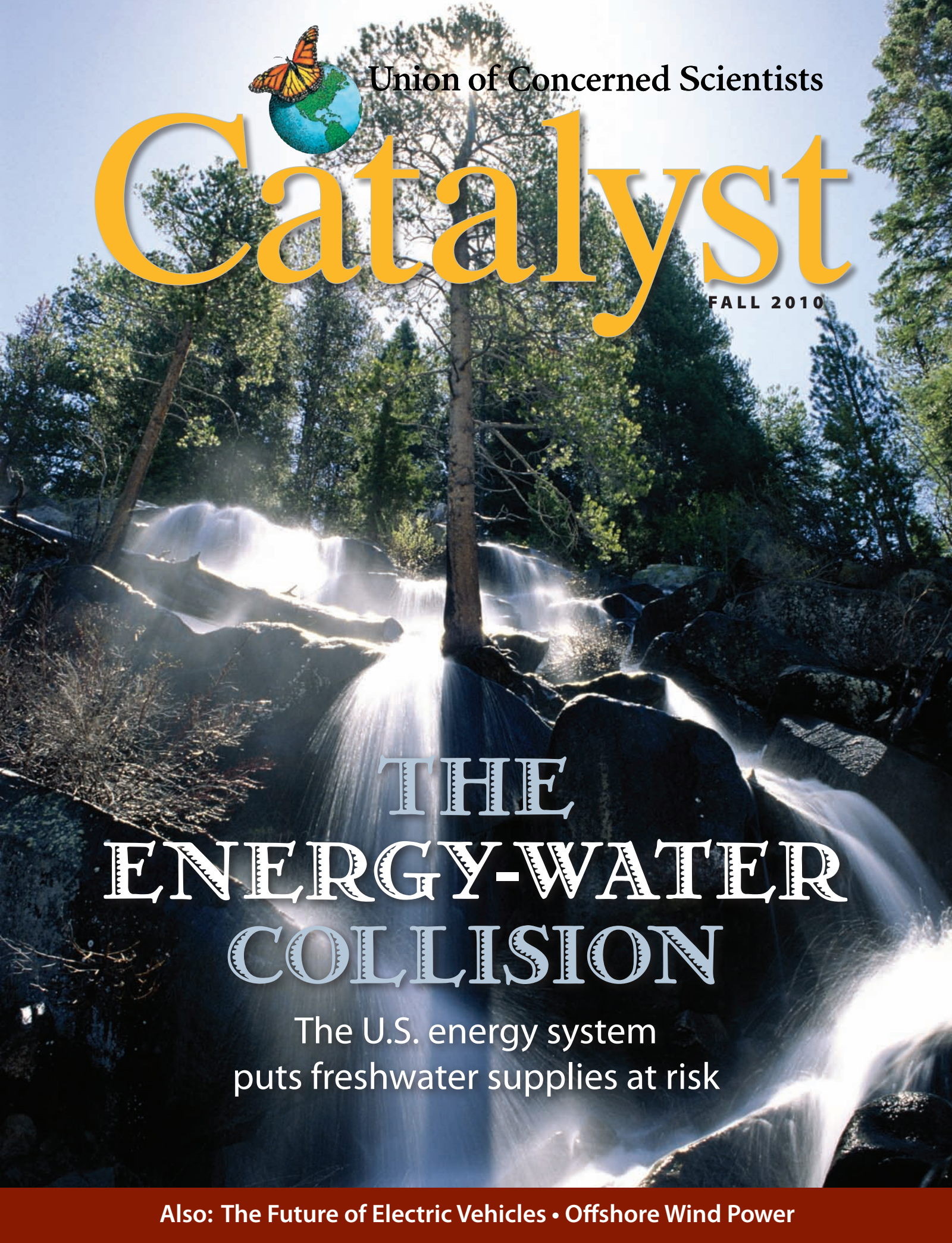

Union of Concerned Scientists

Catalyst

FALL 2010

THE ENERGY-WATER COLLISION

The U.S. energy system puts freshwater supplies at risk

Also: The Future of Electric Vehicles • Offshore Wind Power

Union of Concerned Scientists

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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.*

Climate Science Falling on Deaf Ears?

I admire your optimism in launching your "Weight of the Evidence: Promoting Climate Science for the Public Good" campaign [Summer 2010, p. 7]. However, I fear you are being quixotic. After all, the mainstream press, as well as most radio and TV stations, are owned by corporations. . . . And it's certainly not in the interests of those powerful entities to let the man on the street know the truth about global warming.

David Quintero
Temple City, CA

The author responds:

To help set the record straight on global warming, UCS experts have appeared on Fox News programs and worked behind the scenes to educate their reporters and editors. But we recognize the likelihood that conservative news outlets including News Corporation (which owns Fox News) will continue to allow their commentators to attack climate science and mislead the public.

The good news is that we've been successful in breaking through the media din to showcase the work of climate scientists in print and broadcast venues across the country (see "Newsroom" on p. 5). And we're also putting pressure on News Corporation by encouraging thousands of our members and activists to email owner Rupert Murdoch directly with the message that his paid commentators have the right to broadcast their opinions, but not to make up their own facts.

Rich Hayes
Deputy director of communications

The Promise of Solar Power

I am passing on what I believe is a practicable concept for the problem of the world's energy requirements: concentrating solar energy. It is flexible so it can be adjusted to keep up with demand as time passes. Without active promotion by the scientific community, however, it will be a political ball to be fought over by the coal/oil barons and those who are interested in the long-term preservation of this nation and the planet we call home.

Don George, Ph.D.
Hattiesburg, MS

UCS responds:

UCS is a strong advocate of policies that promote the use of renewable energy sources—including concentrating solar power (CSP), which uses an array of mirrors to boil liquid and drive a steam-powered turbine. Given the marginal cost and potential scale of CSP development, it could play a promising role in a clean-energy future. According to our research, CSP could provide as much as 6,887 gigawatts of electricity-generating capacity by 2030.

One of the biggest challenges to widespread CSP deployment is obtaining the necessary permits to build and operate these facilities. It is also essential to analyze the impacts such large-scale renewable energy deployments could have on water resources (see p. 7) and endangered species.

