

Union of
Concerned Scientists

RC

Catalyst

Volume 21, Spring 2021

Are “Advanced”
Nuclear Reactor
Designs Better?

Looking beyond the hype

Bolstering Fossil Fuel
Lawsuits with Science

Leah Penniman
on Race, Food,
and Farming

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

© 2021 Union of Concerned Scientists

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

EDITORIAL DIRECTOR
Seth Shulman

MANAGING EDITOR
Bryan Wadsworth

PRODUCTION MANAGER
Heather Tuttle

EDITOR
Pamela Worth

CONTRIBUTING WRITERS
Elliott Negin
Jiayu Liang

DESIGN
Rigsby Hull

FRONT COVER
Digital Vision/Getty Images

BACK COVER
Jacob King/Getty Images

The Union of Concerned Scientists puts rigorous, independent science to work to solve our planet's most pressing problems. Joining with people 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.

CHAIR
Anne Kapuscinski

PRESIDENT
Johanna Chao Kreilick

EXECUTIVE DIRECTOR
Kathleen Rest

NATIONAL HEADQUARTERS
Two Brattle Square
Cambridge, MA
02138-3780

PHONE
(617) 547-5552

EMAIL
ucs@ucsusa.org

WEB
www.ucsusa.org

Proud to Be on Team Science



Earlier this spring, I was vaccinated against COVID-19. Of course, I was greatly relieved. It was also an emotional moment. My thoughts went immediately to the scale of this pandemic: the hundreds of thousands of lives lost in the United States, the millions worldwide, and our private and collective grief. While I felt—and continue to feel—gratitude and humility for my ability to stay safe, as a White US citizen, I am also painfully aware of the disproportionate impacts of this pandemic on people and communities of color. I also recognize the layers of privilege that have insulated me from the serious health and economic consequences of COVID-19.

And as a science advocate and public health professional, I feel awe.

Scientists around the world worked quickly, furiously, and cooperatively to sequence the genome of this new virus, implement measures to monitor and track its transmission, create effective diagnostic tests and treatments, identify public health measures to control its spread, and, finally, develop the vaccines that are now going into so many arms.

The pace of scientific discovery in fighting COVID-19 has been amazing and inspiring—a clear testament to the power and importance of a vibrant, well-funded, and inclusive scientific enterprise. When science is conducted in this way, it can protect and improve our lives and our world. It is this belief that grounds the Union of Concerned Scientists; it's why I and my colleagues go to work every day, and why you support us.

Science can also play a pivotal role in court by providing data and evidence for plaintiffs seeking justice for climate change damages (see p. 14). Science helps farmers create healthy soils and produce bountiful harvests (see p. 12). And science can inform our spending priorities, and steer decisionmakers away from investing in wasteful projects (see p. 8 and p. 22).

We are heartened by the Biden-Harris administration's stated commitment to restoring science to its rightful place in public policy. We applaud the many actions the administration has taken in its first 100 days, while fully recognizing the challenges ahead. You'll read about some of these actions in the following pages—and as you do, I hope you will appreciate and reflect on your own role in helping to make this progress possible. I also hope you'll feel inspired imagining how much more we can achieve together.

And let's not forget to recognize the scientists and public health and health care professionals who have worked so hard under difficult conditions to tackle this pandemic. UCS is proud to be on their side: Team Science. {C}

Kathleen Rest is executive director of UCS.

WHAT OUR SUPPORTERS ARE SAYING

Here's a sampling of recent feedback from the UCS Facebook page (www.facebook.com/unionofconcernedscientists). Find us also on Instagram (www.instagram.com/unionofconcernedscientists) and Twitter (www.twitter.com/ucsusa).

ON THE BIDEN ADMINISTRATION'S COMMITMENT TO ADDRESSING US GLOBAL WARMING EMISSIONS

f Donna Englert Ferguson:
So good to hear President Biden make the link between addressing climate change and job creation. The cost of action vs. inaction on this issue (in terms of \$\$\$) should be common knowledge and it's not.

f Vega Anthony:
Great time to push these issues. This Congress seems more receptive than any other toward green, science-driven policies. We've got to strike while that's still hot.

f Nancy Roberts-Moneir:
This time, the [Paris climate] agreement must be ratified by Congress, so just pulling out won't be an option in the future.

ON GEORGIA GOVERNOR BRIAN KEMP SIGNING VOTER SUPPRESSION MEASURES INTO LAW

f Malia Ana Knight:
This can NOT stand in Georgia. Or anywhere in the United States!

f Ryuichi Okamoto:
Thank you, UCS, for staying on top of this.

ON DEB HAALAND BEING CONFIRMED AS SECRETARY OF THE INTERIOR

f Christine Martin Florky:
It's about time a Native American got to decide what happens to the lands of Native Americans!

ON EPA ADMINISTRATOR MICHAEL REGAN'S PLANS TO RESTORE SCIENTIFIC INTEGRITY AT THE AGENCY

f Lizbeth Kauffman:
I am so grateful that real scientists will now be heard, instead of ignorant ideologues and/or corrupt lobbyists.

f Lisa Hastings:
Not only were scientists silenced and removed from EPA, but laws were passed that formalized putting the short-term financial concerns of polluters over public health and the environment!

ON THE TEXAS POWER OUTAGES IN FEBRUARY

f Anne Kiley:
The ultimate blame rests on the lack of state regulation of utilities. The people hit with those high bills were [paying] the wholesale price for electricity, which fluctuates based on demand. Usually it is cheaper, but not in extreme cold or extreme heat. It is the ONLY state that allows this.

f Marlene Taylor:
I don't think any city is prepared for climate change. That's because this nation has not really believed it was coming.

f Tyler Poe:
The utilities are to blame. They didn't prepare. They were warned for years—since 2011. It was a financial choice that cost people their lives.



[IN THIS ISSUE]

8 **With Nuclear Power, “Advanced” Isn’t Always Better**

Our analysis uncovers concerns with new reactor technologies

14 **The Mounting Case against Fossil Fuel Companies**

UCS is bringing the latest climate science to the courtroom

2 *First Principles* **Proud to Be on Team Science**

3 *Observations*

4 *Advances*

12 *Inquiry* **Interview with Leah Penniman**

18 *Ideas in Action* **Communities Find a Voice in Federal Energy Decisionmaking**

20 *Donor Profile* **Lise Beane: Part of an Enduring Movement**

22 *Final Analysis* **Hypersonic Weapons: Looking Beyond the Hype**

Protecting Coal Workers in the Transition to Clean Energy



For generations, coal miners and coal-fired power plant workers in the United States have helped keep the lights

US coal-fired electricity generation dropped by almost 29 percent from 2009 to 2019. The accompanying reduction

in the human toll. Job losses in the coal industry are uprooting families, deepening economic unease, and leaving community leaders scrambling to keep schools open and social services in place.

“People working in coal mines and coal-fired power plants have their lives turned upside down with the closure of these facilities—often with little advance notice,” says Richardson. Coming from a third-generation coal mining family in West Virginia, the issue is personal for him. “In many cases,” he says, “these facilities are the largest local employer and there simply

aren’t any alternatives that pay nearly as well.”

In partnership with the Utility Workers Union of America (UWUA), Richardson estimated the costs of helping dislocated coal workers find support for new career paths, resources to further their education and training, and financial assistance to keep them and their families afloat while finding new employment. Their analysis projects that a sustained and comprehensive set of supports will cost between \$33 billion over 25 years and \$83 billion over 15 years, depending on the pace of the transition to clean energy. This represents a fraction of the \$4 trillion to \$6 trillion that must be invested in the US energy system over the next 10 years to reach net-zero carbon emissions by 2050. And it’s absolutely necessary, says Richardson.

