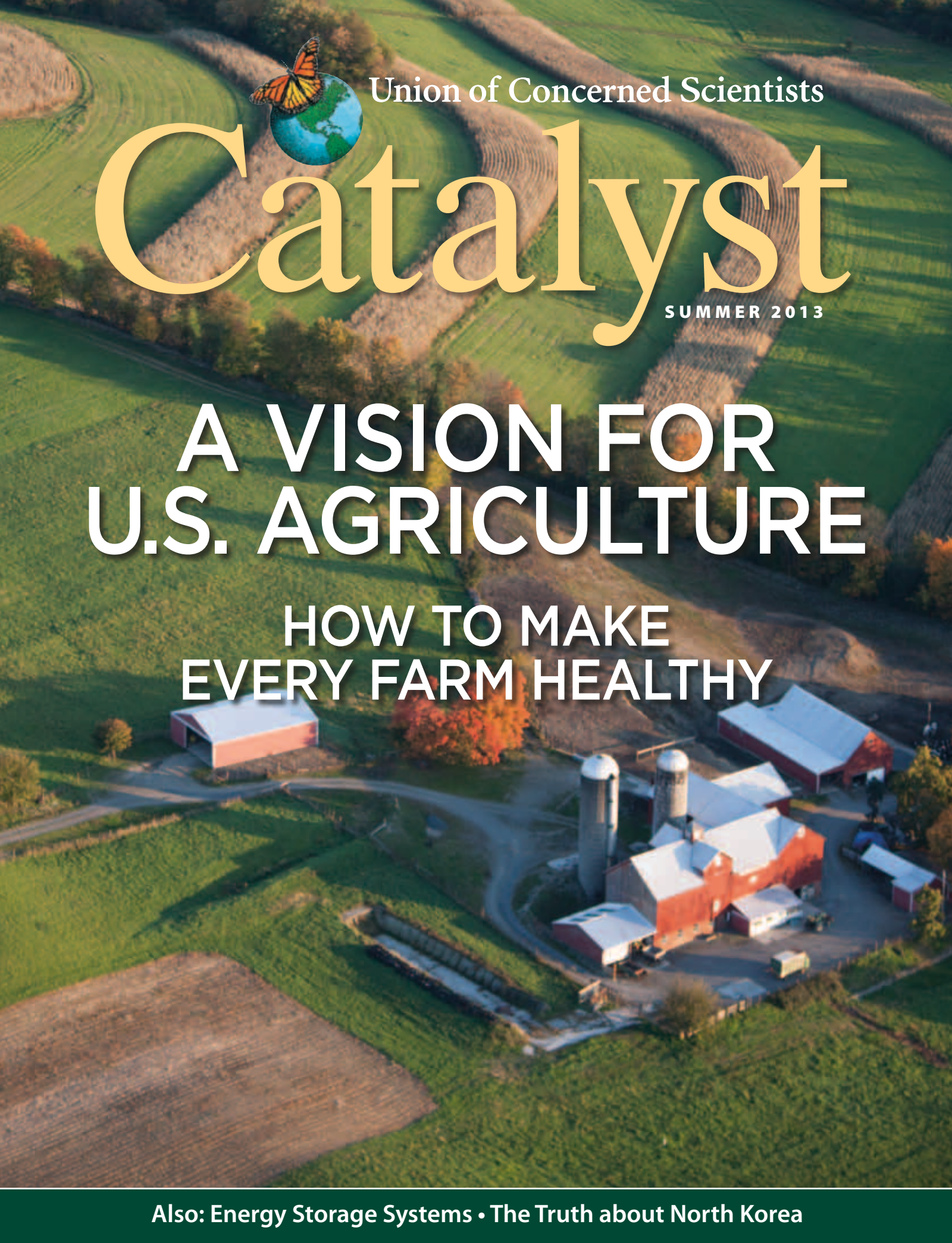

Union of Concerned Scientists

# Catalyst

SUMMER 2013

# A VISION FOR U.S. AGRICULTURE

## HOW TO MAKE EVERY FARM HEALTHY

Also: Energy Storage Systems • The Truth about North Korea

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

The Union of Concerned Scientists puts rigorous, independent science to work to solve our planet's most pressing problems. Joining with citizens across the country, we combine technical analysis and effective advocacy to create innovative, practical solutions for a healthy, safe, and sustainable future.

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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### Do More Wind Turbines Mean Less Wind?

What is the long-term global and local effect of large-scale wind energy harvesting? There must be one: weather is a system, and taking energy out of a system means it will change. Has anyone studied this? There has to be a limit of some kind at some point.

*Dan Downing*
*Reading, PA*

***UCS responds:***

It is true that as the number of wind turbines at a given site increases, the speed of the wind moving through the site decreases, which affects those turbines downwind. Wind developers take this "wind drag" or "wake loss" into account (along with other factors) when siting turbines in order to ensure optimal electricity generation.

While more research is needed, a few recent studies estimate that large-scale development of wind power may be limited to around one watt per square meter of land ($W/m^2$) when wind drag is taken into account. Fortunately, we have a long way to go before this level of density is reached: a 2012 study by the National Renewable Electricity Laboratory found that wind power could reliably supply about 40 percent of U.S. electricity use by 2050—up from 3.5 percent in 2012—with a production density of only 0.02 $W/m^2$ averaged across the 48 contiguous states.

Wind production density will be higher in states with greater wind potential, but still not approaching the estimated upper limit. For example, Texas, which already leads the nation in installed wind capacity, has the potential to meet *all* of its electricity needs with a production density of only 0.08 $W/m^2$.

