentration of pollutants can get better or worse depending on the amount of change in the intensity and duration of small mixed layers.

Stuart Dattner
Austin, TX

The author responds:

We recognize that ozone formation depends on a number of climatic factors, and agree that coupling climate and local air quality modeling is the most comprehensive approach to evaluating ozone concentrations in the atmosphere. We were unable to get into detail on all these factors in the *Catalyst* article, but we do address some of them in our report *Climate Change and Your Health: Rising Temperatures, Worsening Ozone Pollution.* To learn more, visit *www.ucsusa.org/climateandozonepollution*.

Liz Perera, senior Washington representative, UCS Climate and Energy Program

Hybrid Technology for Non-Hybrids?

One of the most sensible and efficient qualities of a hybrid is that its gas engine shuts off when the car is stopped, as is so often the case with stop-and-go driving. . . . The ability to stop the engine as often as [possible] would seem, by itself, able to noticeably reduce fuel usage, emissions, engine wear, and so on.

Would adding the automatic shutdown ability to a regular car be possible, and if so, would it be a good thing to do as well? I also wonder if such a system for a regular car could include regenerative braking (to help recharge the battery and reduce brake pad/shoe wear).

William H. Clarke
Missoula, MT

UCS responds:

"Stop-start" (also known as "micro hybrid" or "idle-off") technology, which shuts off a conventional gasoline engine when idle, is not available as a retrofit for existing cars and trucks. However, this feature is available on some models in Europe and we will soon see it in the United States as well, thanks to new vehicle standards that call for lower global warming emissions and improved fuel economy. Stop-start technology adds between $100 and $400 to a vehicle's purchase price, but quickly pays for itself by cutting fuel consumption around 5 percent.

Regenerative braking, which is available on "mild" and "full" hybrid vehicles, requires a higher-voltage battery and more sophisticated electronic controls. See "How It Works" on p. 13 to learn more about advanced vehicle technologies.

Jim Kliesch, research director, UCS Clean Vehicles Program

Back issues of *Catalyst* are available in PDF form on the UCS website at *www.ucsusa.org/publications/catalyst.*

Photo: © JupiterImages

PERSPECTIVE

Restore Science to Its Rightful Place

Over the past several years, as our members are acutely aware, our nation has been beset by an increasing disregard for objective knowledge and evidence-based analysis in government decisions. Examples abound: industry-funded pseudo-science is injected not only into the news media and the blogosphere, but also into Congress and state capitols; highly qualified experts have found their nominations for important government positions and advisory panels blocked; the facts about climate science—accepted in virtually every other nation—are commonly ignored and disparaged in American discourse. Today's hyper-partisan debate makes it difficult for political leaders (and many of their constituents) to agree on even the basic facts underlying a problem, let alone a policy solution grounded in science.

Our goal: to return science to its essential role in policy making and the democratic process.

We believe this situation calls for a serious and significant response. So, as *Catalyst* goes to press, the Union of Concerned Scientists is preparing to launch a bold new initiative called the Center for Science and Democracy, whose ambitious goal is nothing less than restoring the essential role of science, evidence-based knowledge, and constructive debate in American policy making and the democratic process.

The Center started taking shape last December with a workshop that brought together some of the nation's top thinkers on government, the natural and social sciences, media and communications, and philanthropy. They all resoundingly endorsed the need for action, helped us define the Center's purpose and scope, and offered creative and innovative ideas for addressing the problems identified.

Though the Center will formally launch in May, some activities are already under way. We have begun building a foundation of support among the nearly 20,000 scientists, engineers, economists, and medical professionals who are already members of the UCS Science Network. Next, we will host a series of high-profile forums to facilitate a collaboration between scientists, policy makers, and citizens on the key obstacles to developing and enacting science-based policies. We will also build and strengthen vital partnerships with leading scientific organizations and professional societies, as well as leaders across the political spectrum.

Looking back through our nation's history, we have made the biggest gains in our health, prosperity, and security when our decisions have been guided by the best available science. The Center for Science and Democracy aims to ensure a cleaner and safer environment for all Americans by bringing science *back* to decision making. Stay tuned for more on this exciting new initiative, including opportunities for you to get involved.

—***Kevin Knobloch***, *president*

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Photos: © Richard Howard (Kevin Knobloch); © Catawba River Keepers (power plant)

A Wave of Problems

UCS documents health impacts of flooding

Damage from floods is typically measured in terms of lives lost and costs of damage to buildings and infrastructure. But often overlooked are the potentially costly public health impacts of exposure to disease-causing organisms, agricultural waste, chemical pollutants, raw sewage, and toxic mold that can affect families long after floodwaters have receded. For example, 3 million to 7 million U.S. asthma cases are attributable to dampness and mold, incurring billions in health-related expenses each year.

A new UCS report, *After the Storm*, draws on recent scientific literature to highlight the health hazards of extreme precipitation and flooding, strategies to protect families and communities from such risks, and the role global warming plays in certain types of extreme weather. While a variety of factors affect the potential for damage, flooding will likely only worsen as global temperatures rise, leaving even more people vulnerable. These findings underscore the urgent need to not only reduce our global warming emissions but also invest in measures to protect against future health-related impacts.

To learn more, visit the UCS website at *www.ucsusa.org/climateandhealth.*

Help for Local Foods

Our analysis builds legislative support

Our 2011 report *Market Forces*, which showed that modest public support for up to 500 farmers markets each year could create as many as 13,500 jobs over a five-year period, struck a chord on Capitol Hill. The analysis helped shape the Local Farms, Food, and Jobs Act that was introduced in November, which will provide financial support to farmers seeking organic certification and help farmers growing heavily subsidized commodity crops (like corn and soybeans) plant more fruits and vegetables. It will also help low-income Americans gain easier access to healthy, locally grown food. These provisions, along with dedicated funding, would aid the development and expansion of local and regional food systems, including farmers markets.