“How do you get more people to buy into a clean energy future?” he asks. “You respect the rich history of coal workers and communities—and most importantly, lay out a positive vision. From my perspective, our job as advocates is to fight for a thoughtful and planned transition to clean energy. We owe it to the people and places who have given us so much.”

You can find the joint UWUA-UCS report at www.ucsusa.org/resources/support-coal-workers.

IN THE NEXT 10-20 YEARS, AN ESTIMATED 41,000-66,000 COAL MINERS AND COAL POWER PLANT EMPLOYEES ARE PROJECTED TO LOSE THEIR JOBS BEFORE THEY REACH RETIREMENT AGE.

on. As utilities turn to cheaper sources of energy, including renewables such as solar and wind, coal plants are closing, leaving workers out of jobs;

in emissions is good news, but Jeremy Richardson, senior energy analyst at the Union of Concerned Scientists, says we mustn’t lose sight of



UCS Lays Groundwork for Shift to EVs

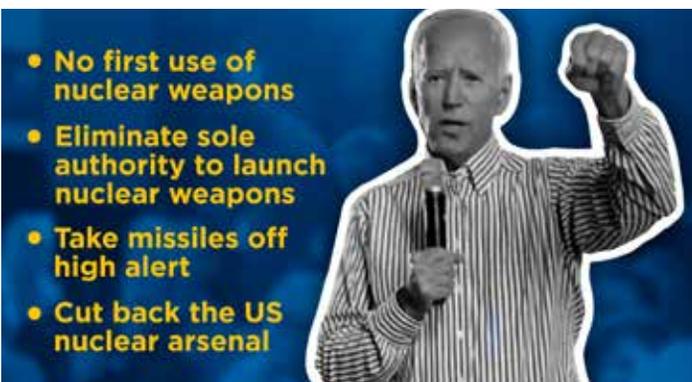
Widespread adoption of electric vehicles (EVs) is needed to achieve the drastic cuts in transportation emissions that can help prevent the worst consequences of climate change.

But it won't be enough for automakers to simply produce more EVs, or for consumers to buy them. We must also ensure the nation's charging infrastructure can accommodate the growth of EV sales.

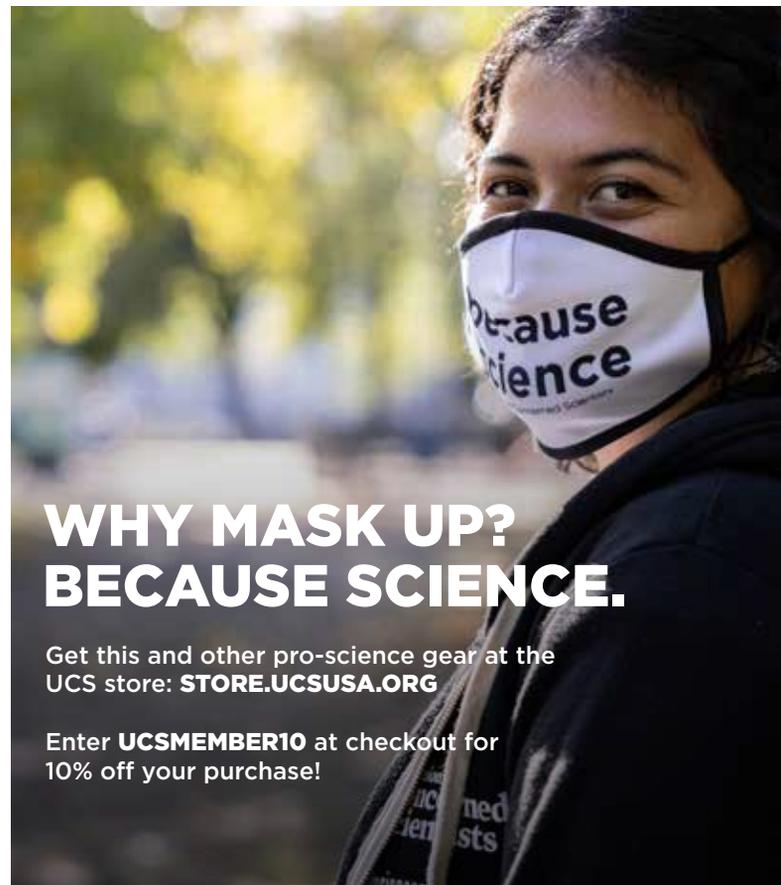
With states such as California committing to phase out the sale of new combustion-engine passenger vehicles by 2035, and with the prospect that EV sales could reach a tipping point soon,

UCS analysts are working to provide policymakers with a plan for equitably and effectively managing this transition. This spring, UCS released fact sheets providing recommendations for widescale EV charging infrastructure and improving the federal EV tax credit; recommendations on electrifying freight trucks and buses will be posted early this summer. This suite of policy recommendations may not get a lot of press coverage, but it's the type of work that will help us get to 100 percent EV sales sooner than anyone expects. Find the full suite at www.ucsusa.org/resources/federal-ev-policy.

Holding the President to His No-First-Use Promise



At a town hall meeting while campaigning for president, then-candidate Joe Biden promoted a “no-first-use” policy for nuclear weapons. Watch the video of Biden’s comments at www.ucsusa.org/resources/no-first-use-policy and sign our petition to hold him to his campaign promises for sensible nuclear weapons policies at <http://act.ucsusa.org/nuclearweaponspetition>.



WHY MASK UP? BECAUSE SCIENCE.

Get this and other pro-science gear at the UCS store: STORE.UCSUSA.ORG

Enter **UCSMEMBER10** at checkout for 10% off your purchase!

Backing Essential Workers During the Pandemic



If there were lessons to be learned about whether we should trust corporations to do the right thing for their workers, COVID-19 has been a grim, unrepentant teacher. Working conditions in large meatpacking plants were already dangerous pre-pandemic; COVID-19 outbreaks at such plants underscored what little priority the nation's giant meat and poultry companies place on the health and safety of their employees. Official death tolls are hard to come by, but nearly 300 people who worked in meatpacking plants died of COVID-19 as *Catalyst* went to press, and more than 58,000 tested positive.

The vast majority of US chicken, beef, and pork processing is controlled by a handful of conglomerates that did little to protect their workers. Industry leader Tyson Foods, for example, experienced some of the worst outbreaks during the spring of 2020, yet the company sought (and received) a Trump executive order to keep the plants open and pressed its workers to keep reporting for duty. Meanwhile, Tyson refused to provide the personal protective equipment and appropriate distancing needed to keep them safe, and its management reportedly offered “incentives” to keep sick workers on the job,

stonewalled local health departments over testing data, lowballed case reports, and lied about the dangers of the virus to interpreters for its immigrant workers.

Joining with partners at the Food Chain Workers Alliance, UCS has called attention to dangerous working conditions and demanded stronger federal protections for meatpacking workers, many of whom are people of color. We made detailed recommendations to Congress calling for codified and enforced worker safety rules, pandemic premium pay, paid sick leave and expanded health benefits, and priority access to testing and vaccines

for frontline food workers. Some of these provisions were included in the final American Rescue Plan Act of 2021, signed into law by President Biden; at press time UCS was still petitioning the Occupational Safety and Health Administration to implement critical emergency protections for such food workers.

Still, further steps are needed to ensure justice. Tyson Foods' treatment of its workers during the pandemic is just one reason UCS is focusing on this company as a major obstacle to a more just and sustainable food system. You'll be hearing more from us about Tyson's corporate behavior in the months ahead.

UCS Fellow Wins National Award



Derrick Z. Jackson, veteran journalist and regular contributor to the UCS blog *The Equation*, won a top journalistic honor in April when he was named as a

recipient of a 2020 Scripps Howard Award for excellence in opinion writing.

The Scripps Howard awards, given in more than a dozen categories, are designed to honor the best in journalism from the previous year. A panel of veteran journalists and media industry leaders selects the winners from roughly 900 entries.