Some studies have shown that wind turbines can have an effect on local climatic conditions: because turbine blades mix the air, they tend to make surface air temperatures slightly warmer at night and slightly cooler during the day. However, these localized variations have little impact compared with the continuing rise in Earth's average temperature due to increased global warming pollution from burning fossil fuels. Wind power generates no heat-trapping emissions during operation, thereby lessening the impact our nation's electricity system has on the global climate.

*Steve Clemmer, director of research and analysis, UCS Climate and Energy Program*

## WE WANT TO KNOW

***What is the best thing you have done to reduce your household energy use?***

**We will publish selected responses (edited for length) in the fall issue of *Catalyst*. You can respond via**

- Email: *catalyst@ucsusa.org*
- Facebook: *www.ucsusa.org/observations*

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



Photo: © PPM Energy

PERSPECTIVE

# Freedom of (Scientists') Speech

In a watershed moment this year, President Obama signed into law the Whistleblower Protection Enhancement Act, which—for the first time—shields government employees from retribution if they report political interference in their scientific work. For nearly a decade, UCS and our supporters helped educate Congress about the need for these protections, and pushed for this and other strong policies that would allow government scientists to pursue critical research and publicly communicate their results.

During President Obama's first term, we advised many federal agencies in their efforts to improve transparency and accountability, and we recently analyzed the government's progress in protecting scientists' First Amendment right to communicate with the public via social media (e.g., Facebook, Twitter, blogs) as well as traditional news outlets. The resulting report, *Grading Government Transparency* (online at *www.ucsusa.org/mediapolicies*), found that some agencies have listened to our concerns and taken action: for example, since the last time we examined the National Oceanic and Atmospheric Administration's policies, the agency had given its scientists the right to review agency materials that rely on their research. And to its credit, the U.S. Geological Survey improved its social media policy within *four hours* of learning of our report's critique of its earlier policy.

**The Center for Science and Democracy at UCS aims to strengthen the role of science in decision making.**

While the gains we've seen on paper are significant, the message has not sufficiently filtered down to all agency managers. Reports of interference with federal scientists' work have persisted under the Obama administration, including attempts by agency officials to prevent staff scientists from speaking to the media. This past April, for example, members of the Society of Environmental Journalists spoke of being stonewalled when they tried to speak with Environmental Protection Agency scientists. We will keep the spotlight on such obstacles to scientific freedom through venues like our Lewis M. Branscomb Science and Democracy Forum; our first forum in September 2012 provided a foundation for our future efforts by bringing together journalists and government officials to identify ways to overcome barriers to scientific information.

In addition to our continuing work to protect scientists' rights, the Center for Science and Democracy at UCS—with your help—aims to strengthen the role of science in decision making. On such complex issues as natural gas "fracking" and disaster preparedness, we will be helping communities fully understand and consider the scientific evidence when making important choices that will affect their economic security and public health. Follow our progress, and learn how you can get involved, at *www.ucsusa.org/scienceanddemocracy*.

—***Andrew Rosenberg**, director, Center for Science and Democracy*

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Photos: © Richard Howard (Andrew Rosenberg); © Nuclear Regulatory Commission (dry casks)


**(Above) David Wright speaks about North Korea's missile capabilities on *PBS NewsHour*; (left) a missile on parade in Pyongyang, North Korea.**

## Is North Korea a Threat?

***UCS expert provided facts on missile tests***

UCS has been following North Korea's pursuit of ballistic missiles for two decades. So when the country ratcheted up international tensions in March by threatening missile attacks on its neighbors and the United States, we were well-positioned to help reporters, the public, and even U.S. officials understand what capabilities North Korea does—and does not—have.

We played an important and highly visible role as a trusted source for information on North Korea's recent attempts to place a small satellite in orbit. Beginning in 2009, those launches used a large, multistage rocket and led to speculation about whether North Korea would eventually be able to place one of its nuclear weapons on a long-range ballistic missile. UCS had the expertise to put this launch—which failed—in the proper context, and shortly afterward, David Wright, co-director of the UCS Global Security Program, co-authored a widely cited technical analysis of the launch vehicle and how its components could be used in a missile.

**UCS is helping the public understand what capabilities North Korea does—and does not—have.**

In April 2012, when North Korea announced it would allow foreign reporters into the country for another launch, major news agencies including CNN, ABC, Fox, the Associated Press, and the *Los Angeles Times* contacted UCS for background on the country's missile program and what they should look for during this launch. We wrote a series of posts about it on our blog *AllThingsNuclear.org* that received more than 30,000 visits, and we were cited in nearly 2,000 press stories. After the launch—which also failed—David was invited to brief members of Congress, officials in the State Department, and members of the broader Washington policy community.

When North Korea successfully launched a satellite last December, David wrote another series of blogs that again received more than 30,000 visits. We also obtained a copy of a South Korean analysis of the launch vehicle (based on pieces recovered from the sea), which we translated and made publicly available online.

So far, North Korea's missiles do not represent a threat to the United States, but they could reach as far as Japan. UCS is continuing to monitor the situation and will post our analysis of the latest developments at *AllThingsNuclear.org/tag/north-korea.*

## Sky's the Limit for Clean Energy

***We show how the grid can handle more renewables***

Renewable energy is a reliable but still underutilized source of electricity, according to a report UCS released in April. The good news is that wind and solar power generation in the United States

nearly quadrupled from 2007 to 2012, and now provide more than 10 percent of the electricity generated in nine states. However, this expanded production amounts to only 3.6 percent of the national electricity mix.