UCS played a key role in developing and building support for the bill. Now, we're asking you to visit *www.ucsusa.org/action* and ask your senators and representatives to co-sponsor this important legislation—with enough co-sponsors, it stands a strong chance of being integrated into this year's federal farm bill, which sets the direction of our country's food policy for the next five years or more.

Taking a Finger Off the Button

UCS seeks to reduce risks posed by nuclear weapons

The United States' nuclear weapons arsenal—developed for a cold war that ended decades ago—has become a liability rather than an asset, given the types of threats we face today. This spring, President Obama will prepare formal guidance that sets out criteria for when and why the U.S. military would use nuclear weapons. The Pentagon will then use this guidance to update the "nuclear war plan" and determine the size and structure of the U.S. nuclear arsenal.

The United States' nuclear weapons arsenal has become a liability rather than an asset, given the types of threats we face today.

UCS is seeking to shape this process, calling for bold steps to end outdated nuclear war-fighting strategy. In meetings with administration officials, we have offered specific risk-reducing recommendations such as lowering the number of U.S. nuclear warheads and the number of submarines, missiles, and bombers that carry them, and

taking nuclear weapons off high alert. At our urging, activists and security experts around the country have called on the administration to support these changes, and we are encouraging key lawmakers to do the same.

Taking these steps will encourage other nuclear-armed countries to join in reductions, and move us closer to a world free of nuclear weapons. Follow our efforts at *www.ucsusa.org/nuclear_weapons_and_global_security*.

Nuclear Safety—or Lack Thereof

UCS monitors near-misses at U.S. plants

In February, UCS released its second annual report assessing the safety-related performance of the U.S. nuclear power industry and the Nuclear Regulatory Commission (NRC), which regulates the industry. *The NRC and Nuclear Power Plant Safety in 2011: Living on Borrowed Time* (online at *www.ucsusa.org/nuclear_power*) analyzes 15 special inspections performed by the NRC last year in response to safety equipment problems and security shortcomings that increased the risk of damage to the reactor core—and thus harm to employees and the public.

Our analysis found that misdiagnosed or unresolved safety problems often cause significant events at nuclear power plants, or increase their severity. For example, when a water pump failed at Michigan's Palisades plant in 2009, workers replaced the broken parts with identical parts; the replacement parts failed for the same reason in 2011. The report concludes that, by consistently enforcing its safety regulations, the NRC can prevent plant owners from accumulating problems that eventually result in next year's near-misses—or worse.

Michigan's Palisades plant experienced a near-miss in 2011.

UCS Hosts a Healthy Discussion

Experts ponder future of science at the FDA

Congress must vote on legislation later this year that governs how the Food and Drug Administration (FDA) approves and monitors new medical technologies and prescription drugs. Because the outcome will determine what authority and resources the FDA has to ensure the safety and efficacy of vital medicines and devices, UCS co-sponsored the "FDA at a Crossroads" conference with George Washington University's School of Public Health and Health Services in November.

In her keynote address, FDA Commissioner Margaret Hamburg reinforced the importance of independent science to the agency's ability to meet its mission. Several panels of experts from academia, government, patient and consumer organizations, and industry then exchanged ideas on patient safety, drug and device efficacy, scientific integrity, and institutional challenges at the agency; many of these same experts met again the next day to develop recommendations for improving how the agency uses science to make decisions.

Our workshop explored improving the ways in which the FDA uses science to make decisions.

UCS is closely following the FDA-related legislation and pushing for many of the reforms outlined at our conference. To view videos of the conference and learn more about the changes we think are needed, please visit *www.ucsusa.org/fda-at-a-crossroads*.

UCS Teams Up with Teens

These Girl Scouts want forest-friendly cookies

In March, UCS released the report *Recipes for Success*, which shows businesses that it is possible to use palm oil and other vegetable oils in their products without contributing to tropical deforestation. Our recommendations came just a few weeks after two 16-year-old Girl Scouts from

Photos: © Nuclear Regulatory Commission (power plant); © FDA (scientist)

Madison Vorva (left) and Rhiannon Tomtishen

Michigan—based on our nomination—won the United Nations' first-ever Forest Heroes Award for their efforts to persuade the Girl Scouts of America to stop using palm oil in its popular cookies. The two girls, Madison Vorva and Rhiannon Tomtishen, started this campaign when they were 11, after learning how palm oil production causes tropical deforestation around the world, particularly in Southeast Asia. With the help of groups like us, Madison and Rhiannon garnered press coverage including a front-page story in the *Wall Street Journal* and an appearance on the *CBS Early Show*.

UCS will continue to support Madison and Rhiannon, and use the findings published in *Recipes for Success* to pressure businesses like Kellogg's, which makes Girl Scout Cookies, to change their practices and go deforestation-free. To read the report, go to *www.ucsusa.org/deforestationfree*.

A Chance to Talk Shop

…and show off what UCS can do

In December, we showcased our current work and achievements for scientists attending the American Geophysical Union (AGU) Fall Meeting in San Francisco—the world's largest gathering of Earth and space scientists, attended by more than 20,000 potential UCS members and activists. Our experts organized and spoke at presentations on topics including political and corporate interference in science, science communication, nitrogen loss in agriculture and urban landscapes, tropical deforestation, and the growing conflict between energy and water demands.

In conversations with reporters, we congratulated the National Oceanic and Atmospheric Administration for finalizing a strong scientific integrity policy, and gave attendees stickers showing support for the agency's move. We also participated in discussions about the AGU's own approach toward scientific integrity and ethics.

Visitors to our booth learned about our redesigned website dedicated to climate "hot spots" around the world (*www.climatehotmap.org*) and our ongoing defense of climate science and scientists from baseless, politically motivated attacks. Each visitor represented a potential recruit to the UCS Science Network (*www.ucsusa.org/sciencenetwork*). To learn more about our activities at the show, go to *www.ucsusa.org/UCSatAGU*.