Jackson won the award for a series of blog posts he wrote for UCS and for *Grist.org* that highlighted issues of systemic racism in the US response to the COVID-19 pandemic.

He was chosen from a group of finalists that included columnists from the *Los Angeles Times* and *Boston Globe*.

As the Scripps Howard judges noted, “Derrick Jackson writes with the aplomb of one heavily armed intellectually and the vigor of a man determined to use his voice to right wrongs. His research and sourcing provide credibility, and his eloquent writing makes his work moving and memorable.” You can find his work at <http://blog.ucsusa.org/author/derrick-jackson>.

A Clean Energy Win in Massachusetts

In Massachusetts, home to UCS headquarters, the state legislature delivered a welcome win this spring, passing a long-awaited bill addressing climate change, advancing environmental justice, and boosting clean energy and clean transportation. The bill, signed into law by the governor, commits the Commonwealth to net-zero carbon emissions by 2050, with clear sector-specific milestone targets for 2030 and 2040, and addresses longstanding socioeconomic inequities.

“This legislation will lead to investments in solar energy, offshore wind, and greater energy efficiency,” says Paula García, UCS senior bilingual energy analyst. The bill also sets clear targets for reducing emissions from transportation, the state’s largest source

of global warming emissions. UCS staff members have been supporting this legislation alongside local environmental justice organizations for years.

“This is the result of years of work, discussions, negotiations, and a lot of effort from organizations, legislators, coalitions, and regular people who care about a healthy and livable

world for current and future generations,” says García. “It also reflects decades of work by environmental justice activists to protect Black, Brown, Indigenous, immigrant, and low-income communities in Massachusetts from the disproportionate share of harm from climate change and pollution. It’s incredibly encouraging.”



Massachusetts Governor Charlie Baker signed legislation in late March that commits the state to net-zero emissions by 2050.

Good Riddance to Restricted Science

Years of behind-the-scenes work paid off for UCS with the defeat of a sneaky strategy intended to pull the foundation out from public health and safety protections. Proponents of this strategy demanded that such protections be based only on studies where scientists are willing to hand over all their underlying data—often a major ethical violation that could release the private medical information of study participants. The result would be to prevent the best available science from informing policies that keep us healthy and safe.

Under the previous administration, leadership at the Environmental Protection Agency (EPA) and the Department of the Interior (DOI) codified this strategy into a rule, despite UCS and other organizations’ sustained efforts to challenge it. UCS even convened a public hearing to gather public comments when the EPA would not.

In February of this year, a judge threw out the EPA’s rule, and in March, the acting secretary of the DOI overturned that agency’s version. We say good riddance to these insidious attempts to remove science from federal protections; UCS will stay vigilant to help make sure they don’t resurface.

WITH NUCL “ADVANCED” ALWAYS

A detailed UCS technical analysis raises safety, security, and sustainability concerns around new reactor technologies.

BY ELLIOTT NEGIN

Nuclear power proponents have long been prone to wishful thinking. Back in 1954, Atomic Energy Commission Chairman Lewis Strauss famously predicted that nuclear-generated electricity would ultimately become “too cheap to meter.” Today, nuclear power is among the most expensive forms of electricity.

Strauss’s successor at the commission, Nobel laureate Glenn Seaborg, projected in 1971 that nuclear power would produce nearly all the world’s electricity by 2000. Today, nuclear energy’s share of worldwide electricity is only 10 percent. In the United States, it produces about 20 percent, and about a third of the country’s fleet of aging reactors is struggling to compete with cheaper electricity sources.

Even so, there is growing interest in expanding the role of nuclear power to address climate change. As a low-carbon electricity source, it has obvious advantages over natural gas and coal. But besides being uneconomical, conventional reactors—called light-water reactors because they use ordinary water to cool their radioactive cores—are beset by serious safety and security issues and generate radioactive waste that has to be sequestered for hundreds of thousands of years.

EAR POWER, ISN'T BETTER





Bill Gates (right) shows a prototype of the Natrium, a sodium-cooled fast reactor, on 60 Minutes. The purported safety and cost benefits Gates describe do not match up with reality, according to our analysis.

ENTER “ADVANCED” REACTOR DESIGNS

Undaunted, some nuclear energy developers are now promoting what they call “advanced” reactor designs as a solution. Unlike light-water reactors, these non-light-water designs rely on materials other than water for cooling, including liquid sodium, helium, and molten salt. Some developers contend that these reactors, which are still in the concept stage, will solve all the problems that plague light-water reactors and be “ready for prime time” by the end of the decade.

The siren song of a cheap, safe, and secure nuclear reactor in the offing has attracted the attention of Biden administration officials and some key members of Congress, who are looking for any and all ways to curb carbon emissions. But are so-called advanced reactors merely the latest version of nuclear wishful thinking? A comprehensive Union of Concerned Scientists analysis of non-light-water reactor concepts in development suggests they are. Published in mid-March, the 140-page report found that these designs are no better—and in some respects significantly worse—than the light-water reactors in operation today.

SAFETY, SECURITY, AND SUSTAINABILITY

The report, “*Advanced Isn’t Always Better*,” assesses the pros and cons of three main types of non-light-water reactors: sodium-cooled fast reactors, high-temperature gas-cooled reactors, and molten salt-fueled reactors (see box). It rates each type on three broad criteria: safety; nuclear proliferation and terrorism risks; and sustainability, which refers to how efficiently they use uranium and how much long-lived nuclear waste they generate. (You can find the full report online at www.ucsusa.org/resources/advanced-isnt-always-better.)

“If nuclear power is to play a larger role in addressing climate change, it is essential for new reactor designs to be safer, more secure, and pose comparable or—better yet—*lower* risks of nuclear proliferation and nuclear terrorism than the existing reactor fleet,” says report author Dr. Edwin Lyman, a physicist and director of nuclear power safety at UCS. “Despite the hype surrounding them, none of the non-light-water reactors we reviewed meet all those requirements.”

At the end of 2020, the US fleet of nuclear power plants was comprised of 94 light-water reactors. This was 10 fewer than in 2003 due to a number of factors, especially aging infrastructure and the inability to compete against natural gas as well as wind and solar, which are now the cheapest source of electricity in most countries around the world.

To try to stem its decline, the US nuclear industry promoted a “renaissance” in the early 2000s, and in 2005, Congress provided nearly \$20 billion in federal loan guarantees for new nuclear reactors. The industry’s multimillion-dollar PR campaign has resulted in only two new Westinghouse AP1000 light-water reactors, which are still under construction in Georgia with price tags of \$14 billion apiece—double their estimated cost—and taking more than twice the estimated completion time.

Given this struggle in building even standard-sized (1,000-megawatt) light-water reactors, the industry has turned to two other strategies to try to secure a bigger market share: small, modular light-water reactors, which—because of economies of scale—would produce even more expensive electricity than conventional reactors; and non-light-water reactors, which are largely based on unproven concepts from more than 50 years ago.

OUTSIZED CLAIMS

The new UCS report takes a close look at unsubstantiated claims developers have been making about these non-light-water designs. With little hard evidence, many developers have maintained they will be cheaper, safer, and more secure than currently operating reactors; will burn uranium fuel more efficiently, produce less radioactive waste, and reduce the risk of nuclear proliferation; and could be commercialized relatively soon.

One of these reactors, TerraPower's 345-megawatt Natrium, a sodium-cooled fast reactor, received considerable media attention earlier this year when TerraPower founder Bill Gates touted it during interviews about his new book, *How to Avoid a Climate Disaster*. In mid-February, Gates told *60 Minutes* that the Natrium reactor will produce less nuclear waste and be safer and cheaper

than a conventional light-water reactor. In fact, according to the UCS report, sodium-cooled fast reactors would likely be less uranium-efficient and would not reduce the amount of waste that requires long-term isolation. They also could experience safety problems that are not an issue for light-water reactors. Sodium coolant, for example, can burn when exposed to air or water, and the Natrium's design could experience uncontrollable power increases that result in rapid core melting.