Laura Wisland, energy analyst
Climate and Energy Program

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

Photo: NREL

PERSPECTIVE

Driving Down Our Oil Use

This summer, whenever I picked up a newspaper my heart sank. The photographs of oil-soaked pelicans in the Gulf of Mexico filled me with frustration and anger. I saw this damage firsthand in September during a wetlands tour in New Orleans, where biologists and fishermen described the untenable harm wreaked by the gushing well.

This catastrophe could not have put America's oil dependence in starker terms. Last year, our country consumed more than 750 million gallons of oil and other petroleum products *each day*—a level of consumption that puts our environment, economy, and national security in serious peril. Whether in relation to the changing climate, the hundreds of billions of dollars we send overseas to pay for fuel imports, or the devastated Gulf coastline, scientific evidence reinforces what our hearts already know: we need to break our dangerous dependence on oil.

The catastrophe in the Gulf could not have put America's oil dependence in starker terms.

That's why UCS has unveiled a new National Oil Savings Plan that would cut our country's projected oil use in half by 2030. We can get there by boosting the fuel economy of our vehicles, producing clean biofuels, investing in the next generation of electric vehicles (see "The Evolution of a Revolution" on p. 10), and improving public transportation options. The rigorous analysis, sound economics, smart policy, and good technology that went into this plan will ensure that we don't repeat the mistakes of the past and stay reliant on oil.

We are calling on President Obama and Congress to adopt the plan and establish concrete steps to reach the goals outlined in it. At the same time, we are holding oil companies and automakers accountable for bringing the necessary clean vehicles and fuels into the marketplace. We are also providing consumers with information about the choices they can make to help reduce oil consumption.

UCS has long been a leader in the fight to promote science-based solutions to America's oil dependence. Our recent success in convincing Congress to pass the first new fuel economy standards for passenger vehicles in more than 30 years, and helping the Environmental Protection Agency understand the science behind sustainable biofuels, shows that UCS has the scientific credentials and policy smarts to get the job done.

It is this expertise and experience that convinces me UCS can and must play a role in developing an effective strategy to cut America's oil dependence. Working together we can put the United States squarely in the driver's seat as a leader in international efforts to shift away from fossil fuels. To learn more about our plan, visit the UCS website at *www.ucsusa.org/OilSavingsPlan*.

—***Kevin Knobloch***, *president*

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Science Under Attack in Virginia

UCS helps defend against baseless charges

This spring, Virginia Attorney General Ken Cuccinelli—a vocal global warming contrarian—accused climate scientist Michael Mann, a former University of Virginia professor, of fraud. Cuccinelli claimed Mann received research funding based on falsified data, and the attorney general issued subpoenas for all the emails, data, and draft papers Mann generated during his tenure.

Scientific discovery is held back when government officials harass or intimidate scientists.

These actions could set a dangerous precedent. Science thrives on rigorous debate and a frank exchange of ideas and perspectives, and scientific discovery is held back when government officials harass or intimidate scientists. UCS therefore spoke out strongly against Cuccinelli's actions, working with coalition partners to organize a letter from more than 800 Virginia scientists and academic leaders urging Cuccinelli to drop his investigation, and to file a court brief in support of the university's decision to fight the subpoenas.

Multiple independent investigations found Mann's methods to be sound, and at the end of August, a Virginia judge dismissed Cuccinelli's case, citing a lack of evidence. The attorney general, however, is planning to resubmit the subpoenas and may appeal parts of the judge's ruling to the Virginia Supreme Court. To follow this case and UCS's involvement in it, visit *www.ucsusa.org/cuccinelli*.

A New Way to Deliver Jobs

We find economic benefits in cleaner trucks

In May, President Obama announced plans to set the first-ever fuel economy and global warming emissions standards for large trucks, a category that includes everything from delivery vans and concrete mixers to long-haul tractor-trailers. These trucks consume 20 percent of all the transportation fuel used each year in this country, despite representing just 4 percent of all vehicles on the road.

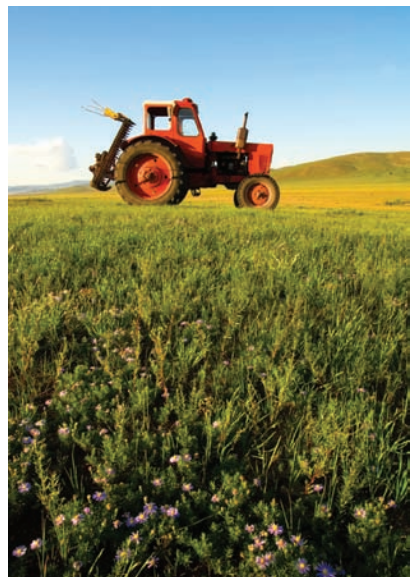
Just prior to the president's announcement, UCS and CALSTART (a clean-transportation technology consortium) released the findings of a joint analysis examining the economic benefits of improving heavy-duty truck fuel economy. The study found that an increase in average fuel economy from about six miles per gallon today to 9.7 miles per gallon by 2030 could create as many as 124,000 jobs across the nation and, after paying for technology improvements, save $24 billion in fuel costs that year. Increasing truck efficiency would also decrease America's oil dependence, cutting annual consumption up to 11 billion gallons by 2030 and reducing global warming emissions by 140 million metric tons—equivalent to removing 21 million of today's passenger vehicles from the road.

To read the report *Delivering Jobs*, visit the UCS website at *www.ucsusa.org/deliveringjobs*.

Getting Biofuels Back on Track

Our plan for a smart shift from gasoline

Biofuels hold the promise of reducing two major problems: oil dependence and global warming emissions from transportation. Yet despite numerous government programs and subsidies, biofuels are not measuring up to their potential. Corn ethanol production, for



example, has taken off, but growing corn for fuel puts increased strain on the food system and environment—and fails to reduce global warming emissions over the fuel's full life cycle. "Cellulosic" biofuels made from grass, wood waste, or even garbage promise to be cleaner, but are struggling to reach commercial scale.