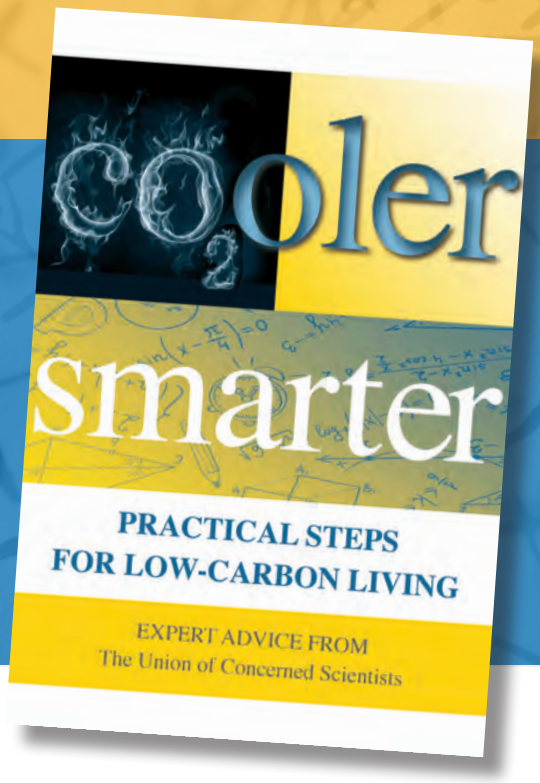
We congratulated the National Oceanic and Atmospheric Administration for finalizing a strong scientific integrity policy.

Science Working for Local Change

Biologist Sandra Albers describes for members of the UCS National Advisory Board the challenge of protecting endangered southern steelhead trout when the obsolete Rindge Dam in California's Santa Monica Mountains is demolished. Scientists have developed a plan to remove nearly a century's worth of silt (harmful to fish) from behind the dam prior to its demolition.

Smarter Ways to Keep the Planet Cool

A new book from UCS challenges you to lower your carbon emissions by 20 percent this year—and shows you the most effective strategies for getting it done.



By Seth Shulman

There's no shortage of advice about lowering your carbon footprint—recommendations range from starting a worm farm in your basement to drinking locally brewed beer. Given the enormity of the problem of global warming, recommendations like these make it easy to wonder: can my individual actions really make a difference?

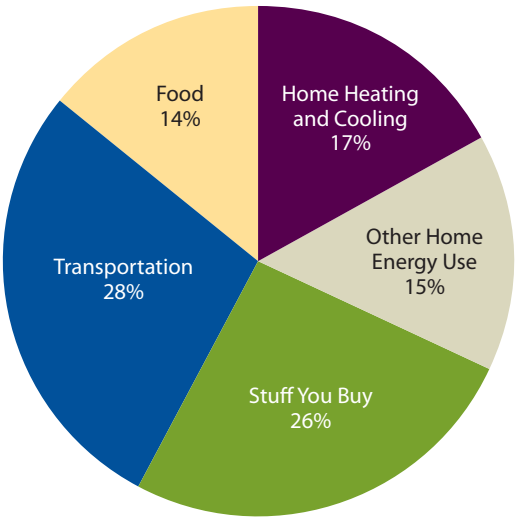
The answer is yes.

Over the past two years, the Union of Concerned Scientists conducted in-depth research to determine which individual actions are most effective for averting the worst effects of global warming. The results are presented in our new book *Cooler Smarter: Practical Steps for Low-Carbon Living*, which will be published by Island Press in May. Here is a sneak preview of what we uncovered.

The Challenge: 20 Percent Lower Emissions

Our research painstakingly tracked both the direct and indirect emissions resulting from every dollar spent by U.S. consumers, analyzing the climate impact of our decisions on hundreds of topics as varied as home insulation and diet. We found that the average American is responsible for emitting a whopping *21 tons* of heat-trapping carbon dioxide into the atmosphere annually. That's more than an average car would emit driving around the world at the equator. (The pie chart shows the breakdown of these emissions by activity.) On a per capita basis, Americans emit four times more carbon dioxide than the global average, and twice as much as most Europeans (even though their standard of living is similar to ours).

Sources of the Average American's Carbon Emissions



In other words, there's no question Americans can use energy more efficiently. And making smart decisions about what to have for dinner, where to shop, and how to get to work can collectively make a real difference in saving energy and helping forestall the worst consequences of global warming. Whether you live in the Midwest, Deep South, or on one of the coasts, *Cooler Smarter* offers simple, straightforward steps to cut your emissions by 20 percent (equivalent to about four tons of carbon dioxide on average) in the coming year. Because no two people are the same, we have developed a menu of options designed to satisfy everyone's carbon-cutting appetite. Many of the choices save you money, others are great long-term investments, and some even improve your health. And they are easier to implement than you might think.

Tame Home Energy Hogs

As you can see in the pie chart, your largest contribution to climate change is most likely parked in your driveway. Driving accounts for more than one-quarter of the average American's total carbon emissions, with the average U.S. car—logging 12,000 miles per year and getting roughly 20 miles per gallon—responsible for more than six tons of carbon dioxide annually. For

Background illustration: © Thinkstock/Zoonar

many of us, switching to a more fuel-efficient car could reduce our emissions by four tons or more in one fell swoop—and nearly pay for itself in gas savings alone.

Reducing energy use inside your home also offers opportunities for big savings. For instance, if every household added just a few rolls of inexpensive insulation to the attic, the nation could save *more than $1.8 billion* in annual energy costs; we would also keep more than 12 million tons of carbon dioxide out of the atmosphere each year—the equivalent of taking some 2 million cars off the road. Switching from incandescent to compact fluorescent lightbulbs (CFLs) would reduce lighting-related electricity costs from $190 (the national average) to just $48; changing to light-emitting diode (LED) bulbs would drop the total to $22, allowing you to recoup the purchase cost in just a couple years.

If every household added just a few rolls of insulation to the attic, the nation could save *more than $1.8 billion* in energy costs and avoid more than 12 million tons of carbon emissions each year.