*Ramping Up Renewables* (online at *www.ucsusa.org/rampinguprenewables*) shows that we can increase this percentage significantly because the U.S. grid can accommodate much more wind and solar power. Despite the fact that these resources' output varies based on local conditions, grid operators are already used to making adjustments for constantly changing levels of demand, and for planned and unplanned power plant outages.

**Smart strategies and strong policies could make it possible for renewable energy to generate 80 percent of U.S. electricity by 2050.**

A number of strategies are available for incorporating more clean energy into the grid, including: drawing electricity from a broad geographic area to help smooth out supply, improving weather forecasting to better predict wind and solar power output, building new transmission lines, and increasing the use of more flexible hydroelectric and natural gas plants. These strategies, along with strong policies, could make it possible for renewable energy to generate 80 percent of U.S. electricity by 2050, while reducing power plants' global warming emissions and water use by the same amount.

Brazil has learned that cattle can be produced in the Amazon without clear-cutting forests, as was done on the land shown here.

## A Victory in the Amazon

***Effective policies slow deforestation***

Because tropical deforestation is a major contributor to global warming, UCS has been working for years to build support for a set of policies that will reduce heat-trapping emissions from deforestation and forest degradation (known as REDD+). So we were very encouraged to learn earlier this year that the policies we've championed are paying off in the Amazon—the world's largest expanse of tropical forest.

Three recent datasets all confirm that, compared with the early 2000s, Amazon deforestation has dropped between 20 and 40 percent; most of the credit goes to Brazil, where deforestation is down about 75 percent. That country, supported and incentivized by REDD+ funding from Norway, has achieved this success through strong law enforcement, the creation of protected areas including reserves for the exclusive use of indigenous peoples, and moratoria on the purchase of soybeans and beef produced on deforested land. Brazil has done this while reducing poverty and hunger and sustaining economic growth—even in the soy and beef industries that had previously cleared forest to expand their operations.

UCS will continue to promote REDD+ and show how businesses and consumers can become deforestation-free. To learn more, visit *www.ucsusa.org/deforestationfree.*

## UCS Finds Needless Pain at the Pump

***Car buyers should consider long-term gas costs***

Our report *Where Your Gas Money Goes,* released in February, found that if you bought a car in 2010 with a fuel economy rating of 22.8 miles per gallon and drove it for 15 years (the lifetime of a typical vehicle), you would spend more than $22,000 on gasoline—just $2,000 less than the average cost of a new 2010 vehicle. Not surprisingly, the majority of this expenditure—66 percent, or nearly $15,000—goes directly to oil companies.

Even if you own shares in these companies, your gasoline purchases

Photo: © Rhett Butler/mongabay.com

do virtually nothing to benefit your stock portfolio: an average driver with $20,000 in ExxonMobil stock would see far less than a penny of growth after spending $1,700 on ExxonMobil gas over the course of a year. Driving a more fuel-efficient vehicle, on the other hand, could save you as much as $11,000 in gas costs over the vehicle's lifetime, even after paying for fuel-saving technology.

*Where Your Gas Money Goes* (online at *www.ucsusa.org/gasmoney*) was released on the same day as U.S. Department of Energy data showing Americans are spending the highest percentage of their pre-tax income in 30 years on gasoline, and just a week after ExxonMobil and Chevron posted near-record profits for 2012. Our findings garnered widespread news coverage, including stories in the *Los Angeles Times*, *San Francisco Chronicle,* and *Washington Post*, and on NBC's *Today*.

## Starting a Bicoastal Conversation on Climate

***We bring experts, decision makers together***

This spring, UCS reached out to decision makers on both coasts to discuss the latest science on global warming and best practices for dealing with the impacts of a hotter climate. In California we brought eight climate experts from around the state (most of whom are members of the UCS Science Network) together in Sacramento on April 3 for a "Climate Science Day." In their meetings with 26 state legislators or their staffs, the scientists emphasized both the seriousness of the climate impacts we face—including water supply disruptions, extreme heat, and wildfires—and the fact that delaying action to reduce heat-trapping emissions increases risk.

**UCS staff members met with California scientists, assembly members, and their staffs at the state capitol for "Climate Science Day" in April.**

Two weeks later, UCS convened 35 city and county planners, emergency managers, sustainability officers, and elected officials from Florida, New Jersey, New York, North Carolina, and Virginia for a day-long roundtable in New York City to share their experiences and lessons learned in recovering from Hurricane Sandy or coping with recurrent coastal flooding—both made worse by rising sea levels. The event included a presentation by the U.S. Army Corps of Engineers' coastal and storm risk management team and a press conference covered by multiple media outlets.

Both events garnered positive feedback from participants, and we look forward to building on these relationships in the months ahead to gain additional support for strong policy solutions. To learn more about how communities can adapt to, and protect against, our changing climate, visit *www.ucsusa.org/global_warming*.