"When it comes to safety and security, sodium-cooled fast reactors and molten salt-fueled reactors are significantly worse than conventional light-water reactors," says Lyman. "High-temperature gas-cooled reactors may have the potential to be safer, but that remains unproven, and problems have come up during recent fuel safety tests."

(continued on p. 21)

WHAT TYPES OF "NON-LIGHT-WATER" REACTORS DID UCS REVIEW?

SODIUM-COOLED FAST REACTORS

These reactors are known as fast reactors because, unlike light-water reactors or other reactors that use lower-energy (or "thermal") neutrons, the liquid sodium coolant does not moderate (slow down) the high-energy (or "fast") neutrons produced when nuclear fuel undergoes fission. The characteristics and design features of these reactors differ significantly from those of light-water reactors, stemming from the properties of fast neutrons and the chemical nature of liquid sodium.

HIGH-TEMPERATURE GAS-COOLED REACTORS (HTGRS)

These reactors are cooled by a pressurized gas such as helium and operate at temperatures up to 800°C, compared with around 300°C for light-water reactors. HTGR designers developed a special fuel called TRISO (tristructural isotropic) to withstand this high operating temperature. HTGRs



The reactor vessel and coolant piping of the BN-800 in Russia, one of the few operating sodium-cooled fast reactors in the world. UCS found that these reactors can pose unique safety issues, as their sodium coolant can burn when exposed to air or water.

typically contain graphite as a moderator to slow down neutrons. There are two main variants of HTGRs: *prismatic-block HTGRs* use conventional nuclear fuel elements that are stationary; *pebble-bed HTGRs* rely on moving fuel elements to circulate continuously through the reactor core.

MOLTEN SALT-FUELED REACTORS (MSRS)

In contrast to conventional reactors that use fuel in a solid form, these use liquid fuel dissolved in a molten salt at a

temperature of at least 650°C. The fuel, which is pumped through the reactor, also serves as the coolant. MSRs can be either *thermal reactors* that use a moderator such as graphite, or *fast reactors* without a moderator. All MSRs chemically treat the fuel to varying extents while the reactor operates, so unlike other reactors, MSRs generally require on-site chemical plants to process their fuel as well as elaborate systems to capture and treat large volumes of highly radioactive gaseous by-products.

Building a Sustainable— and Equitable—Food System

INTERVIEW WITH LEAH PENNIMAN



LEAH PENNIMAN is co-founder of Soul Fire Farm and author of the book *Farming While Black*. She is a farmer, science educator, and food sovereignty activist with more than 20 years of experience. Her work showing the next generation of farmers a more equitable and sustainable way to tend the land has been recognized by the Soros Racial Justice Fellowship, Fulbright Program, the Presidential Award for Science Teaching, and the James Beard Foundation Leadership Award, along with many other accolades. Hear more about how she's uprooting racism in the food system on our *Got Science?* podcast at www.ucsusa.org/resources/farming-while-black.

How did you go from teaching science in Albany, New York, to developing your vision for what would become Soul Fire Farm?

LEAH PENNIMAN: Big projects have many origin stories, but one of them was that my partner, Jonah, and I were living in the South End of Albany, a neighborhood under “food apartheid,” that insidious system of segregation that relegates certain people to food opulence and others to food scarcity. We were challenged to find fresh vegetables and fruits and whole foods for our then-newborn and two-year-old. When our neighbors found out that we had over a decade each of farming experience, they started peer pressuring us to create a farm for the people. You know, a farm that would pull forth the bounty of the earth and make it available to those who’d previously been excluded from access to these fresh, healthy, culturally appropriate foods.

Tell me more about injustice in the food system.

LEAH PENNIMAN: There are many barriers to Black and Brown people in farming, as the entire food system in this nation is really built on a bedrock of theft of land and theft of labor. Almost 98 percent of rural agricultural land is White-owned, so land ownership is a major barrier. Another factor is that over 85 percent of farm labor is done by people of color, mostly Latinx and Hispanic, but also incarcerated Black men, Asian folks, and others. Meanwhile, only a few percentage points of folks of color are in farm management. [Farm laborers] are experts in their craft, but they’re trapped in a cycle of low wages and being exploited

in their work. Equalizing labor laws and creating healthy pathways to leadership for farm laborers is going to be essential in making sure that we have producers of food who reflect the beautiful diversity of this country.

Although Soul Fire Farm is productive and thriving today, the land was not very fertile when you bought it. How did you transform it?

LEAH PENNIMAN: Soul Fire Farm is located on 80 acres of traditionally Stockbridge-Munsee Mohican territory outside of Albany, New York. We purchased land that we could afford, which meant that it was heavily logged, degraded, and eroded. We spent 2006 until 2010 just making the place habitable for our vision by building up high levels of organic matter, building terraces, raised beds, and using no-till, animals, and cover crops to enrich the soil. We also do polycultures, which means planting crops that help each other out in one section, such as corn, beans, and squash. These are “the three sisters,” an Indigenous technology. The corn provides support for the beans, the beans fix nitrogen, and the squash provides a cover that suppresses weeds.

And I think it’s very important that we don’t forget how to use our senses as we interact with the environment. A very popular way that we analyze soil quickly in the field is something called the texture-by-feel test, which originated among the Yoruba people in what is now Nigeria. And we cannot talk about restoring degraded soils without giving a major shout-out to George Washington Carver of Tuskegee University in the late 1800s and early 1900s, who was one of the founders of regenerative agriculture. He noticed that monocropping of cotton

Equalizing labor laws and creating healthy pathways to leadership for farm laborers will be essential in making sure that we have producers of food who reflect the beautiful diversity of this country.

was completely destroying the soils of the South and economic collapse wouldn't be far behind. So many of these technologies that we use on the farm mirror what Dr. Carver set in motion.

It sounds like you practice a more sustainable type of farming, but can these methods succeed at a large scale?

LEAH PENNIMAN: I had the opportunity to work with a couple of researchers at The New School [a private research university in New York City] on this very question. One of their most powerful findings was that, if you look at yields within just [one] season, conventional industrial agriculture is going to outperform organic regenerative practices. However, as soon as they stretched the time scale to four or five years or more, time enough for climate chaos events—hurricanes, floods, droughts, fires, pest outbreaks—they started to see that gap diminish over time because regenerative agricultural systems are much more resilient. They're able to respond to uncertainties in weather and climate and ecology. They start to outperform.

So your farming methods aren't just sustainable—they're also more resilient?

LEAH PENNIMAN: Absolutely. When Hurricane Sandy hit in 2013, we got so much rain. But because of the high levels of organic matter, and because we have raised beds, and water is channelized, we saw very little damage to our crops. Not that we would celebrate in any way anyone else's losses, but it was really powerful to see that other farmers in our area had lost all their topsoil. All their crops just washed into the river because they didn't have

raised beds or this protective forest cover all around. So, if we had any doubt at that time that this was a good way to go, that doubt was erased, and we doubled down on implementing these regenerative and ancestral practices.

Many UCS members love to grow their own produce and are interested in how they can help make our food system fairer and more resilient. What resources would you recommend?