In *The Billion Gallon Challenge*, released in June, UCS lays out a plan to quickly develop 1 billion gallons of clean biofuels. The first component of the plan is a set of financial incentives that would support construction of the first commercial-scale cellulosic biofuels facilities around the country. The second component is a Biofuels Performance Tax Credit that would reward biofuels producers who clean up their production processes. Replacing current biofuels tax credits with this new credit would save more than $5 billion a year. To learn more, visit the UCS website at *www.ucsusa.org/smartbioenergy*.

Eden Place Director Michael Howard and UCS Analyst Karen Perry Stillerman explained the benefits of climate-friendly gardening to Chicago residents.

Sowing Seeds of a Cooler Climate

UCS helps urban gardeners go greener

Since our spring release of *The Climate-Friendly Gardener*, UCS has been partnering with groups around the country to spread the word on how smart gardening practices can improve soils while reducing heat-trapping emissions. One of these partnerships was with Eden Place Nature Center in Chicago, where we co-hosted an event in July to celebrate the many benefits of urban gardening.

Karen Perry Stillerman, an analyst in the UCS Food and Environment Program and author of our report, joined Eden Place Director Michael Howard in leading more than 100 participants on a tour of the center,

New UCS Ads Generate Media Buzz

Our "Curious for Life" ads, launched this summer, have succeeded in bringing increased national attention to both our organization and our efforts to counter attacks on climate scientists. The ads, which show how scientists' childhood curiosity about the natural world motivated their research on global warming, have been discussed in USA Today, on National Public Radio's "Marketplace" segment, and in blogs by Time and New York Times reporters. You can learn more about the campaign and download full-size versions of the ads at *www.ucsusa.org/evidence.*

highlighting its contributions to both the local community and the global environment. For example, Eden Place addresses the lack of affordable, nutritious foods in its low-income neighborhood by growing produce on-site, making it available to the community at a weekly farmers market, and teaching area residents gardening and cooking skills. The center helps increase carbon storage in its soil and reduce heat-trapping landfill emissions by composting animal and plant waste (which also fertilizes the garden). The center's trees also store carbon while providing shade and cooling the surrounding air, which helps reduce the neighborhood's need for air conditioning.

Smart gardening practices can improve soils while reducing heat-trapping emissions.

At the end of the tour, the participants signed our pledge (online at *www.ucsusa.org/gardenpledge*) to adopt climate-friendly gardening practices at home.

UCS Inspires Young Scientists

Kids learn about space security

Robert Goddard is not a household name. But the Worcester, MA, scientist was a pioneer in developing rockets to carry satellites (and eventually people) into space. To honor him, and draw attention to space-related problems such as growing levels of debris in orbit, the Goddard School of Science and Technology—a Worcester elementary school with a science focus—started the Goddard Lecture Series this year. For the inaugural lecture, Principal Marion Guerra invited David Wright, physicist and co-director of the UCS Global Security Program, to speak at the school in June.

David explained to the students how space and satellites serve critical scientific, military, and civilian functions and how the increased use of space has led to growing amounts of debris (mainly pieces of old satellites) that can damage or destroy active satellites. He also explained what needs to be done to keep space safe and usable. The presentation was part of a daylong series of educational and engaging events related to space, including a model-rocket launch and a game of space-junk bingo. David's talk, which was filmed by a local public-access TV station, and other information on space security can be found on our website at *www.ucsusa.org/spacesecurity.*

David Wright addresses students at the Goddard School of Science and Technology.

We Put Every Dollar to Work

Our sound finances draw praise (again)

We are pleased that UCS continues to receive the highest possible recognition from the United States' premier charity rating agencies: an accreditation seal from the Better Business Bureau, an A rating from the American Institute of Philanthropy, and a four-star rating from Charity Navigator. These independent organizations have assessed our finances and practices and determined that we rank among the most trustworthy charities in the country.

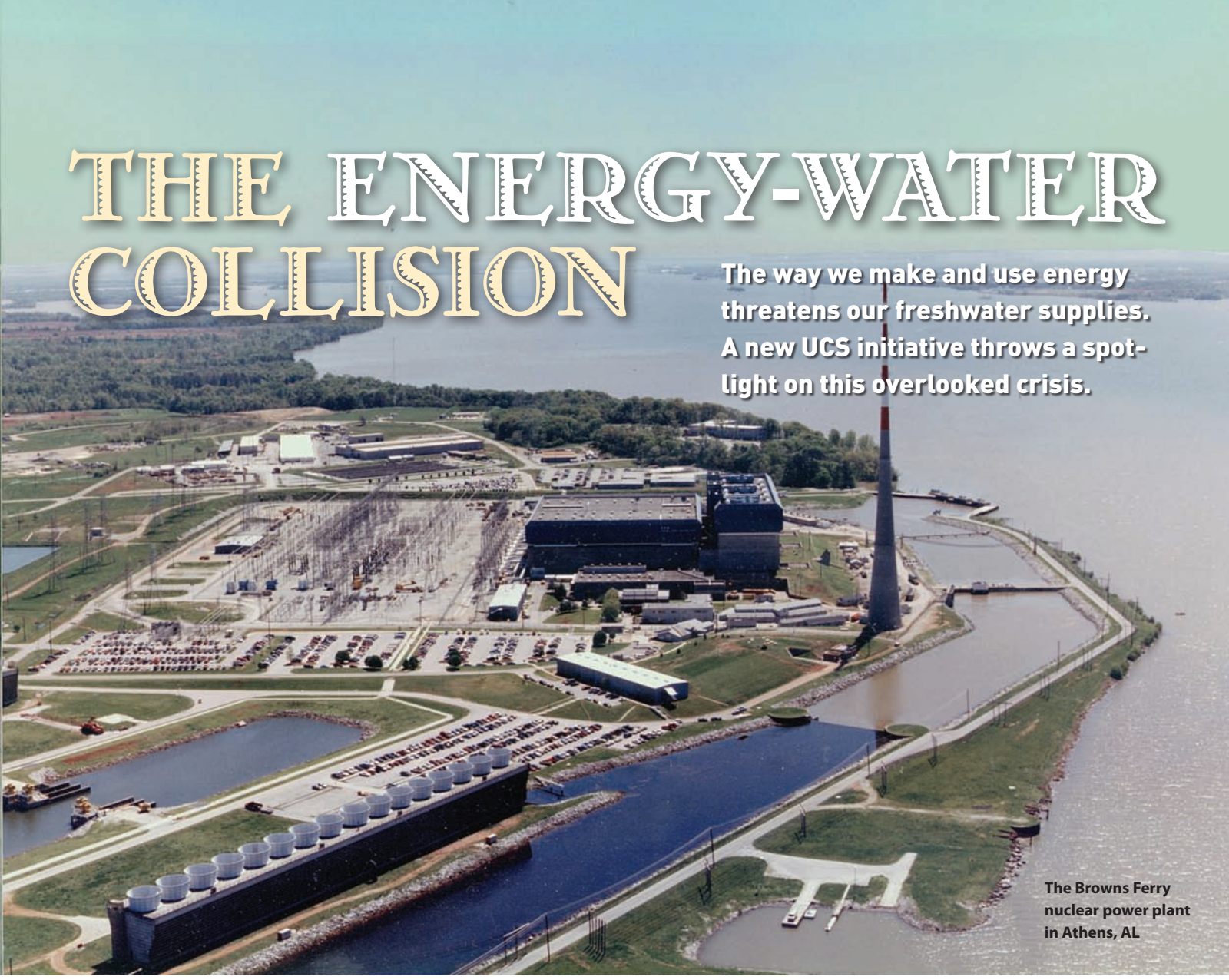
UCS has a long and proud history of sound financial management. Our careful and effective use of your donations—fully 85 percent of which go directly to fund our program work—ensures that your gift will have a direct impact on the issues that concern you most.