## Give with Confidence

**UCS uses your donations carefully and effectively, investing 86 cents of every dollar in our vital program work. To view our complete financial statement and the accomplishments you helped us achieve, go to *www.ucsusa.org/annualreport*.**

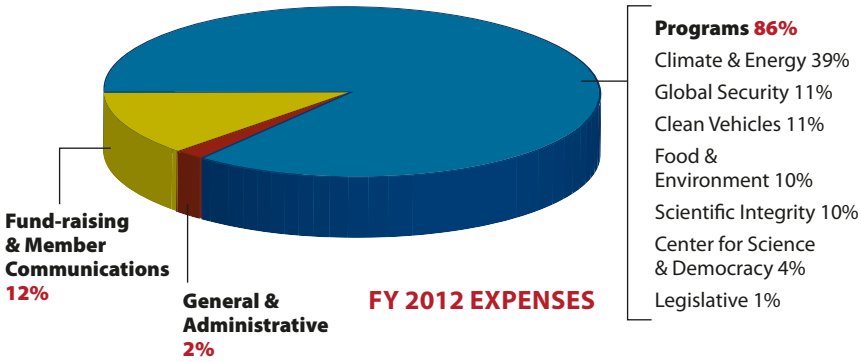





Photo: © Carly Starr

# THE FUTURE OF FARMING IS NOW

**UCS shows how we can revolutionize U.S. agriculture to produce nutritious food and reduce pollution while strengthening our economy.**

By Brian Middleton

From the air, the American Corn Belt looks like a corduroy quilt: mile upon mile of rectangular patches stitched together by ribbons of country road...

. . . here and there sits a house, surrounded by a few trees and a bit of lawn, garden, or (less often) a tiny scrap of uncultivated land. But mostly what you see is that vast expanse of fine wale, stretching in every direction.

This is monoculture—the practice of growing a single crop intensively over a large area of land—and it is the hallmark of the industrial system of food production that has dominated the Corn Belt since World War II. This system was once hailed as a technological breakthrough that would solve the problems of feeding a burgeoning world population. But that hasn't happened, and today the fabric of industrial agriculture is growing threadbare and fraying at the edges. Its reliance on chemical fertilizers, pesticides, and antibiotics has led to depleted soils, herbicide-resistant "superweeds," and pollution that has fouled drinking water and created coastal "dead zones."

In short, industrial agriculture is unsustainable—a dead end. If we keep growing our food this way, we will eventually exhaust our farmland and despoil our air and water. Fortunately, we have a better option.

## Enter the Healthy Farm

The future of farming is what scientists call agro-ecological agriculture, but we simply call it "healthy farms." Healthy farms must be:

- **Productive** enough to ensure abundant, affordable food for U.S. consumers while helping meet the needs of others around the globe; it should also produce a wide variety of foods important to healthful diets (see the sidebar, p. 9)
- **Economically viable**—capable of providing a good living for farmers and farm workers while contributing to a robust regional economy
- **Environmentally sustainable**, using and replenishing resources in a way that maintains the fertility of the soil—and the health of the surrounding landscape—for future generations

Meeting all three goals will be a challenge. However, a growing body of scientific research and agricultural practice shows it can be done, and on farms of any scale. The key is to avoid the temptation of relying on incremental improvements to the existing industrial system, and instead apply

Photo: © Alex S. MacLean/Landslides

**A conservationist with the U.S. Department of Agriculture (left) meets with an Oklahoma farmer to review the progress of a grass-planting project on his farmland.**

our knowledge to build a new system altogether—one that recognizes farms to be multifunctional, regenerative, biodiverse, and interconnected with the natural and human landscape.

## Practices Make Perfect

Farmers face many practical questions in their day-to-day operations: How do I keep my soil and maintain its fertility? How do I prevent my crops from being overwhelmed by weeds and pests, or shriveled by drought? How do I make the most of the available resources, maximizing productivity and efficiency?

Industrial agriculture's answers to these questions tend to be simplistic, generally involving a liberal application of costly chemicals. This approach may work in the short run, but in the long run it leads to the erosion of both farmland and farming knowledge. Healthy farms, on the other hand, use a more sophisticated, science-based toolkit for ensuring both short- and long-term productivity. UCS has identified the following four practices as central to healthy farming:

**Take a landscape approach.** The industrial model treats the farm as a production facility isolated from its surroundings. But scientists and farmers are finding that the uncultivated areas around the farm are a powerful resource; the biodiversity they foster provides important benefits including pollination and pest control.

**Grow and rotate more crops.** Monoculture depletes the soil while creating an inviting habitat for pests. Growing a wider variety of crops—including fruits, vegetables, and even energy crops—avoids those problems and can facilitate longer, more complex crop rotations that enhance productivity while reducing the farm's reliance on chemical inputs.

**Reintegrate livestock and crops.** The industrial system separates animal and plant agriculture, with animals crowded into CAFOs (confined animal feeding operations), where the large volume of manure produced often leads to environmental hazards such as polluting spills. On a healthy farm (or group of neighboring farms), livestock manure can be used to fertilize nearby field crops, making it a valuable resource; well-managed pastures also reduce erosion, store carbon, and provide habitat for beneficial organisms.

**Use more cover crops.** Cover crops such as rye, clover, and hairy vetch are grown not for harvest and sale but to cover the soil between plantings of cash crops. This practice reduces erosion, retains or adds soil nutrients, reduces pests and weeds, and makes the farm less vulnerable to drought.

Some of these practices, such as crop rotation and crop/livestock integration, have been around for a long time. But there is nothing "old school" about the way forward-looking farmers are using them, and scientific evidence shows they can be just as productive as industrial methods.

**Learn more about the principles and practices behind healthy farms with our interactive graphic, online at *www.ucsusa.org/HealthyFarmVision*.**

Last year, for instance, a peer-reviewed report from the U.S. Department of Agriculture, Iowa State University, and the University of Minnesota examined the effects of increased crop diversity—particularly long, complex crop rotations—and bringing animals back into the mix. The study found compelling evidence that these practices do pay dividends. Other recent studies have provided evidence for the benefits of cover crops and whole-landscape approaches, as well as the viability of developing new markets for fruits and vegetables that can be sold at premium prices based on their place of origin.