LEAH PENNIMAN: My daughter, Neshima, says the food system is everything it

takes to get sunshine onto your plate. It includes the way land is shared, the way labor's treated, the access to capital, the access to food, and, of course, the earth herself. And the good news about this wide arc of the food system is that there are so many points of intervention and so many right answers for how to help. And for folks who are interested, you can go to www.soulfirefarm.org. We've created an action guide for how to heal and repair the food system to make it just for everyone. I really believe that everybody who eats food and everybody who lives on land has a role to play in improving the food system. {C}

EVERY SCIENTIST NEEDS PARTNERS

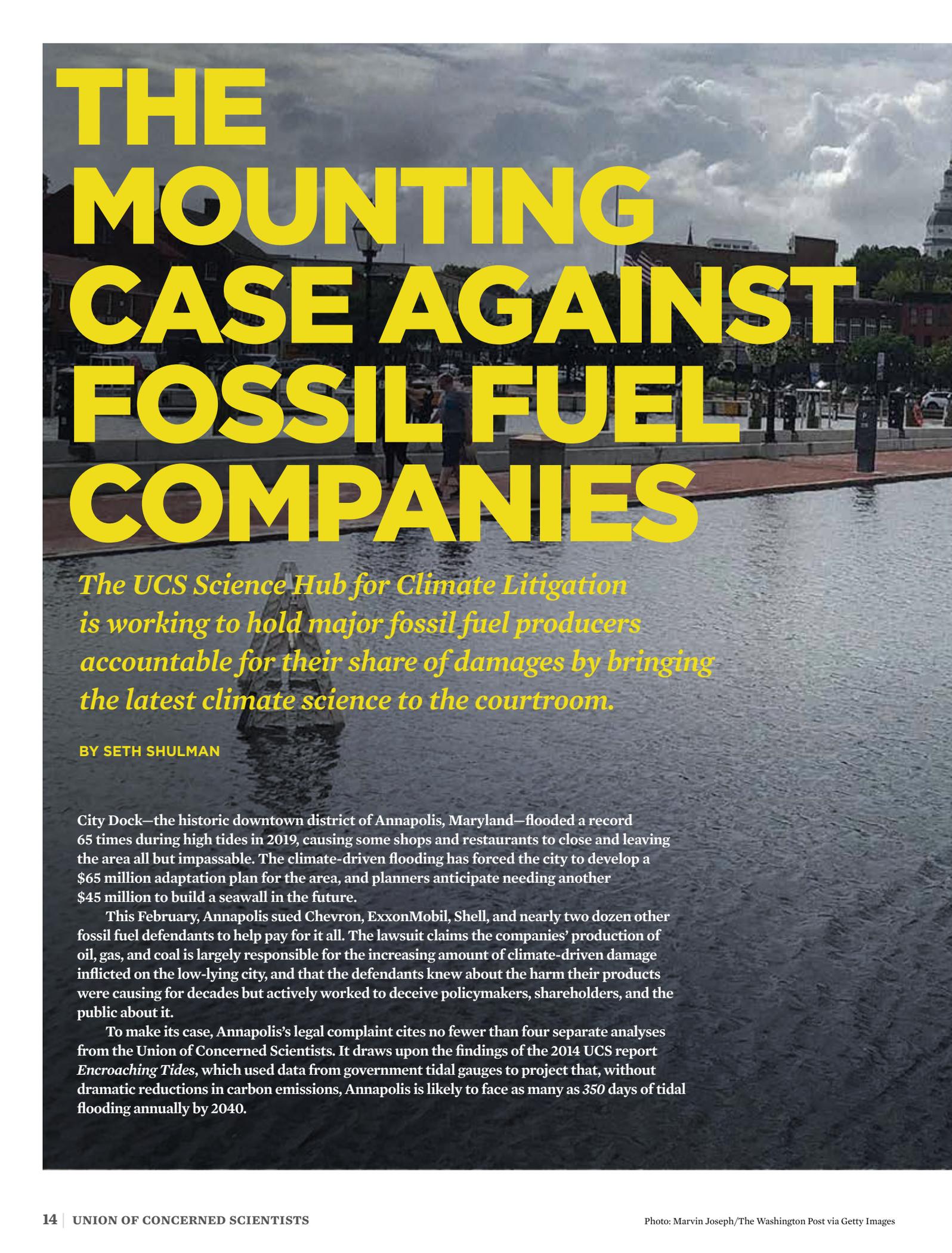
UCS PARTNERS FOR THE EARTH support a healthy planet and a safer world by making an easy and affordable **MONTHLY GIFT**.

By making an automatic monthly gift you can help fight for science and fact-based policies every month, all year long.

IT'S SIMPLE TO SIGN UP.

Join online at www.ucsus.org/monthly or call (800) 666-8276.





THE MOUNTING CASE AGAINST FOSSIL FUEL COMPANIES

The UCS Science Hub for Climate Litigation is working to hold major fossil fuel producers accountable for their share of damages by bringing the latest climate science to the courtroom.

BY SETH SHULMAN

City Dock—the historic downtown district of Annapolis, Maryland—flooded a record 65 times during high tides in 2019, causing some shops and restaurants to close and leaving the area all but impassable. The climate-driven flooding has forced the city to develop a \$65 million adaptation plan for the area, and planners anticipate needing another \$45 million to build a seawall in the future.

This February, Annapolis sued Chevron, ExxonMobil, Shell, and nearly two dozen other fossil fuel defendants to help pay for it all. The lawsuit claims the companies' production of oil, gas, and coal is largely responsible for the increasing amount of climate-driven damage inflicted on the low-lying city, and that the defendants knew about the harm their products were causing for decades but actively worked to deceive policymakers, shareholders, and the public about it.

To make its case, Annapolis's legal complaint cites no fewer than four separate analyses from the Union of Concerned Scientists. It draws upon the findings of the 2014 UCS report *Encroaching Tides*, which used data from government tidal gauges to project that, without dramatic reductions in carbon emissions, Annapolis is likely to face as many as 350 days of tidal flooding annually by 2040.



It references the 2016 UCS report *The US Military on the Front Lines of Rising Seas*, which outlines anticipated climate-driven impacts faced by US military bases along the East and Gulf Coasts—including the US Naval Academy in Annapolis. And, to help prove the companies knew about the threat their products posed to the climate, the lawsuit quotes internal company documents published by UCS in its 2015 *Climate Deception Dossiers* report, and in its landmark 2007 work *Smoke, Mirrors, and Hot Air*, which detailed Exxon’s funding of third parties who mislead the public about climate science.

For lawyers to cite UCS reports speaks to the caliber of the organization’s research and highlights our position in the vanguard of the so-called climate accountability movement, which seeks to hold fossil fuel companies responsible in court for the climate-related harms they’ve caused. As Dr. Delta Merner, project lead for the UCS Science Hub for Climate Litigation, explains, Annapolis is not alone in relying upon UCS research. “Of the 26 major cases of climate litigation we’re now following closely,” she says, “19 of them cite UCS materials.”

UCS launched the Science Hub (<https://www.ucsusa.org/resources/science-hub-climate-litigation>) last year with partners as a resource center, intended to build greater capacity in the scientific community to conduct research that could be relevant in court, and to connect the growing number of plaintiffs (mostly states and municipalities) with credentialed scientists around the world who can inform these cases with top-notch research.

ACTIVIST SCIENTIST

Finding the right person to lead the new Science Hub wasn’t easy. The job requires someone conversant with the technical aspects of climate science, the ins and outs of the legal system, and the kinds of issues communities face from climate-related catastrophes. Equally important, the position requires someone undaunted by the prospect of taking on powerful fossil fuel companies with huge teams of lawyers and a history of deception. By training, experience, and temperament, Merner—a geographer and environmental scientist—checked all those boxes and more.

She arrived at UCS just before the pandemic struck in 2020, with firsthand knowledge of climate impacts and a deep understanding of hydrology and risk analysis, honed by years of working in the West Virginia coalfields—some of it living in a tent—studying and mapping the industry’s threat to community water supplies. She’s gone up against coal companies and the Army Corps of Engineers in court, worked as a disaster preparedness trainer in Texas, and spent a year helping a neighborhood in New Orleans’ Lower Ninth Ward rebuild after Hurricane Katrina.

Merner traces her willingness to fight all the way back to second grade, when she undertook a sit-down strike to prevent her school in New Jersey from cutting down a favorite oak tree in the playground, persisting until the tree was spared.