We know how important it is for you to be confident that your money is being invested wisely, so we hope you share our pride in these testaments to our fiscal responsibility. Your ongoing support makes it possible for us to deliver the expert analysis, policy savvy, and citizen engagement that together can address the most pressing environmental and security issues facing us today.

Photo: Courtesy of the Goddard School of Science and Technology

THE ENERGY-WATER COLLISION

The way we make and use energy threatens our freshwater supplies. A new UCS initiative throws a spotlight on this overlooked crisis.



The Browns Ferry nuclear power plant in Athens, AL

By John Rogers and Erika Spanger-Siegfried

When it comes to energy and water, it's hard to have one without the other—producing energy uses water, and providing freshwater uses energy. Power plants, for example, use water to cool the steam that spins electricity-generating turbines; fuel producers use water in the mining of coal, extracting of petroleum, and growing of crops for biofuels. Conversely, using water in our communities requires energy to get it there, treat it, heat it, and more. Because of these links between energy and water, problems for one resource can create problems for the other, and the energy-water connection can easily turn into a collision.

The energy choices we make today and in the future will therefore have a major impact on our water supplies and the energy sources that depend on them. UCS has launched a new initiative to examine the nexus between water, energy, and climate change, and to identify and promote clean-energy solutions that can reduce global warming emissions while protecting our water supplies. What follows are just some of the findings of our initial research.

Thirsty for Power

The U.S. electricity system requires an enormous amount of water to function: just one day's worth of electricity generation requires more than 140 times the water used by New York City. More than half of the country's nuclear power reactors, and almost half of our coal-fired power plants, use "once-through" cooling, meaning they withdraw water from nearby water bodies, pass it through the plant to cool the steam, and return it to the source. Each of these plants withdraws between 20 and 60 gallons of water for each kilowatt-hour of electricity it generates, far exceeding the amount of water used in homes directly (see the sidebar on p. 8).

Some plants lose large amounts of withdrawn water to evaporation. For example, just one typical 600-megawatt coal-fired power plant loses more than 2 billion gallons of water

Photo: Nuclear Regulatory Commission

annually—an amount that could fill more than 3,000 Olympic-sized swimming pools.

In Hot—and Dirty—Water

Water discharged from a coal or nuclear plant is hotter—by an average of 17 degrees Fahrenheit (°F) in summer—than when it entered the plant. Half of all coal plants report releasing water in the summer at peak temperatures of 100°F or more. This thermal pollution can stress or kill fish and other wildlife.

Thermal pollution is not the only danger to water supplies, however. Arsenic, mercury, lead, and other toxic substances contained in coal plant waste can severely contaminate drinking water supplies. Mountaintop-removal coal mining has buried almost 2,000 miles of Appalachian headwater streams—some of the most biologically diverse streams in the country. And while natural-gas-fired power plants are less water-intensive than coal or nuclear plants, extracting gas from shale deposits can affect water quality and strain water supplies in local communities.

Water-dependent power plants have had to reduce their output during times of drought—when electricity demand is often at its highest.

Water Unrest

Water supply conflicts are growing across the United States, particularly in the West, where farmers, electric utilities, cities, and other water users all compete for the same limited resource. Even without factoring in the exacerbating role of climate change (see below), conflicts over water are considered highly likely in major Southwest cities such as Albuquerque, Denver, Las Vegas, and Salt Lake City by 2025.

Such tensions are not confined to arid regions. In the Southeast, drought has brought simmering disputes between states like Georgia, Tennessee, Alabama and Florida over the rights to key rivers to a boiling point in recent years. By 2030, electric capacity is predicted to grow nearly 30 percent in the western United States and 10 percent in the Southeast—a trend that raises the difficult question: With what water?

Climate Complications

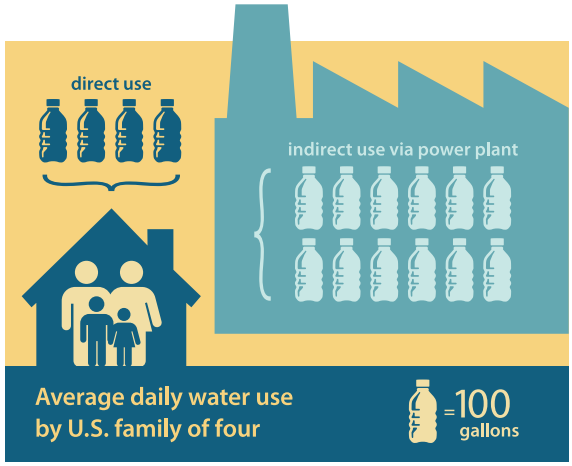
Compounding the issue of competing water demands are the effects of global warming. Increasing climate variability—in the form of extreme heat and extended drought, in particular—is already testing the resilience of energy and water systems in some regions. Further climate change will pose far-reaching challenges. The Northeast and Midwest, for example, can expect

Hidden Water Use at Home

We all use hundreds of gallons more than we may realize.