20 Days, 20 Ways, 20% Less Carbon

In less than a month, our new Web feature will help cut your global warming emissions.

UCS is bringing our *Cooler Smarter* research to life with an interactive online tool that will help you identify the most effective ways to reduce your global warming emissions. Simply answer some questions about your household activities and we'll show you the changes you can make to have the maximum possible impact—and see what a difference your individual actions can have when they are widely adopted. You can also receive helpful emails to guide your efforts.

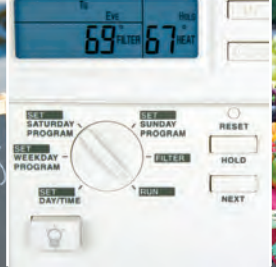
Go to *www.ucsusa.org/coolersmarter* in late April to get started.

Sweat the Right Stuff

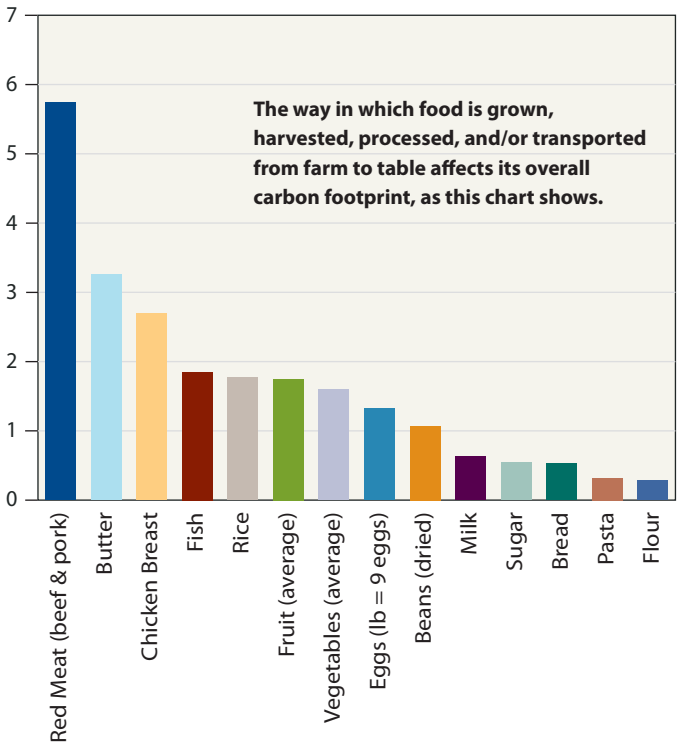
You may have already implemented some of these kinds of changes in your lifestyle. But, no matter what your circumstances, some of our team's findings recommendations are likely to surprise you. For instance, did you know that leaving a laser printer on all day could waste as much as $130 a year in electricity costs? That washing your clothes in hot water creates five times as much emissions as a cold-water wash? Or that playing a DVD on a gaming console (like a Sony Playstation) can use upwards of 20 times the electricity used by a standard DVD player?

Cooler Smarter helps you focus on steps that matter by busting several "eco-myths." Buying locally grown food, for instance, is often touted as a way to fight global warming, but transportation from the farm to the marketplace makes up only a tiny fraction—some 4 percent on average—of the emissions related to food production. Even if local food eliminated *all* transportation emissions, long-distance food produced on a farm that reduces its emissions by just 5 percent might actually contribute less to global warming. Of course, we still advocate buying local food—it is a great way to support local farmers and get fresh fruits and vegetables—but there are more-effective ways to reduce global warming emissions through dietary changes, as our book explains (see the chart on p. 9). Another myth holds that conservation is the best way to save energy but it turns out that locking in efficiency is often more effective. Take lighting, for example: you would have to turn off incandescent lights entirely for three of every four days to achieve savings comparable to CFLs.



Comparison of Global Warming Emissions by Food Type (by Pound or Pint)



Our individual actions must be supplemented with policies that secure the large-scale emissions reductions needed.

Meeting the Climate Challenge

Politicians in Washington have not done nearly enough to address climate change, and until they have the courage to do so, any success in reducing carbon emissions will have to start with us. But it is also true that, as individuals, we cannot stabilize Earth's climate on our own. That's why UCS and our supporters need to continue to call on elected officials and corporate leaders to create policies that will secure the large-scale emissions reductions required.

The burning of coal, oil, and natural gas around the world is not likely to end right away, but an international transformation has begun. How fast we can bend the curve toward a low-carbon future depends on you. *Cooler Smarter* gives you the tools not only to curb your own emissions but also to inspire your friends, family, neighbors, and coworkers to do the same. Working from the bottom up *and* the top down, we can ensure a healthier planet for our children and grandchildren.

Seth Shulman *is senior staff writer at UCS and co-author of* Cooler Smarter.

Be the Biggest (Emissions) Loser on Your Block

Some friendly competition might make it easier for you to reach—or exceed—your climate goals.