Merner says her work on disaster relief taught her lifelong lessons about how our systems fail people all too often, a fact

that motivated her to pursue her PhD in environmental science. Her work helping communities facing water contamination and environmental degradation showed her how devastating the impacts of fossil fuel production can be. And, as meaningful and rewarding as she found that work to be, she increasingly thought about how she might work to address climate change in the hopes of avoiding some of those impacts altogether.

“Part of what drew me to the UCS Science Hub is that we address a root cause of climate change with a very basic call for accountability,” she says. “It’s important to remember that people in positions of power at these fossil fuel companies made choices that resulted in many of the conditions we live with today, and that we will likely be living with for a long time to come.”

She adds that, especially in our society, litigation is a powerful tool. “By using it,” she says, “we can change the behavior of the companies, which have benefited and profited from fossil fuel extraction and marketing that directly connect to damages today. And we can do so in a way that ultimately benefits the communities now suffering from these damages.”

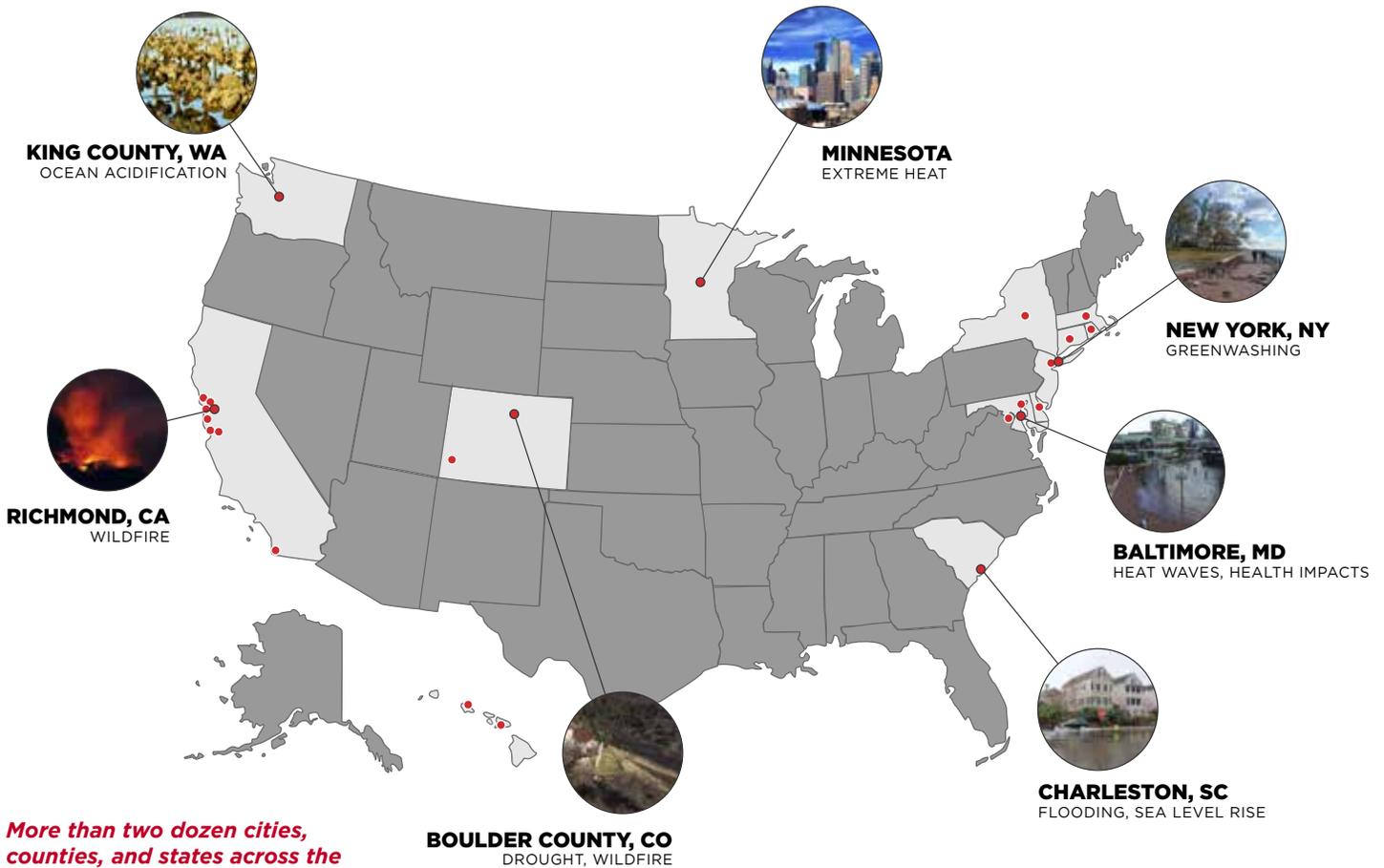
RISING TIDE OF CASES

Merner comes to the UCS Science Hub at a time when climate-related litigation against fossil fuel companies is riding its own tide of momentum: a 33 percent increase in cases over the last 18 months according to one study. The Sabin Center for Climate Change Law at Columbia Law School is tracking more than two dozen cases like the one brought by Annapolis, all seeking monetary damages to help pay to remediate climate impacts—what Merner calls “cost recovery” cases. And that’s just one of roughly a dozen categories of climate litigation the Sabin Center tracks.

The sense of momentum was readily apparent last fall when the UCS Science Hub hosted its first major webinar, sponsored in partnership with the Sabin Center, Columbia University’s Earth Institute, and the Climate Science Legal Defense Fund. The virtual event featured presentations by leading scientists and legal practitioners through multiple online channels and tapped into a wellspring of interest, attracting some 650 registrants from 30 different countries, almost every US state, and Puerto Rico. (Many more have since watched the recorded version, available at www.ucsusa.org/resources/science-climate-litigation-and-law.) Participants sent in far too many questions to be answered during the Q&A session, but the organizers promised more opportunities for answers and sharing of information in the future, adding to the almost palpable sense that the event was helping to forge powerful connections.

WHAT’S NEXT

When it comes to legal cases against powerful corporations, the wheels of justice turn slowly. It took decades and literally hundreds of separate legal cases to finally hold the tobacco industry accountable in court for misleading the public about



More than two dozen cities, counties, and states across the United States have sued the fossil fuel industry over climate damages and deception.

the health risks of its products. Ultimately, the legal process of “discovery” in one landmark case forced the tobacco companies to release damning internal documents that showed they had known about these risks for years. The revelations helped turn the tide of public opinion about tobacco addiction in the United States and eventually found that the companies had engaged in a decades-long conspiracy to deceive the public, forcing them to pay enormous settlements.

At the moment, fossil fuel companies fighting climate litigation are trying hard to move cases like the one brought by Annapolis to federal court, where they expect more favorable judgments. These jurisdictional legal maneuvers have already caused major delays, but so far most of the climate-related cases have been sent back to state courts. In one climate case brought by the city of Baltimore, a narrow procedural question now stands before the US Supreme Court, which, as of our press date, has yet to rule on the matter.

While the outcome in that case remains uncertain, the stakes are clear. If the high court allows the damages and fraud lawsuits to proceed at the state level, the litigation is far more likely to wind up holding the fossil fuel industry, like the tobacco industry before it, accountable for massive and preventable

harms to people and the climate. Regardless of the outcome, Merner says the UCS Science Hub is focused on four key objectives: catalyzing more climate-related research that could be effectively used in the courtroom; expanding the community of scientists and legal scholars lending their expertise to climate litigation; making the best existing research accessible to the communities, legal scholars, and practitioners bringing these cases to court; and connecting legal teams with experts in relevant technical fields.

For its part, ExxonMobil has unsurprisingly called the Annapolis lawsuit “baseless and without merit,” adding that: “Legal proceedings like this waste millions of dollars of taxpayer money and do nothing to advance meaningful actions that reduce the risks of climate change.”