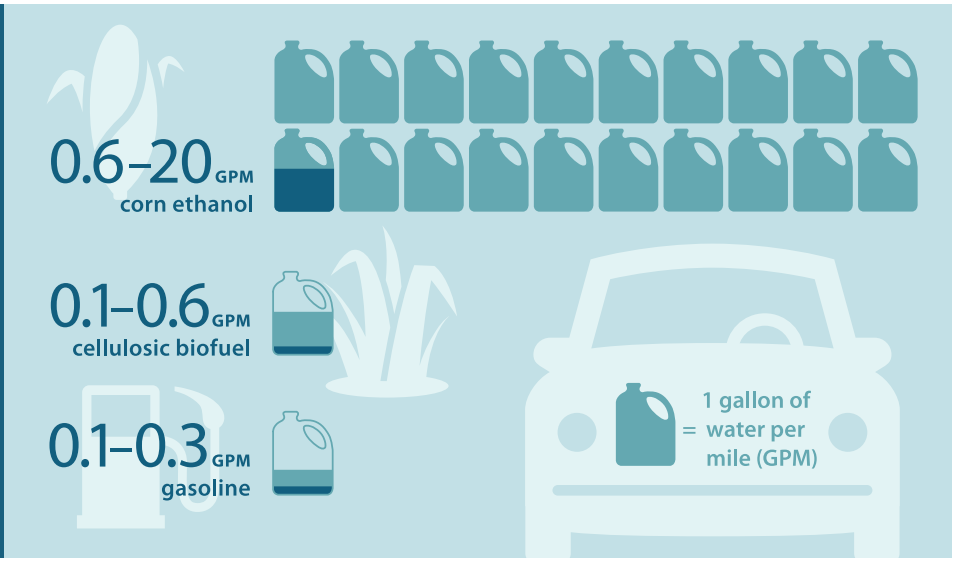
Between the kitchen, bathroom, laundry, and yard, the average U.S. family of four uses about 400 gallons of freshwater per day—not including the water required to generate the electricity this family uses. Assuming their home is powered by a coal-fired or nuclear power plant that takes lake or river water for once-through cooling, this family's electricity use requires an additional 600 to 1,800 gallons of freshwater per day. Just one load of hot-water laundry (using an electric washer and hot-water heater) uses 3 to 10 times more water at the power plant than inside the washer itself.

This indirect—but massive—water use related to energy consumption underscores the need to invest in water- *and* energy-saving appliances at home—which will save consumers money in the long run while protecting our natural resources. In addition, consumers can support cleaner electricity generation by purchasing "green power" (from low-water resources such as wind) from their electric utility.



Water required to produce transportation fuels

Running a typical car (getting the equivalent of 24 miles per gallon of gasoline) on corn ethanol can require one-half to 20 gallons of water per mile—or more—depending on the water used for irrigation. "Cellulosic" biofuel would require less than one gallon of water per mile. Gasoline, while not a renewable resource, requires the least water: less than half a gallon for extracting and refining oil.



changes in seasonal precipitation patterns including more spring flooding and extended summer drought. In the Southeast, instances where water is too warm for power plants to use for cooling may become much more frequent. The Southwest can expect far less runoff and precipitation, especially in the warm months, while longer, more severe droughts will leave arid areas even drier.

Since 2004, water stress has forced at least a dozen U.S. power plants to temporarily reduce their power output or shut down entirely. The Browns Ferry nuclear plant in Alabama, for example, was forced to cut the power output of all three of its reactors for nearly five straight weeks this summer when nearby water temperatures hit 90°F—all while cities in the region were experiencing high power demands due to heavy use of air conditioning. This and other water-related shutdowns have prompted at least eight states to reject new power plant proposals.

Avoiding a Disastrous Collision

A number of technologies can help the United States shift to a low-carbon, low-water energy system. The easiest to implement are also the most cost-effective: energy- and water-efficient appliances, buildings, and vehicles. Old coal and nuclear power plants can also be made more water-efficient with cooling technologies that could reduce water withdrawals by two orders of magnitude (though more water would be lost to evaporation than before).

Shifting to non-fossil-fuel sources of energy could further reduce our water use—if we make the right choices. Biofuels, for example, have the potential to reduce the environmental impacts associated with gasoline use, but the "water footprint" of conventional biofuels such as corn ethanol can be very large (see the diagram above). Creating a single gallon of corn-based ethanol consumes, on average, about 100 gallons of freshwater—some 15 to 30 times more than it takes to produce a gallon of gasoline. In some regions, ethanol production can take three or more times that amount, depending on irrigation needs. However, the water requirements for producing a gallon of "cellulosic" biofuel from low-water grasses or waste wood may require as little as 2 to 10 gallons of water. Non-plant fuel sources such as animal waste or even garbage could lower the water requirements of biofuel production even further.

Wind turbines and solar photovoltaic panels can generate electricity without any water, while concentrating solar power plants, which traditionally require significant amounts of water, can avoid straining water supplies by using dry cooling (albeit at a higher cost).

As our new energy-water initiative continues, UCS will work with decision makers and other important stakeholders—representing agriculture, fishing, river protection, water conservation, and clean energy, among others—to ensure government policies support energy solutions that reduce both carbon emissions and the strain on our freshwater supplies. Working together, we can not only avoid the worst impacts of climate change, but also make our energy supplies more resilient in the face of a water-constrained future.

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

Our fact sheet, *The Energy-Water Collision: 10 Things You Should Know*, provides more detailed information on the impacts described in this article, as well as other aspects of our energy and water use. Read it online at *www.ucsusa.org/energy-water.*

The Evolution of a Revolution

Electric-drive vehicles have the potential to give us a zero-emissions transportation future. UCS outlines the steps needed to make this dream a reality.