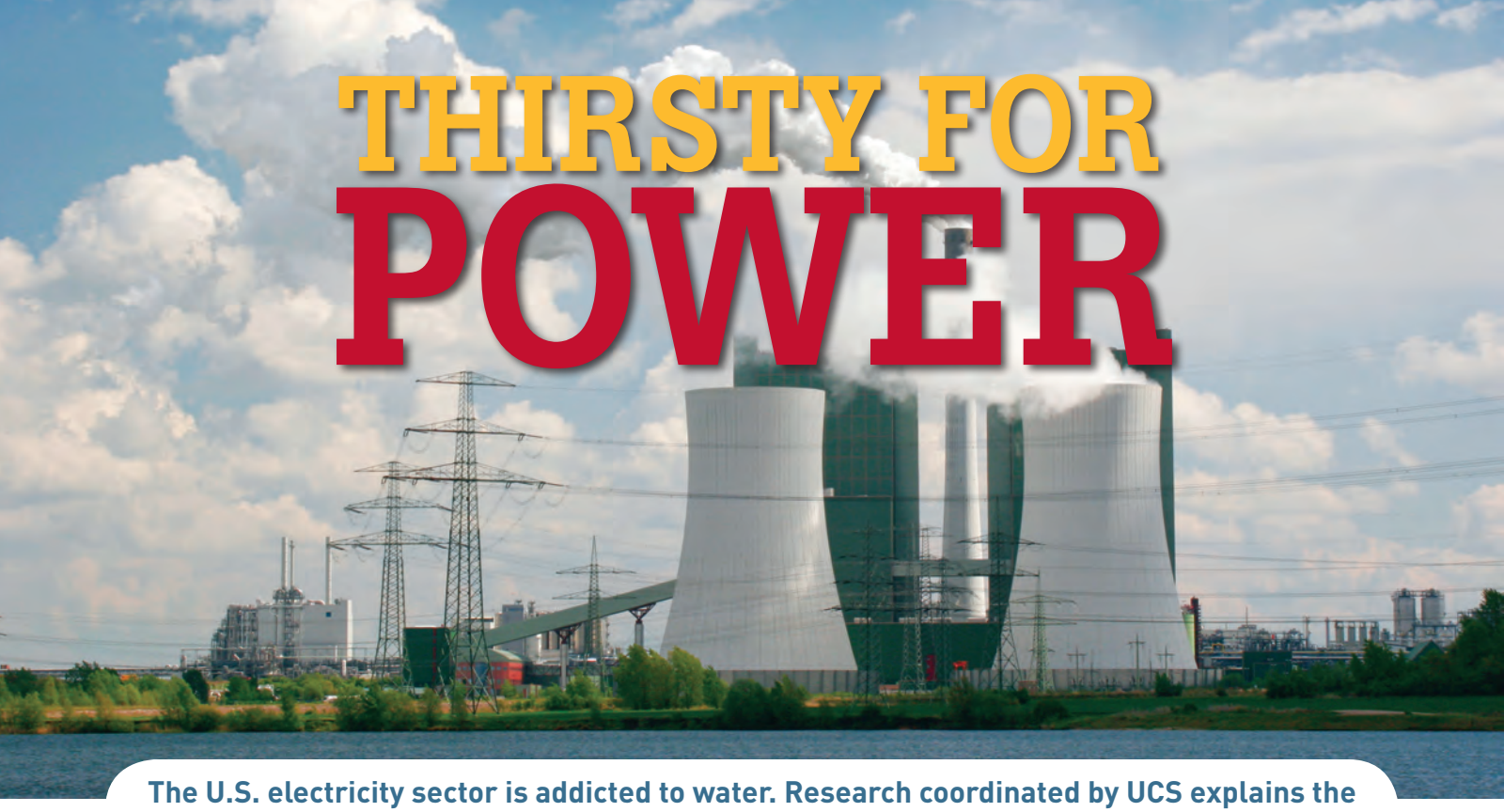
A Boston-area cable television show clearly demonstrates how much each of us can do to help combat global warming at home. Building on the idea of a popular reality-TV show in which contestants compete to lose weight, *Energy Smackdown* challenged three local teams (each comprising about 100 households) to see which could achieve the biggest reductions in carbon emissions.

After receiving an energy audit to determine their baseline energy use, households undertook many of the kinds of the energy-saving tips outlined in our book *Cooler Smarter*, and had their efforts filmed for the show over the course of a year. The results were dramatic: the participants reduced their carbon emissions by an average of 20 percent overall, and the program's winning household cut its emissions by 54 percent. One enterprising household even managed to lower its electricity use by a whopping 73 percent.

If *all* Americans met the 20 percent challenge laid out in *Cooler Smarter*, we would keep well over a billion tons of heat-trapping carbon dioxide out of the atmosphere. That's the equivalent of closing some 200 average-sized coal-fired power plants.

Get ready to kick-start your lower-carbon lifestyle by pre-ordering one or more copies of *Cooler Smarter* at *www.ucsusa.org/coolersmarter*.

Photos: © iStockphoto.com



THIRSTY FOR POWER

The U.S. electricity sector is addicted to water. Research coordinated by UCS explains the dimensions and implications of this addiction, and how utilities can kick the habit.

By John Rogers and Erika Spanger-Siegfried

Take the average amount of water flowing over Niagara Falls in a minute. Now triple it. That's almost how much water U.S. power plants take in for cooling purposes every minute, on average. At the same time, water demand is increasing and heat waves and drought are compounding the strain placed on vital freshwater supplies—a problem that global warming is projected to worsen. Understanding this energy-water nexus is critical to making smart policy and planning decisions, but until recently even basic information on power plant water use was difficult to obtain.

To bridge this gap, UCS and a team of independent experts undertook the first-ever systematic assessment of both the effects of power plant cooling on U.S. water resources and the quality of information available to public- and private-sector decision makers. Our analysis provides a strong initial basis for making water-smart energy choices—the only choices suitable to a warmer, water-constrained future.

The Scope of the Problem

Our analysis used new analytical approaches to calculate the water use of virtually every power plant in the United States, looking across the range of fuels, technologies, and cooling systems. As it turns out, thermoelectric power plants—those that boil water to create steam, which in turn spins the turbines that produce electricity—have a massive thirst. On an average day in 2008 (the latest year for which data were available), these plants withdrew roughly 100 billion gallons of freshwater from rivers, lakes, streams, and aquifers, to condense the steam from the turbines. They consumed (i.e., evaporated) billions of gallons of that water rather than returning it to waterways. Our nation's coal fleet alone, which generates less than half of our electricity, was responsible for two-thirds of both power plant withdrawals and consumption.

We also found tremendous variation in water use, not just by technology but also by location. For example, plants in Michigan, Missouri, North Carolina, and Virginia withdrew 40 to 55 times as much freshwater as plants in California, Nevada, and Utah in 2008 (see the map on p. 11). U.S. nuclear plants withdrew nearly eight times more freshwater than natural gas plants on average. And some renewable energy facilities used essentially no water, but others consumed more than the average coal or nuclear plant. (All comparisons are per unit of electricity generated.)