Merner takes a decidedly different view. “At the UCS Science Hub, we’re working hard to demonstrate the robust scientific basis for holding ExxonMobil and the rest of the fossil fuel industry to account for their actions and inaction with regard to the climate crisis. We know we’ve got the science on our side, and we’re building a group of talented experts from around the world that is legally savvy and motivated to seek climate justice.” {C}

Communities Find a Voice in Federal Energy Decisionmaking

By Pamela Worth

This spring, the Union of Concerned Scientists acted quickly after learning that, at long last, a channel was opening for regular people to weigh in on the energy issues that affect them. UCS Energy Campaign Organizing Manager Edyta Sitko and her colleagues had just weeks to take advantage of the first opportunity in decades to make a difference in the decisionmaking process of a key government agency: the Federal Energy Regulatory Commission (FERC).

More than 40 years ago, Congress authorized the creation of the Office of Public Participation within FERC to give the public a voice in how this independent federal agency conducts its work (which includes the regulation of interstate energy transmission). Since 1978, the Office of Public Participation had existed in name only because it was never actually funded, but at the end of 2020, it was finally granted a budget and a charge to report to Congress.

The historic lack of public input at FERC has too often stymied communities and organizations fighting for energy justice, says Sitko. Low-income households that have a hard time paying their monthly bills have historically struggled to have their voices heard at FERC. Households with incomes above the poverty line pay just 2 to 3 percent of their income for energy but families below the poverty line pay between 10 and 26 percent of their income.

And it's not just about electricity prices, she says. Communities across the country have struggled when trying to address FERC's flawed permitting



Giving Black, Brown, Indigenous, rural, and low-income communities a voice in energy-related decisions can reduce the risk of them being saddled with polluting power plants or pipelines (above) and instead increase the chances of them reaping the benefits of renewable energy (right) and energy efficiency.

processes that would place polluting facilities such as compressor stations in their neighborhoods. And decisions about where to site transmission lines or where to build pipelines don't affect communities equally: pipeline buildouts, for example, most often affect predominantly Black and Brown, rural, and Indigenous communities.

As Sitko puts it, "The FERC permitting process has largely been inaccessible—technical and cumbersome—to individuals and

communities that often don't have the expertise, time, or financial resources to take it on."

With the effects of climate change already straining our electrical grid, people need more input into grid and transmission decisions that will need to be made in response. "These problems are only going to get worse," Sitko says. "It's in everyone's best interest to rethink the way FERC, grid operators, and utilities make decisions—and to do this equitably."



If industry is allowed to have a voice, then communities that have been harmed by FERC's decisions, or by a lack of public participation, also need a voice.

COMMUNITIES, CONSUMERS, AND UCS MAKE THEIR CASE

One of the Office of Public Participation's first actions was to convene several community listening sessions along with a daylong workshop to solicit input on its scope and function, and who should be involved. UCS quickly reached out to several partner organizations working on energy justice to encourage their input. And Sitko and her team compiled their top recommendations for how the office should operate, submitting verbal and written public comments guided by a UCS report, *Public Participation in Rulemaking at Federal Agencies*, released

last year in anticipation of changes under the Biden administration.

"Transparency, communication, accessibility—these were the themes of our comments," she says. "For example, we strongly recommended that all communication around issues or processes that affect people, like where a pipeline might be sited, be clear and understandable, whether that means removing jargon or translating documents into Spanish." UCS recommendations also included: opening field offices to be closer to communities; providing longer lead times before public hearings, workshops, or comment periods; ensuring information

about projects be available in multiple formats; and that people or organizations that take on companies—e.g., a tribal community suing an energy company over a planned pipeline—be compensated for the time and money they must spend to mount these challenges against well-resourced corporations.

"If industry is allowed to have a voice, then communities that have been harmed by FERC's decisions, or by a lack of public participation, also need a voice," Sitko says. "Right now, they have to jump through hoops just to be heard. There's a lot the Office of Public Participation can do to reduce this burden and encourage greater engagement." {C}

Lise Beane: Part of an Enduring Movement



For Lise Beane, public health is personal. Decades ago, she helped take care of several friends and loved ones after they developed breast cancer. Some died, including her sister. Around the same time, her brother contracted AIDS and also passed away. Beane connects these devastating losses to the lack of public awareness and funding for medical research around both diseases in the 1980s and 1990s—because of whom they affected.

“For us women, breast cancer was both a fairness and feminist issue,” she says, pointing out that it was predominantly men who were making decisions about national public health priorities. Beane became active with the Massachusetts-based Women’s Community Cancer Project and used her creativity and marketing skills to sound alarms about breast cancer and its links to environmental pollutants, and to demand federal research funding for the disease.

As she learned more about the science of cancer and how our environment affects our health, she also learned about another threat to public health: climate change. Attending lectures on the subject in Boston, Beane noticed the consistent presence of staff from the Union of Concerned Scientists.

“That’s one of the reasons I liked UCS so much. You were always there,” she says. A public talk by the late UCS co-founder Henry Kendall on the imperative to act on global warming inspired her further. “He initiated a call to action that had been missing,” she says. Today, Beane is proud to be part of the Henry Kendall Society and appreciates that UCS is still calling for federal spending to be diverted from new nuclear weapons, working on climate change, and advocating to protect the public from environmental pollutants.

The losses Beane has endured in her life make her appreciative of enduring movements. “UCS has sustainability. Even after Henry Kendall passed away, you still went on,” she says. “Sustainability is important, both for our planet and for organizations that are working toward helping it.”

Learn more about the Henry Kendall Society at www.ucsusa.org/hks. (C)

A STAND FOR SCIENCE. AN INCOME FOR LIFE.

Charitable gift annuities offer significant tax benefits and reliable income.

By establishing a charitable gift annuity with UCS, you can receive significant tax benefits and income for life. Payment rates are based on your age (minimum age 60) and can be as high as 8.6 percent. Gift annuities can also help reduce capital gains taxes on gifts of stock.

CONTACT US FOR MORE INFORMATION

Please contact the Planned Giving Team at (617) 301-8095 or email plannedgiving@ucsusa.org.



With Nuclear Power, “Advanced” Isn’t Always Better

(continued from p. 11)

Proponents of non-light-water reactor designs are hyping them as a climate solution and downplaying their safety risks.

Fast reactors have another major drawback. “Historically,” the report points out, “fast reactors have required plutonium or [highly enriched uranium]-based fuels, both of which could be readily used in nuclear weapons and therefore entail unacceptable risks of nuclear proliferation and nuclear terrorism.”

UNREALISTIC TIMETABLE

Timing is also an issue. Some developers claim they can demonstrate, license, and deploy their non-light-water reactors on a commercial scale within as little as six years, enabling them to address the climate crisis in the near term. Last fall, for example, the Department of Energy (DOE) gave TerraPower and X-Energy, developer of a high-temperature gas-cooled “pebble-bed” reactor, \$80 million each to begin operating first-of-a-kind commercial units by 2027, most likely at the Columbia Generating Station site in Washington State.

From concept to a commercial unit in six years? The new Westinghouse AP1000 light-water reactor provides a cautionary tale. It took more than 30 years of research, development, and construction before the first one was built in China and began to generate power in 2018. According to the report, if federal regulators require the necessary safety demonstrations, it could take at least 20 years—and billions of dollars in additional costs—to commercialize non-light-water reactors, their associated fuel cycle facilities, and other related infrastructure.

“One of the new reactor designs being considered, the ‘breed-and-burn’ reactor, has the most potential because it doesn’t require reprocessing—or recycling—spent nuclear fuel, which poses unacceptable proliferation risks,” says Lyman. “But the concept is still saddled with considerable technical obstacles and safety hazards due to the fact that fuel would remain in the reactor longer than in a light-water reactor, allowing fission

gases and pressure to build. That may be the reason why TerraPower suspended work on a breed-and-burn reactor design in favor of the Sodium.”