**Smart, evidence-based agricultural policy, along with more research and outreach on health practices, can level the playing field for healthy farms.**

### How to Make Every Farm Healthy

If the evidence shows that healthy farms are better for farmers, the environment, and the community, why has this approach been slow to gain a foothold in mainstream U.S. agriculture?

The answer is complex, lying at the intersection of market realities, corporate influence, and public policy. Some healthy practices, such as cover crops, require up-front investment. Others, like taking land out of cultivation, may reduce revenue in the short term. In addition, the domination of U.S. agriculture by corn and soybeans tends to be self-perpetuating; farmers who want to grow a broader range of crops may have difficulty finding markets for them, or obtaining insurance and credit (as our 2012 report *Ensuring the Harvest*, online at *www.ucsusa.org/ensuringtheharvest*, found). Federal farm policy and publicly funded research, which have evolved to serve the needs of "Big Ag," currently offer farmers little help in addressing these issues.

The good news is that none of these barriers are immovable. Smart, evidence-based agricultural policy, along with more research and outreach on healthy practices, can level the playing field for healthy farms, giving them the incentives and resources they need to thrive.

The resulting fabric of twenty-first-century agriculture will be different from the old industrial corduroy; it will be a more complex weave with many different threads. And with the help of smart policies and investments, and the contributions of innovative farmers and scientists, it will also be a more durable material—one that can serve our needs for many generations to come.

*UCS Web Content Manager* ***Brian Middleton*** *writes on food and agriculture issues.*

Photo: © Peter Goodman

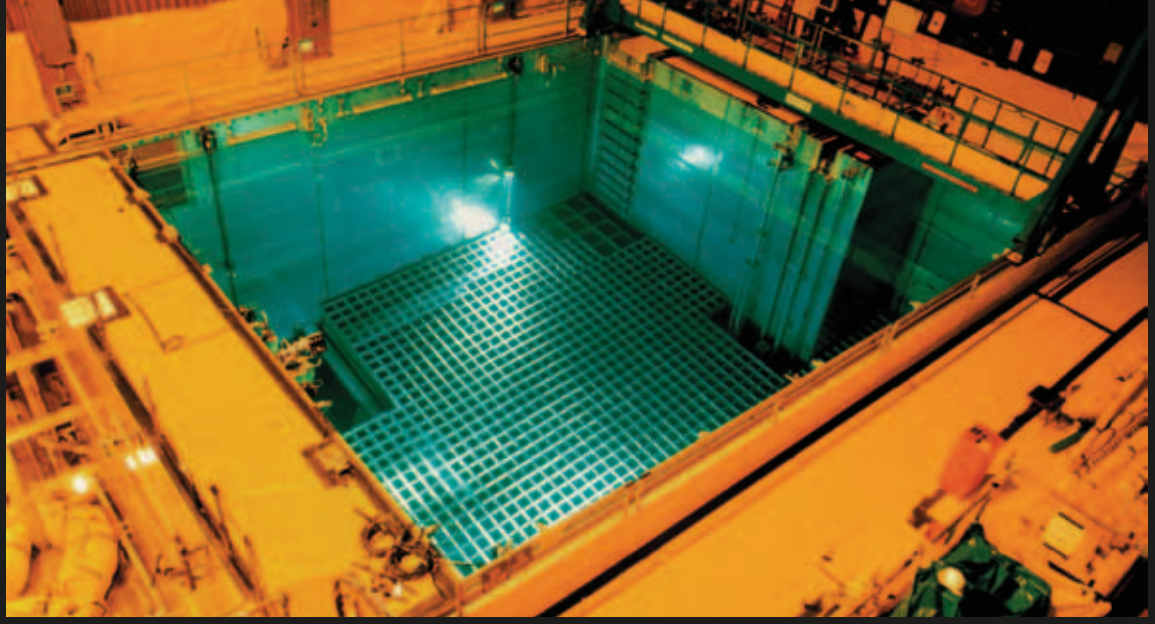
## Do Healthy Farms = Healthy Food?

**A change in farming practices could steer our diet in a better direction.**

One of the key healthy farming practices UCS advocates is diversifying U.S. crop portfolios. As farmers add more fruits, vegetables, grains, and legumes to the mix, the percentage of corn and soybeans in our national harvest should drop while the percentage of healthy foods increases. In other words, as our agriculture sector becomes healthier in its practices, it should become healthier in its products as well.

Of course, this outcome is not guaranteed; farmers can (and do) grow fruits and vegetables using industrial methods—as a visit to California's Central Valley will attest. Conversely, healthy farming methods can be used to produce the raw materials for sugary drinks and other processed foods. Farmers, by themselves, may not be able to fix what's wrong with our nation's food system and the unhealthy ways of eating it encourages, but they can contribute to the solution by adopting healthy farming practices and demanding more support for them.

To learn more about—and get involved in—our campaign to transform U.S. farm policy, visit *www.ucsusa.org/food_and_agriculture.*



# THE GROWING THREAT OF NUCLEAR WASTE

**Americans face an increasing risk from the accumulation of spent reactor fuel in vulnerable cooling pools. A safer storage alternative exists, and UCS is calling on Congress to put it to work.**

**By Seth Shulman**

Earlier this spring, workers at Reactor Unit 3 of the Indian Point nuclear power plant, 40 miles north of New York City, undertook a routine procedure vital to the operation of any such plant in the United States: they replaced the reactor's "spent" nuclear fuel rod assemblies with fresh ones, transferring the older assemblies to a cooling pool adjacent to the reactor core.