By David Friedman

The latest news from the auto industry is electrifying—most major car companies and some start-ups are planning to offer at least one car driven partially or completely by electricity in the next few years, with the Nissan Leaf and Chevrolet Volt leading the way this fall. These electric-drive vehicles could be the start of a revolution that helps to dramatically cut urban smog-forming pollution, reduce U.S. global warming pollution 80 percent or more, and effectively end our oil addiction by 2050.

To make electric-drive vehicles a reality, we need patience and smart policy changes.

But to make such a revolution reality, we need patience and a mix of smart policy changes. Electric-drive vehicles won't solve global warming overnight, or even in the next 10 or 20 years, but their long-term potential as a key part of the solution is so great that we cannot afford to let them fail.

Believe (Much of) the Hype

Expectations are high for electric-drive vehicles, and rightfully so. Battery-electric vehicles (BEVs), for example, have no gasoline engine and do not directly emit smog-forming or global warming pollution; fuel-cell electric vehicles (FCEVs), which run on hydrogen, emit only water. Plug-in hybrid-electric vehicles (PHEVs), which have both an electric motor and a gasoline engine, do emit pollution when they run on gasoline, but can travel between 10 and 40 miles solely on battery power. The environmental impact of these vehicles is further reduced if the electricity or hydrogen on which they run is produced by renewable energy such as solar or wind power, which creates little or no smog-forming or global warming pollution.

These vehicles offer other benefits as well. For example, they can be recharged or refueled at home, are quieter than conventional cars, and deliver better acceleration from a stop. And electric-drive vehicles could be less expensive to own than even the best hybrids if industry and government research efforts are successful in bringing down the costs of fuel cells and batteries.

Of course, even if the auto industry could offer all new-car buyers an electric-drive vehicle today, it would still take about 15 years before all the cars on the road today could be replaced. A full phaseout will in all likelihood take even longer because of the time needed for the auto industry to develop the manufacturing capacity to make a lot of electric-drive vehicles (and for both research and economies of scale to make such vehicles less expensive).

An aggressive, but achievable, path for electric-drive vehicles would be to reach 3 to 5 percent of the new-car market by 2020—a faster penetration than hybrids achieved over the past decade—then accelerating to about 15 percent of the market by 2025 and about 80 percent by 2040. Even that will not be enough to end our oil addiction and cut global warming

pollution from cars at least 80 percent by 2050. But we *can* achieve those goals if we complement electric-drive vehicles with a combination of better fuel economy, better biofuels, and the policies needed to get these solutions in place (see the sidebar on p. 12).

Moving Electric-Drive Cars into the Fast Lane

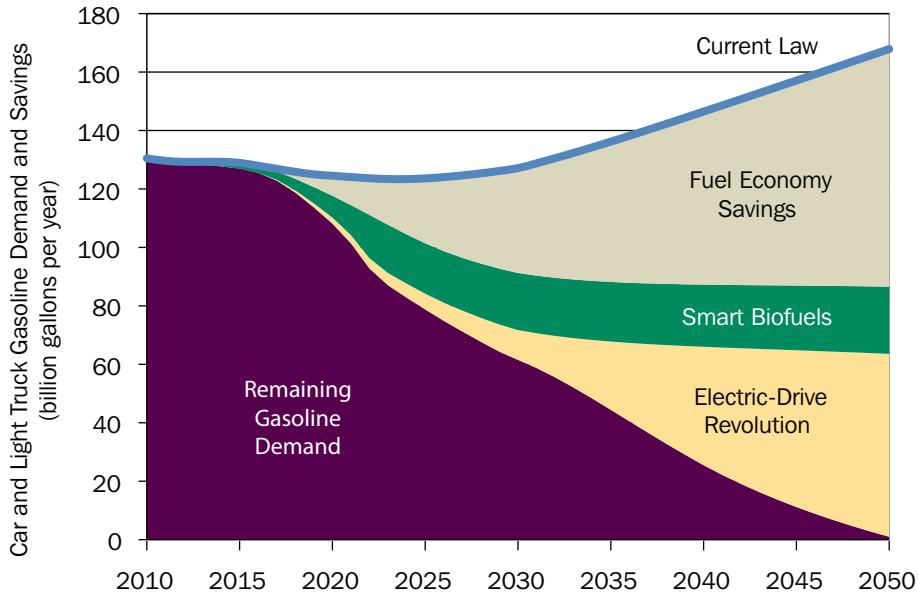
If electric-drive vehicles are to deliver on their significant promise, they will need help. UCS is working with decision makers in both government and the auto industry to adopt the following strategies, which would help ensure electric-drive cars and light trucks fulfill their potential:

Provide certainty for investors. For more than 40 years, the United States has shifted its financial and policy support from one promising energy technology to another, making it impossible for industry and venture capitalists to make long-term investments of their own. To break this cycle, the United States needs to adopt both a National Oil Savings Plan that would cut the country's projected oil use in half by 2030 (see "Perspective" on p. 3), and an emissions limit that would reduce global warming pollution at least 80 percent by 2050.

Invest in the vehicles. Today's electric-drive vehicles are too expensive for most consumers, with price premiums of at least $10,000 to $20,000 above the cost of a hybrid. Bringing these costs down will require both technological progress and economies of scale. The federal government should provide research funding for better batteries and fuel cells, incentives to help consumers buy electric-drive vehicles, and grants and loan guarantees for automakers as an incentive to manufacture more of these vehicles in the United States.

Invest in infrastructure. Electric-drive vehicles will be impossible to sell if consumers cannot easily recharge or refuel them, but oil companies and utilities will have little interest in paying for charging or hydrogen fueling stations if they lack confidence in a technology's future. And even for home recharging, most consumers will have to spend as much as a few thousand dollars to upgrade their home wiring to accommodate the cars' higher-voltage charging needs. The only way to solve this proverbial chicken-and-egg problem is to roll out infrastructure and vehicles at the same

The Road to a Gasoline-Free Future



This chart shows how the policies outlined in this article could eliminate gasoline demand in the U.S. transportation sector by mid-century. The uppermost line represents our projection of gasoline demand under current policies; the different colors represent the individual impacts of higher fuel economy standards, increased production of cellulosic biofuels, and a transition to electric-drive vehicles.