NEXT STEPS

The Nuclear Regulatory Commission (NRC) may have to adapt some regulations when licensing reactor technologies that differ significantly in design from the current fleet, but Lyman says that should not mean loosening standards that protect public health and safety. He finds no justification for the claim that “advanced” reactors will be so much safer and more secure that the NRC can exempt them from fundamental safeguards. On the contrary, because there are so many open questions about these reactors, they may need to meet even more stringent requirements.

The report recommends that the DOE suspend its advanced reactor demonstration program until the NRC determines whether full-scale prototype tests will be required before any designs are licensed for commercial deployment, which the report argues are essential. The report also calls on Congress to require the DOE to convene an independent commission to review the technical merits of all proposed non-light-water reactors and approve only those projects that have a high likelihood of commercialization and are clearly safer and more secure than the current fleet.

Finally, the report recommends that the DOE and Congress consider spending more research and development dollars on improving the safety and security of light-water reactors, rather than on commercializing immature, overhyped non-light-water reactor designs.

“Unfortunately, proponents of these non-light-water reactor designs are hyping them as a climate solution and downplaying their safety risks,” says Lyman. “Given that it should take at least two decades to commercialize any new nuclear reactor technology if done properly, the non-light-water concepts we reviewed do not offer a near-term solution and could only offer a long-term one if their safety and security risks are adequately addressed.” Any federal appropriations for research, development, and deployment of these reactor designs, he says, “should be guided by a realistic assessment of the likely societal benefits that would result from investing billions of taxpayer dollars, not based on wishful thinking.” {C}

Hypersonic Weapons: Looking Beyond the Hype

By Cameron Tracy



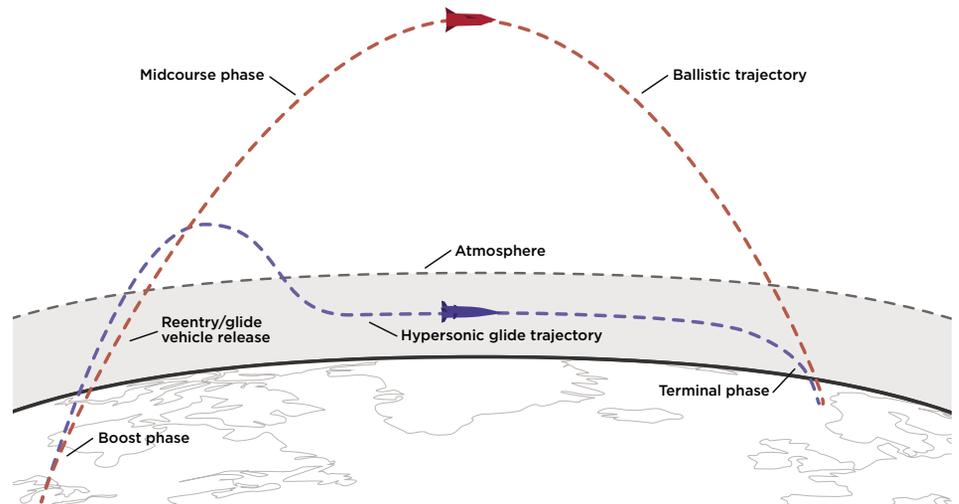
The debut of the world's first guided ballistic missile marked a dramatic shift in military technology when, in September 1944, the Nazis fired their newly developed V-2 rocket at Paris from a base hundreds of kilometers away.

Since then, ballistic missiles have, of course, become a cornerstone of military power, allowing nations to threaten far-off targets from safe distances. While refinements have greatly improved their speed, range, and accuracy, the basic principles have remained largely unchanged: long-range ballistic missiles carry explosive warheads on the front of rockets that detach and fall back to Earth once they run out of fuel. The warheads continue on in unpowered flight, traveling into outer space before gravity pulls them down to their targets.

Now, as tensions between major military powers—particularly the United States, Russia, and China—have increased, each has sought a technological edge over its rivals, prompting an arms race over a different type of missile: the hypersonic boost-glide weapon. These weapons are distinguished from ballistic missiles by their flight trajectories (see the figure). Both have warheads launched on the front of rockets. But while ballistic missile warheads continue on high, arcing paths through outer space, hypersonic gliders quickly dive back into the atmosphere and glide through the air to their targets.

FOCUSING ON THE SCIENCE

Proponents of hypersonic weapons claim they are game changers that are faster, stealthier, and harder to intercept



Hypersonic and ballistic missiles are distinguished primarily by their flight trajectories. Both weapons are accelerated out of the atmosphere on rockets, but hypersonic missiles quickly reenter the atmosphere and glide to their targets, while ballistic missiles fly mainly through outer space. Learn more about these missiles on our website at <https://ucsusa.org/resources/hypersonic-missile-myths>.

than ballistic missiles. This narrative is driving enormous US investment in the technology—\$3.2 billion in this year's defense budget. There's just one problem: many claims of hypersonic weapon performance fall apart when subjected to scientific scrutiny.

At the Union of Concerned Scientists, we performed computational simulations of hypersonic missile flight to better understand their capabilities. Our findings show that the performance of these weapons is strictly limited by the physics of hypersonic flight, highlighting a misalignment between the global rush to acquire these weapons and their actual utility.

Consider, for example, the speed of hypersonic weapons. Unlike ballistic missiles, they fly primarily within the atmosphere, where air resistance slows them down. As a result, calculations show that hypersonic weapons will take longer to reach their targets than currently deployed ballistic missiles.

Claims regarding the purportedly unmatched stealth and evasiveness of these weapons are also overblown. We found

that the intense heat generated by hypersonic flight through the atmosphere causes these weapons to glow, giving off infrared light intense enough to be spotted by existing satellite sensors. And while our calculations show that hypersonic weapons could potentially evade many defensive interceptors, advanced ballistic missiles can already do the same.

In short, the case for continued investment in these weapons, and for the nation's participation in a dangerous arms race, lacks a clear technical basis. Pursuit of hypersonic missiles will yield few new capabilities, while costing billions of dollars per year and inflaming international tensions. As it formulates a comprehensive hypersonic weapons policy, the United States would be wise to focus on the science, not the hype. {C}

Cameron Tracy is a Kendall Fellow at the Union of Concerned Scientists whose research focuses on nuclear arms control and the interface between science and security policy. Read more from Cameron on our blog, All Things Nuclear, at <https://allthingsnuclear.org/author/ctracy>.

PUT SCIENCE INTO ACTION

WITH YOUR LEADERSHIP GIFT

By joining the Henry Kendall Society with a contribution of \$1,000 or more, you'll play a leading role in standing up for science, democracy, and a healthier planet and safer world.

You'll also receive benefits such as:

- Invitations to high-level teleconferences with UCS scientists
- Special updates from UCS experts on current issues and events
- Direct access to a dedicated staff member

And did you know you can also join the Henry Kendall Society with a gift from your IRA or donor advised fund? For more information, or to join the Henry Kendall Society, contact Amanda Bennett at (617) 301-8092 or join online at www.ucsus.org/kendall.



**Union of
Concerned Scientists**
Science for a Healthy Planet and Safer World

Two Brattle Square
Cambridge, MA 02138-3780

NONPROFIT
ORGANIZATION
US POSTAGE
PAID
UNION OF
CONCERNED
SCIENTISTS

Member of
EarthShare

THANK YOU



**Health-care professionals,
first responders, essential workers:
Science has your back.
Thank you for having ours.
Stay connected at www.ucsusa.org.**

@UCSUSA



[www.facebook.com/
unionofconcernedscientists](http://www.facebook.com/unionofconcernedscientists)



@unionofconcernedscientists