Back in 1976, when Unit 3 was first licensed, the Nuclear Regulatory Commission (NRC) authorized its cooling pool to hold a maximum of 264 spent fuel assemblies. Now, however, *1,218* assemblies are packed into the pool like giant radioactive sardines in a large underwater tin.

This is not only more than four times the number of spent fuel assemblies for which the pool was initially designed, but also close to the maximum 1,345 permitted by the NRC—a reality that no doubt presents a headache for Indian Point's corporate owner, Entergy. After all, as Entergy spokesperson Jerry Nappi notes, "A reactor cannot continue to operate unless there is room in its cooling pool for its spent fuel."

Of course crowded cooling pools represent more than an inconvenience for the nuclear industry. As UCS Nuclear Safety Project Director Dave Lochbaum explains, "Densely packed cooling pools represent an undue risk to the public because they are unacceptably vulnerable to accidents, natural disasters, or terrorist attack."

**Densely packed cooling pools represent an undue risk to the public because they are unacceptably vulnerable to accidents, natural disasters, or terrorist attack.**

## Running Out of Room

Sadly, the situation at Indian Point is the norm in the United States rather than the exception: more than 50,000 tons of spent fuel now sit in cooling pools that were never intended for long-term storage. Companies like Entergy, Nappi rightly notes, had expected the U.S. government to take title to this waste and bring it to a permanent repository. But Congress has stood at an impasse over the siting of such a repository since 1998.

In the interim, the NRC has authorized U.S. plants to follow the easiest and cheapest storage path available: namely, to pack their pools ever tighter and add boric acid to the water in order to absorb neutrons and limit the likelihood of a nuclear reaction caused by the increased proximity of fuel



Photo: © Nuclear Regulatory Commission

assemblies. Even with these so-called re-racking authorizations, the NRC says that all the nation's nuclear power plants will run out of space in their pools by 2015.

The danger inherent in overcrowded storage pools lies in their nature as an "active" storage system; that is, plant operators must ensure a constant supply of water is pumped into the pool and circulated around the fuel assemblies in order to keep them cool. If the water supply is interrupted, the assemblies are hot enough to begin boiling away the water in the pool; the more fuel a pool contains, the faster its water will boil away. Once the fuel is exposed to air, it can burn, melt, and possibly release massive amounts of radiation—which could be cataclysmic at a plant like Indian Point that is so close to a metropolitan area. This was one of the main concerns during the 2011 nuclear disaster in Fukushima, Japan, when cooling systems lost power. (Thankfully, none of the storage pools lost all their water, and the plant operators were able to dump and spray seawater into the pools and restore cooling before the fuel could overheat.)

And while a nuclear reactor is surrounded by six to nine inches of steel and sits within a concrete containment dome some three to four feet thick, the spent fuel pool is located outside the containment dome, in a traditional industrial building often composed of "sheet metal siding like that in a Sears storage shed," according to Lochbaum. These structures are not better reinforced because neither the industry nor its regulators intended to store spent fuel in pools for as long as they have.

### Industry, Congress Delay the Inevitable

Fortunately, there is an established and sensible solution to the problem of overcrowded cooling pools: storing waste in dry casks on site (see the sidebar). Most analysts agree that dry casks provide a safer and more secure way to store spent fuel at nuclear power plants while it is waiting to be moved offsite to long-term storage—a process that will require the transfer of spent fuel to dry casks anyway. So as David Wright, co-director of the UCS Global Security Program, puts it, "If the industry

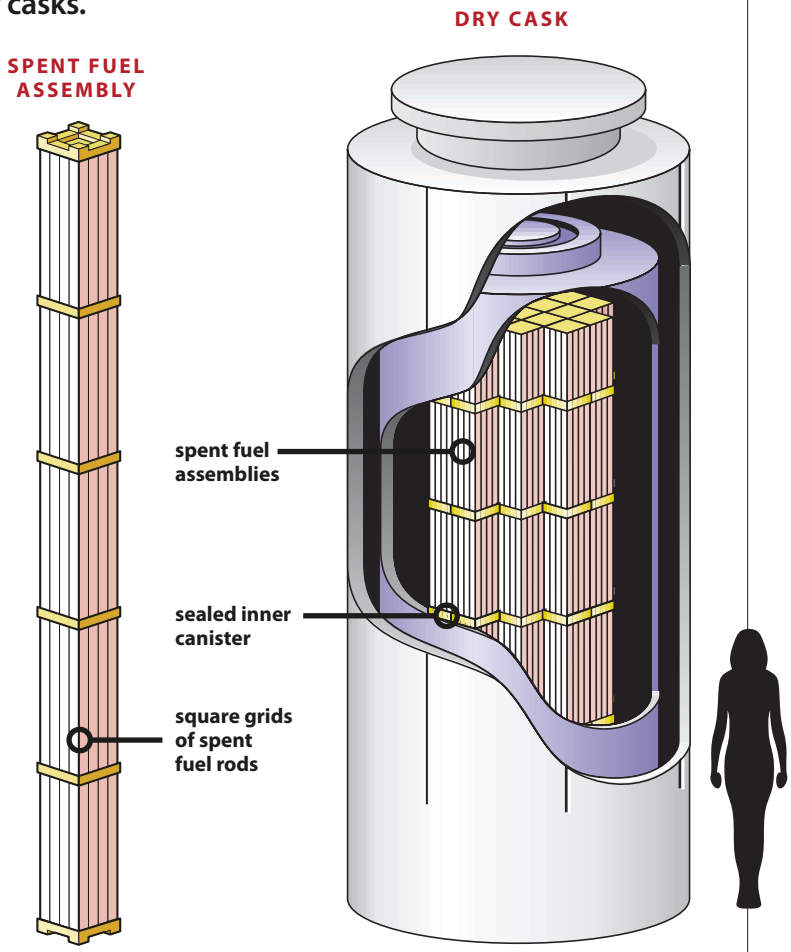
## The Simpler, Safer Choice

**Why nuclear waste should be moved to dry casks.**

**After five years in a cooling pool, spent fuel assemblies are cool enough to be moved into dry casks: concrete and metal containers that are filled with inert gas, then placed on concrete pads or in large concrete silos at the reactor site. Unlike cooling pools that require mechanically driven water circulation, dry casks employ "passive" cooling: air enters an opening at the bottom of the cask, absorbs heat from the spent fuel, then rises and exits through an opening at the top, creating a "chimney effect" that pulls more air into the bottom of the cask.**