Understanding the energy-water nexus is critical to making smart policy and planning decisions.

Water Supplies Feel the Stress

Using these data, we then assessed the stress that power plants place on water systems across the country. According to our

analysis, 400 out of 2,106 watersheds across the country in 2008 experienced water supply stress—the point at which demand for water by all users (including power plants, agriculture, and municipalities) exceeds a critical threshold of the available supply, typically surface and groundwater. Power plants, by tapping this overstretched resource for cooling purposes, contributed to water supply stress in nearly 80 of those watersheds.

Water quality can be similarly stressed by high temperatures. Even with the sparse temperature data available, we found more than 350 power plants across the country had discharged water that exceeded 90°F, the limit set by many states to control harm to fish and other wildlife. Warmer water stresses power plants, too, decreasing their efficiency (see the sidebar on p. 12) and forcing operators to reduce output, or even temporarily shut down, to avoid the risks—to the environment or the plants themselves—posed by higher water temperatures.

Our analysis also revealed a number of gaps and inaccuracies in even the most comprehensive water-use database, with details reported by plant operators and compiled by the federal government, in 2008. About 25 to 30 percent of power plant water use went unreported, and discrepancies were widespread across the country. As a result, analyses based on federal data would have overlooked regions facing water stress.

A Water-Smart Energy Future

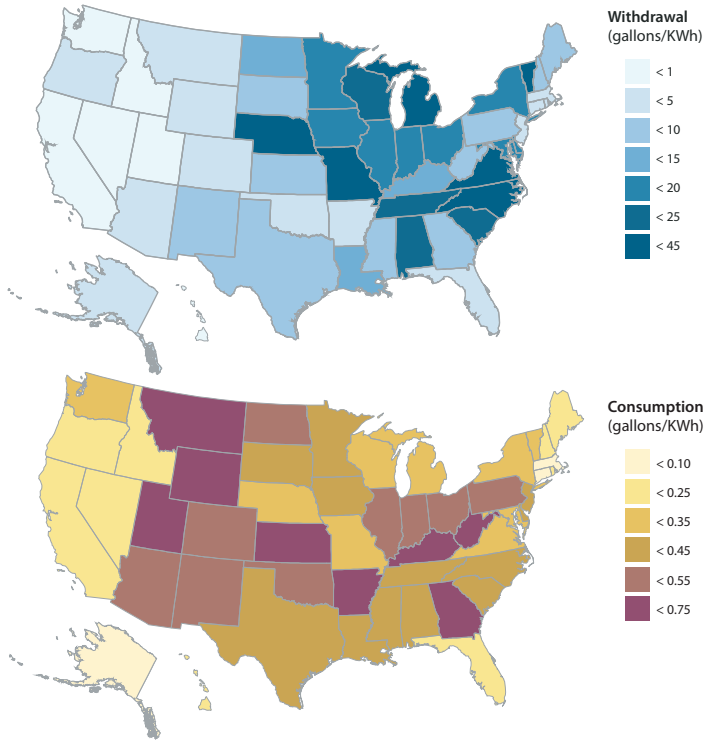
Getting better information is a critical step, but only a first step. Decision makers must then put that information to work in curbing electricity's thirst, especially in water-stressed regions. We offer the following recommendations for making water-smart energy choices:

Get it right the first time. Particularly in regions of current and projected high water stress, utilities and other power plant developers planning new generating facilities could prioritize low-water options including dry cooling (which uses fans instead of water) and technologies that do not require cooling at all, such as wind and solar photovoltaics. Some developers are already deploying dry cooling in projects located in the desert.

Retool existing plants. Owners and operators of existing water-hungry power plants in water-stressed areas could consider retrofitting to low-water cooling. Some plants have already made the switch; for example, the 1,250-megawatt (MW) Plant Yates near Newnan, GA, added cooling towers in

Freshwater Use for Electricity Generation

Water use intensity can vary greatly from state to state based on electricity mix (including water-free sources such as wind) as well as power plant efficiency and cooling. States that make water-smart energy choices may set an example for others to follow.



Renewable energy development should be approached with an eye toward minimizing water use. The Ivanpah solar thermal plant in California (left) uses dry cooling to save water, while wind turbines require no water at all.

Photos: © BrightSource Energy (solar); © Digital Vision (wind)

The Carbon-Water Balancing Act

Decision makers must consider the impacts that global warming, electricity generation, and water all have on each other.

As scientific evidence shows, heat-trapping carbon emissions from human activities are driving up global average temperatures. Because warmer air can hold more water, precipitation patterns that affect water resources are changing, contributing to flooding in some areas and drought conditions in others (which has a direct impact on the operation of water-cooled power plants). Water temperatures are also rising in many streams, lakes, and rivers, causing water-cooled power plants to run less efficiently, which in turn increases the cost of electricity and the amount of water these plants need.

Compounding the problem is the fact that the power sector is a major source of carbon emissions, accounting for one-third of the country's total in 2009. As fossil-fueled power plants are forced to run longer and harder to provide consumers with relief from rising temperatures, they generate even more emissions.

No Easy Answers

Power plant fuels and cooling technologies vary greatly in both water requirements and carbon emissions: traditional coal-fired plants are carbon- and water-intensive; nuclear is virtually carbon-free but water-intensive; wind power is both low-carbon and low-water. Solutions to one problem do not necessarily address the other; adding cooling towers to coal plants, for example, reduces water use but not carbon emissions.

And in some cases, solutions create problems elsewhere. Consider carbon capture and storage, a set of technologies that can prevent power plants' carbon emissions from escaping into the atmosphere by injecting them underground instead. Though this strategy would curb heat-trapping emissions, it could increase water consumption between 35 and 95 percent.