Shell Hydrogen and General Motors teamed up to build the first combined hydrogen and gasoline fueling station in North America, located in Washington, DC.

Photo: © Shell Hydrogen

time. Making this work will require incentives for both consumers and industry, as well as changes to local building codes and zoning laws that can unnecessarily make infrastructure more expensive—or even impossible—to install.

Other Components of a Clean-Car Future

Beneficial technologies must be accompanied by complementary policies.

Since electric-drive vehicles can't solve global warming by themselves, UCS has been working to shape these key U.S. transportation policies:

Next-generation fuel economy standards. **UCS played a critical role in delivering new regulations (finalized earlier this year by the Obama administration) that will raise the average fuel economy of passenger vehicles to more than 34 miles per gallon (mpg) by 2016 and establish the first-ever national global warming pollution standards for cars and light trucks. Our next step is to push the administration to boost fuel economy even more: to 60 mpg by 2025—which would save at least 40 billion gallons of gasoline by 2030 on top of the benefits from the 2016 standards.**

Next-generation biofuels. **Cellulosic biofuels made from grass, wood waste, or even garbage could cut gasoline use by another 20 to 25 billion gallons. We are working to get the right incentives in place to help move this technology out of the lab and into the marketplace. To learn more, see "Newsroom" on p. 4.**

Ensure the availability of "green" energy. Electric-drive vehicles reduce or eliminate tailpipe pollution, but if they are recharged with electricity generated by fossil fuels, or refueled with hydrogen made from fossil fuels, they will be far from pollution-free. We therefore need a strong renewable electricity standard that requires utilities to increase the percentage of clean power they generate, and a low-carbon fuel standard that ensures hydrogen, biofuels, and other gasoline alternatives are as clean as possible.

Starting the Revolution

The concept of supporting electric-drive vehicles is not new; some tax breaks and other financial resources for such vehicles have been on the books for years. But they are not big enough and do not last long enough to help these vehicles reach the mainstream market. For this revolution to have a chance at success, an investment on the order of $5 billion per year over the next 15 years will be required. The good news is that this money does not have to come out of taxpayers' wallets. We can instead redirect subsidies that currently go to polluting industries like oil (which currently receives about $5 billion a year).

We need a renewable electricity standard that requires utilities to increase the percentage of clean power they generate, and a low-carbon fuel standard that ensures gasoline alternatives are as clean as possible.

UCS will continue to remind lawmakers that the typical two- to four-year political cycle is not enough time to deliver big results, and that we have to invest in technologies with some risk if we are to succeed. Considering that our nation has relied on one basic engine technology and one fuel for more than a century, the switch to electric-drive vehicles may feel more like evolution than a revolution—but it is high time we face the challenges of climate change and America's oil dependence by moving our transportation system into the twenty-first century.

David Friedman *is research director in the Clean Vehicles Program.*

Visit our website at *www.ucsusa.org/clean_vehicles* to learn more about electric-drive vehicles and other technologies and policies that can help end U.S. oil dependence.

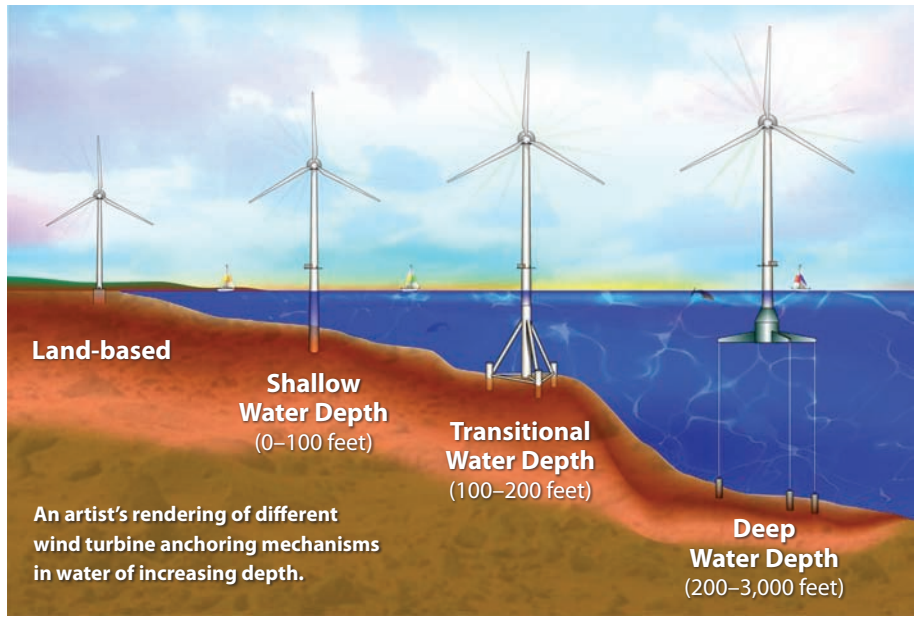
Photo: © Associated Press

Offshore Wind Power

The United States has built wind power facilities on land at a record pace in recent years. Following in the footsteps of Europe and other regions, U.S. wind developers are now looking offshore, where the winds blow stronger and more consistently. Offshore wind could more directly deliver clean energy to major coastal cities, where demand for electricity is high, without the pollution and global warming emissions associated with extracting and burning fossil fuels.

Wind turbines capture the kinetic energy of wind with their turning blades, which transfer the energy to a spinning rotor shaft that drives an electric generator. Because of the relative ease of transporting large components by sea, offshore wind turbines can be much bigger—and capture more kinetic energy—than their land-based counterparts. Offshore turbines have blades that spin in a circle up to 400 feet in diameter—twice as wide as the wingspan of a Boeing 747—and generate up to five megawatts (MW) of electricity, compared with the 240-foot span and 1.5 MW capacity common for today's land-based turbines. Offshore turbine towers also do not need to be as tall (relative to the size of their blades) as land-based turbines (which average 250 feet), because open water is free of the vegetation and topography that create wind shear and turbulence over land.