**Passive cooling makes dry casks less likely to lose their cooling capacity than "active" systems like cooling pools, which are vulnerable to mechanical failure, technical or human error, terrorist attack, and natural disaster. In addition, maintaining safety is simpler with dry casks, involving such mundane tasks as ensuring that birds have not built nests that block the chimney's air flow.**

**It is worth noting that some of the spent fuel from Japan's Fukushima Daiichi plant had already been stored in dry casks prior to the 2011 earthquake and tsunami. The safety of this radioactive waste was never a concern during the subsequent crisis.**




Illustrations: Annie Bissett (fuel assembly); Nuclear Regulatory Commission (dry cask)

The Indian Point nuclear power plant is located just 40 miles from New York City.

is going to have to do this eventually and we know it is safer, why not do it now?" Because of what's at stake for public safety, UCS and its team of technical specialists, legislative experts, and activists have made dry cask storage a top priority.

Rob Cowin, our senior Washington representative on nuclear waste issues, has been working with the offices of four U.S. senators to make sure overcrowded cooling pools are addressed in comprehensive nuclear waste management legislation. When draft legislation released in late April focused primarily on long-term waste repositories and failed to outline short-term storage strategies at power plants, UCS mobilized its activists to call for the inclusion of dry cask storage guidelines. We have been publicizing both the benefits of dry cask storage and the favorable experience many nuclear operators have had with dry casks; in addition, the BlueGreen Alliance (made up of 14 of the nation's largest environmental and labor organizations, including UCS) sent a letter to the four senators in May explaining how dry cask storage could also create a substantial number of skilled American jobs and improve worker safety.

## What You Can Do

**Congress must not sidestep one of nuclear power's major risks to public health and safety: cooling pools at more than 100 reactor sites across the country that are overcrowded with spent radioactive fuel. Urge your senators and representative to support the transfer of this spent fuel to safer, more secure dry cask storage. Send an email from the online UCS Action Center at *www.ucsusa.org/action*, or call the Capitol switchboard at (202) 224-3121 and ask to be connected to the appropriate office.**

**Because of what's at stake for public safety, UCS and its team of technical specialists, legislative experts, and activists have made dry cask storage a top priority.**

As *Catalyst* went to press, policy makers were reviewing these and other public comments and preparing a final draft bill that will likely be debated by the Senate Energy and Natural Resources Committee later this summer. See the sidebar to learn how you can get involved during the next round of debate.

Even if dry cask storage is included in the final bill, Cowin emphasizes that many logistical hurdles remain, such as determining how quickly the industry should be required to transfer waste to dry casks, and whether funds the government has collected from the industry for creating long-term storage solutions might be used for the task. The industry has wanted to delay fuel transfers until its pools are filled to capacity, but Cowin says this strategy "leaves the risks to the public unacceptably high."

UCS is committed to reducing these risks. With your help we can push the nuclear industry to develop long-term solutions for nuclear waste storage that put public safety first.

***Seth Shulman** is senior staff writer at UCS.*

Learn more about our efforts to improve U.S. nuclear power plant safety by visiting our website at *www.ucsusa.org/nuclear_power.*

# Energy Storage

At any given second of the day, the operators of our nation's electricity grid must match electricity supply from multiple energy sources with demand from multiple consumers. Both ends of this equation are constantly variable; on the supply side, electricity generation can drop due to planned power plant outages for maintenance purposes and unplanned outages stemming from severe weather, equipment failure, or natural disasters. Fortunately, grid operators have a number of strategies for balancing supply and demand; one of them is energy storage.

## Keeping the Juice Flowing

There are many types of storage technologies, some of which have been used for decades to help integrate coal and nuclear power plants (which are difficult to ramp up or down to meet demand) into the grid, and to compensate for variability and uncertainty in the power system more generally. These include:

**Pumped hydroelectric.** Some hydroelectric plants have reservoirs at a higher elevation to which they pump water when electricity supply exceeds demand; that water can then run downhill through a turbine to produce electricity when demand is high. With 22 gigawatts (GW) of installed capacity in the United States, pumped hydro is the largest form of energy storage in the power system today, though it constitutes less than 2 percent of total U.S. generating capacity. The potential for more capacity of this type is limited due to the long permitting process and high costs involved in new hydropower facilities, and the amount of land and water needed for reservoirs.

**Energy storage will ultimately make the goal of clean energy that meets demand at all hours achievable.**

**Thermal storage.** Concentrating solar power plants can store the sun's heat in water, molten salts, or other fluids, and use it to generate electricity for hours after sunset. Several such plants are operating in Arizona and Nevada, and another is proposed in California. Also, a pilot program under way in the Northwest connects utility customers' water heaters to the grid, allowing them to store excess power (in the form of hot water) from a nearby wind farm.