2007, cutting water withdrawals by 93 percent (while also eliminating the large fish kills caused in part by hot water discharges from the plant). Xcel Energy slashed freshwater consumption at its 1,080 MW Harrington Station in Amarillo, TX, by switching to treated wastewater for its cooling needs in 2006.

Set strong guidelines for power plant water use. Public officials including legislators and public utility commissioners can play an active role in averting energy-water collisions. For example, the Colorado legislature's 2010 decision to retire more than 900 MW of coal plants in favor of natural gas, energy efficiency, and renewable energy will annually save a volume of water roughly equivalent to that used by 50,000 people.

> **Informed and empowered stakeholders can help ensure strong decisions are made and implemented.**

Engage diverse stakeholders. Informed and empowered stakeholders—mayors securing water supplies for their cities, anglers concerned with sport and commercial fishing, water resource managers at all levels, and many others—can help ensure strong decisions are made and implemented.

Reduce power plant carbon emissions. Because human-caused climate change is worsening water stress across much of the United States, water-smart energy choices should also be low-carbon. However, not all water-saving technologies reduce heat-trapping carbon emissions, nor do all low-carbon options save water (see the sidebar).

Averting energy-water collisions means taking a long view. Power plants are designed to last for decades, and much of our existing infrastructure will continue functioning for years as well. Yet over the next several decades, our nation's precious freshwater resources will face ever more stress from growing populations, a changing climate, and other trends. Making smart decisions today about which power plants to build, which to retire, and which technologies to develop and deploy will help ensure that both our electricity system *and* our water supplies remain viable for future generations.

John Rogers *and* ***Erika Spanger-Siegfried*** *are co-managers of the UCS energy-water initiative and senior analysts in the Climate and Energy Program.*

Learn more about the energy-water nexus in *Freshwater Use by U.S. Power Plants: Electricity's Thirst for a Precious Resource*, available on the UCS website at *www.ucsusa.org/electricity-water-use.*

Electric-Drive Vehicles

We stand on the verge of an exciting transition in the auto industry. More than two dozen hybrids are available in showrooms today, and most major car companies are planning to offer even more advanced vehicles within the next few years, building on the recent introduction of the battery-electric Nissan Leaf and the gasoline-electric, plug-in hybrid Chevrolet Volt. As the market expands, electric-drive vehicles will play a critical role in cutting our nation's oil dependence—and the environmental, security, and economic risks associated with it.

Trading Gasoline for Electricity

Electric-drive vehicles rely partially or completely on an electric motor to move down the road. Four types of electric-drive vehicles are currently on the market:

Hybrid electric vehicles (HEVs) comprise the majority of advanced vehicles on the market today. They rely on gasoline for fuel, but supplement the engine with an electric motor and battery. The battery pack can store excess energy produced by the engine under certain conditions, as well as energy that would otherwise be lost during braking (a process known as regenerative braking, which is featured in all electric-drive vehicles). This energy can then be used to power onboard electronics when the vehicle is stopped at a light or in traffic—eliminating the need for wasteful idling of the engine, allowing it to shut down or "idle off"—or to supplement the engine during acceleration. These features reduce fuel consumption by allowing the engine to be used more efficiently.

Plug-in hybrid vehicles (PHEVs), like HEVS, include both a gasoline engine and electric motor, but have a larger battery that can be recharged via a household wall outlet or public charging station. When fully charged, PHEVs can travel about 15 to 50 miles using little or no gasoline, depending on the model and driving conditions. Once the battery is nearly depleted, PHEVs switch to gasoline and operate like a regular HEV.

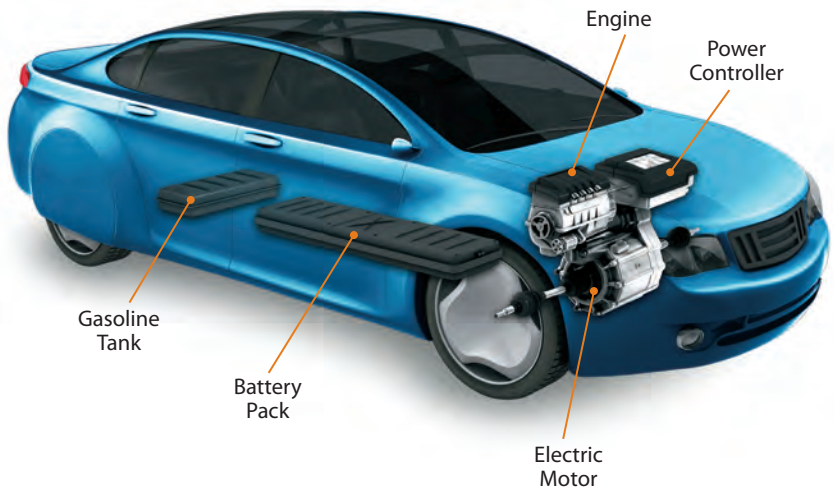
Electric-drive vehicles will play a critical role in reducing emissions and our nation's oil dependence.

Battery electric vehicles (BEVs) do away with the combustion engine completely, relying solely on a battery pack to power the electric motor. Like PHEVs, BEVs plug into an external electricity source. Today's BEVs can travel at least 60 to 100 miles on a full charge, which is sufficient for the majority of Americans' daily travel needs.

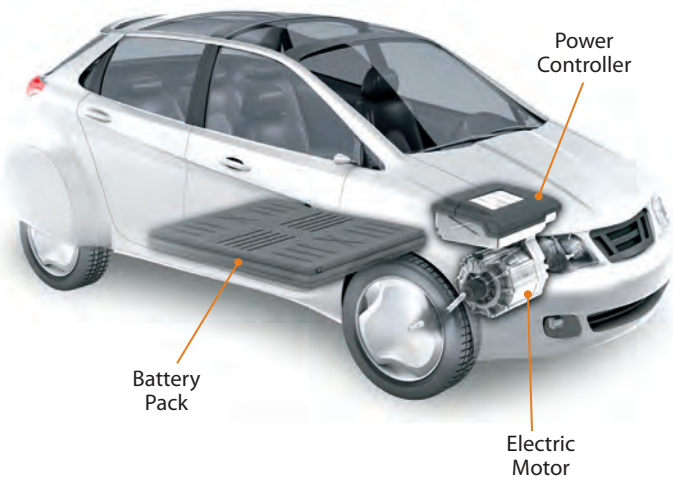
Fuel cell electric vehicles (FCEVs), like BEVs, eliminate the combustion

Electric-drive vehicles incorporate a number of advanced technologies, like those highlighted below, to reduce fuel consumption and emissions. Plug-in hybrid electric vehicles (below left) supplement the battery pack with a small gasoline tank, while battery electric vehicles (below right) rely solely on battery power.