In shallow waters (less than 100 feet deep), where almost all offshore wind projects are located, turbines can be built directly on the sea floor, with the tower anchored into a large steel tube driven 80 to 100 feet deep into the seabed (see the diagram). Turbines in deeper waters require more complex mounting structures; two recent deep-water installations in Europe use wider-base structures (such as tripods) to support their five-megawatt turbines. The electricity generated from offshore turbines passes through cables buried under the sea floor to a substation either onshore or on an offshore platform, and is then delivered to the electrical grid.



An artist's rendering of different wind turbine anchoring mechanisms in water of increasing depth.

Offshore wind could more directly deliver clean energy to major coastal cities, where demand for electricity is high.

A Promising Solution . . .

Though offshore wind power is a new development for the United States, it has been producing clean electricity for Europe since 1991. Today, nine European countries have developed more than 2,000 megawatts of offshore wind capacity; another 16 projects under construction will almost triple this capacity, and dozens more are planned. Elsewhere, China and Japan have completed their first offshore wind farms and have more projects in the pipeline.

In the United States, the National Renewable Energy Laboratory estimates that offshore wind has a technical potential three times the country's current electricity capacity. Yet only one such project has received federal and state approval for construction (see the sidebar on p. 14). Thirteen other projects along the East Coast, Gulf of Mexico, and Great Lakes are at advanced stages of permitting or development. To help coordinate the efforts of stakeholders (including project developers, regulatory agencies, and clean energy advocates) and ensure the sustainable growth of offshore wind in the United States, UCS joined with government, environmental, industry, and academic colleagues to form the U.S. Offshore Wind Collaborative in 2009.

. . . And a Unique Set of Challenges

Like its land-based counterpart, offshore wind offers several important benefits.

Illustration: Adapted from NREL

This Dutch wind farm is just one of many offshore projects that provide clean electrcitiy to Europe.

It generates electricity without consuming fuel or water, and produces no global warming emissions, air pollution, water pollution, or waste during operation. However, as on land, turbines can harm birds and bats, interfere with aircraft navigation, and raise social, cultural, and economic concerns for local communities. Offshore developers also need to take into account the potential impact on fish, marine mammals, and the sea floor.

Despite these concerns, studies of existing offshore wind projects have been largely positive. Observational data from the 72-turbine Nysted facility in Denmark, for example, show that birds tend to fly around, rather than through, the wind farm, even in conditions of poor visibility. Potential avian impacts can be minimized by siting turbines away from high-traffic flight paths and adjusting operations during seasonal migrations.

The other obstacle facing offshore wind development is cost. Offshore facilities often have large numbers of turbines, each of which must be actively monitored and maintained. Because of the difficulty of servicing wind farms at sea, offshore turbines involve more remote monitoring and automated systems than their land-based counterparts, but even with only a few visits to each turbine per year, operation and maintenance costs are considerably higher than those for onshore wind projects. Deep-water projects—including the first full-scale floating wind turbine, installed off Norway in 2009—currently cost considerably more than today's fixed-base offshore turbines, but will become more cost-competitive as developers gain experience with the technology and undertake projects with multiple turbines.

Offshore wind is still a young technology and, like any emerging energy resource, will take time to become established. By continuing to support research and development, and building construction and maintenance experience, we can help make offshore wind a promising source of clean, reliable, carbon-free power.

Owen Westbrook *is a former research fellow in the Climate and Energy Program.* ***John Rogers*** *is a senior analyst/advocate in the program.*

Finally, Wind Power off Our Own Shores

The nation's first offshore wind facility clears a final hurdle to construction.

Cape Wind, a 130-turbine, 468 MW wind power project proposed five miles off the coast of Cape Cod, MA, received federal approval in April 2010 after almost nine years of exhaustive reviews by state and federal agencies. The review process—which took much longer than comparable reviews for traditional coal-fired power plants—included a two-year study that examined 27 categories of potential environmental, safety, and socioeconomic impacts during construction and operation.

The vast majority of the impacts were found to be minor, negligible, or even positive. Cape Wind's developer agreed to perform several years of post-construction monitoring to assess the turbines' impact on birds, bats, and other wildlife, and to take measures to minimize these impacts.

The facility will generate enough energy, on average, to meet almost three-quarters of the demand on Cape Cod as well as the nearby islands of Martha's Vineyard and Nantucket, displacing electricity generated from dirtier fossil fuels. Because of Cape Wind's precedent-setting potential for the U.S. offshore wind industry as a whole, UCS participated in every stage of the permitting process to provide information on the economic and environmental benefits of wind power. The project can proceed once long-term financing is secured.

To learn more about the environmental and economic benefits of wind power, visit the UCS website at *www.ucsusa.org/windpower.*

Investors in a Clean-Energy Future

Like many people, UCS member Tom Blakeslee invested in oil and gas stocks for years before he understood that those companies were responsible for worsening global warming. He and his partner, Margo Landry, have since changed their investment practices to more closely align with their values, putting both their money and their time into the fight against climate change.

Margo and Tom know the U.S. government must set an example for the rest of the world.

Tom, an engineer by training, has written a book on renewable energy, *Fuel Free! Living Well Without Fossil Fuels* (CreateSpace, 2009), and regularly contributes to several clean-energy blogs. He believes geothermal energy is one of the most promising technologies for reducing global warming emissions, and has given talks on the topic in such distant locales as Australia and China.

American Leadership Needed

Margo notes that, "There are many workable solutions to climate change all over the world, but the U.S. has so far been too stubborn to look outside its borders for examples." Still, she and Tom know it is up to the U.S. government to drive real change and set an example for the rest of the world.

They admire UCS for pushing the federal government in this direction, and for standing up to powerful interests like the oil and gas companies whose stocks they once owned. As recent additions to our National Advisory Board, Tom and Margo support UCS for the voice of scientific reason we bring to legislative debates on climate change and energy. As Tom explains, "It is important for the U.S. government to listen to scientists and focus on the best ways to solve the problem of global warming, instead of legislating to benefit the industries with the most powerful lobbyists."

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