**Compressed air.** These systems use excess electricity to compress air and store it in underground caverns. When needed, the compressed air is heated and used to generate electricity in a natural gas combustion turbine. One such facility is operating in Alabama, and developers have proposed several new projects in California and Texas.

**Batteries.** Rechargeable batteries like the ones in cell phones and cameras can be used on a much larger scale to supply electricity to the grid. For example, batteries are used on the Hawaiian islands of Kauai and Lanai to lessen the variability in output from solar power plants, which generate a large portion of the islands' electricity. Batteries in plug-in electric

**Hydropower facilities, concentrating solar power plants, and electric vehicle batteries can store excess electricity and return it to the grid as needed to ensure consistent, sufficient electricity output.**

Photos: © NREL (hydro plant); Sandia National Laboratories/Hugh Reilly (concentrating solar plant); © Ford Motor Company (plug-in vehicle)

vehicles that are outfitted with special equipment can also supply electricity to the grid when the vehicles are idle. A current challenge with this technology is that the batteries can wear out sooner with frequent charging cycles, though newer designs may reduce this risk. In addition, the owner must be sure to leave enough power to actually drive the vehicle.

**Hydrogen.** Excess electricity can be used to produce hydrogen gas from water molecules; the hydrogen is then stored for later use in a fuel cell, engine, or gas turbine. The National Renewable Energy Laboratory (NREL) has also researched the possibility of producing hydrogen from wind power and storing it for use in generating electricity when demand is high and the wind is not blowing. No commercial-scale hydrogen storage systems currently exist.

**Most energy storage technologies can respond within seconds to meet demand (unlike coal and nuclear plants) and their output can be easily adjusted to the specific needs of the grid.**

## Part of a Cleaner Energy Future

Energy storage technologies differ in the services they provide to the grid; some can help manage variability over short time frames while others can store larger amounts of electricity for times when demand is high. Most can respond within seconds to meet demand (unlike coal or nuclear plants) and their output can be easily adjusted to the specific needs of the grid. They can also be useful in remote locations such as rural and island communities, where long-distance transmission lines are difficult or expensive to build.

Despite these potential benefits, energy storage systems currently do not play a major role in the growing renewable energy market. While renewable energy facilities have low operating costs (their "fuel"—such as wind and sunlight—is free), transferring electricity to and from storage systems also uses electricity, which reduces their overall efficiency. Energy storage is also expensive: a 2010 NREL study found that few large-scale, commercially available storage systems cost less than $1,000 per kilowatt of capacity—comparable to the cost of building new natural gas generators. Other power management strategies such as reducing energy demand (see the sidebar) are less expensive in most circumstances.

Nevertheless, energy storage does have a role to play as renewable energy development expands; indeed, NREL has found that renewable energy could supply 80 percent of U.S. electricity by 2050. Though that is still a long way from the 17.6 percent we generate today, energy storage—along with other improvements to the grid and strong state and national policies—will ultimately make the goal of clean energy that meets demand at all hours, in every region of the country, achievable.

***Heather Tuttle** is editor at UCS.*

Learn more about how we can build a clean, reliable U.S. electricity system at *www.ucsusa.org/clean_energy.*

## How to Be Less Demanding

### Using less electricity at key times is more effective (and less costly) than storing energy.

**To avoid interruptions in service, our electricity supply must be able to meet peak demand—the maximum amount of power needed by consumers at any given time. This generally occurs during summer afternoons, when air conditioner use is highest. Many power plants that have been built solely to meet peak demand sit idle most of the year, but customers pay for their construction and maintenance through higher rates. Reducing demand can eliminate the need to build such plants, and also saves consumers money by lowering the peak consumption on which utilities base their rates for the following year.**

**The easiest way to reduce peak demand is to avoid using appliances such as air conditioners and clothes dryers during peak hours (typically 2:00 p.m. to 5:00 p.m.). You also want to be sure your appliances run efficiently by choosing an Energy Star-rated air conditioner sized properly for your room or home, and setting your thermostat as high as you can tolerate. Many utilities even provide financial incentives for customers to change their consumption patterns: different rates based on time of day, or rebates for heavy-use customers (like factories) who reduce their usage during peak hours.**

# An Artist Who Thinks Green

UCS member Meredith James has been concerned for the environment ever since her second-grade teacher showed the class a video on global warming and acid rain. A native of New York City, Meredith spent summers with her parents in rural northern Michigan, where she played in the woods and loved catching frogs. Suddenly, she found herself worrying about their population dwindling. "It's an age when you start realizing you don't have control over everything," she recalls, "and I began to see how fragile the world seemed."

> **"I feel better knowing my money is helping UCS focus on the facts."**

Today, Meredith is an artist in Manhattan working with perception and landscape, and her concern has not waned, especially as artist-in-residence programs take her to places as far afield as Utica, NY, and Omaha, NE. "From depressed, unsustainable cities to drought-ridden corn and soy farmlands," she observes, "I'm regularly reminded how our agricultural and energy systems just aren't working." But she knows solutions exist, and appreciates the fact that UCS has delivered victories that serve as "glimmers of hope—as evidence of our ability to solve big problems and make progress toward a better world."

A commitment to social and environmental causes runs in Meredith's family; her parents manage a family foundation and work with their children to identify the groups they will support. Meredith is proud to direct a portion of the foundation's funds to UCS through her membership in our leadership giving group, the Henry Kendall Society. As she explains, "Many organizations seem to be in a state of panic about climate change. I feel better knowing my money is helping UCS focus on the facts, break down the big problems, and find practical ways to tackle them, step by step."

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