Plug-in Hybrid Electric Vehicle (PHEV)



Battery Electric Vehicle (BEV)



Illustrations: © Union of Concerned Scientists/James Provost

engine, but the electric motor is powered by fuel cells that combine hydrogen, from an onboard tank, with oxygen from the air to produce electricity (and water—the only waste produced). Most of the 50 or so hydrogen refueling stations in the United States today are located in Southern California, which is the only region in the United States where an FCEV (the Honda Clarity) can currently be leased. No FCEV models are currently sold commercially, but the market holds promise: the Clarity can travel an estimated 240 miles before refueling, and most automakers expect to introduce models by 2015 that will have a range of about 400 miles.

Cut Down on Emissions—and Fuel Costs

In addition to saving consumers money on fuel, electric-drive technology has the potential to dramatically reduce global warming, smog-forming, and toxic pollution from cars and trucks. HEVs help by boosting fuel economy; PHEVs, BEVs, and FCEVs are not only very efficient, both in their operation and how their fuel (electricity or hydrogen) is produced, but also replace petroleum fuels with cleaner alternatives, delivering their greatest potential reductions *if* the electricity or hydrogen used to power these vehicles comes from renewable energy sources (see the sidebar).

One hurdle some electric-drive vehicles must overcome in today's market is cost.

Today's BEVs can travel at least 60 to 100 miles on a full charge, which is sufficient for the majority of Americans' daily travel needs.

For example, BEVs and PHEVs cost more up front than their closest conventional counterparts, but federal tax breaks of up to $7,500, along with state incentive programs and lower fuel costs (on a per-mile basis, electricity can be about 50 to 75 percent less expensive than gasoline), can more than offset the initial investment.

The Future Needs a Push Start

If a BEV or PHEV fits your budget, you should seriously consider purchasing one, especially if you live in an area of the country where much of the electricity is generated from natural gas or renewables. In addition to reducing fuel costs, global warming pollution, and oil use, you will show the auto industry there is a market for electric-drive vehicles. Early adoption is critical to help drive up production volumes and spur additional research that can lower costs and improve technologies. If you can't purchase a BEV or PHEV, your next-best bet is a good HEV. There are many excellent models on the market, and the UCS Hybrid Scorecard (*www.hybridcenter.org/hybrid-scorecard*) can help you pick one.

Considering that our nation has relied on one basic engine technology and one fuel for more than a century, a full-scale shift to electric-drive vehicles will take time. However, the promise is simply too big and too important to ignore in a world facing the immense challenges of global warming and oil dependence. Policy makers must accept the reality that the typical two- to four-year political cycle is too short to deliver big results, and that we must invest in a portfolio of technologies if we are to succeed. Together, political action and consumer support can help move our transportation system—however belatedly—into the twenty-first century.

Amine Mahmassani *is an analyst/engineer in the UCS Clean Vehicles Program.*

To learn more about these electric-drive technologies, visit our website at *www.ucsusa.org/Model-E*.

Not All Electrons Are Created Equal

Electric vehicles are only as green as the power plants fueling them.

When charging a BEV or PHEV, it is important to consider the source of the electricity. For example, using renewable energy such as solar or wind power nearly eliminates smog-forming, heat-trapping, and toxic pollution associated with operating the vehicle, while using electricity produced exclusively from coal results in global warming emissions only slightly better than the average gasoline vehicle today. Electricity from natural gas falls somewhere in between, with a carbon footprint better than a good hybrid.

It can be difficult to determine the impact of operating a specific electric vehicle because the mix of electricity sources varies greatly across the United States. To help consumers better understand these impacts, UCS has conducted an in-depth analysis of electric vehicle charging in different regions of the United States, based on the electricity generation resources in those regions. Look for the results soon on the UCS website and in our publications.

Retirement Hasn't Slowed Her Down

When Helen Winsted, 97, was growing up on a South Dakota farm, she says "living green" was simply the norm. Today she beams with pride when talking about her retirement community, Frasier Meadows in Boulder, CO, where she has been a member of the recycling committee since moving there in 2001, and four years later persuaded the CEO to participate in Boulder's subsidized energy audit program.

> **Seniors like Helen Winsted will jump on the green bandwagon if you just show them how.**

"The audit found we were only 65 to 70 percent energy-efficient, and uncovered many areas in which we could improve. We rolled up our sleeves and got to work making some big changes," says Facilities Director Chuck Wellman. After installing compact fluorescent lightbulbs, high-efficiency boilers, and 500 new windows, Frasier Meadows increased its overall efficiency considerably, according to Wellman.

Living Green in the Golden Years

Why has Helen supported UCS for more than a quarter of her life? "That's easy!," she exclaims. "UCS works to clean up and protect our most precious resources: air, land, and waterways. I want to do whatever I can to support the fight for reducing pollution and protecting the environment." She also shares our belief that individuals can make a difference in global problems. "Seniors want to jump on the green bandwagon if you just show them how. We understand that going green is a healthy and safe choice that not only benefits our own life but also contributes to the greater whole."

Photo: © Chuck Wellman

As for her own small part of the world, Helen says the residents and management of Frasier Meadows "are not about to rest on our laurels now. There is always more to do." Next up: water conservation measures including sprinkler timers and low-water plantings.

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