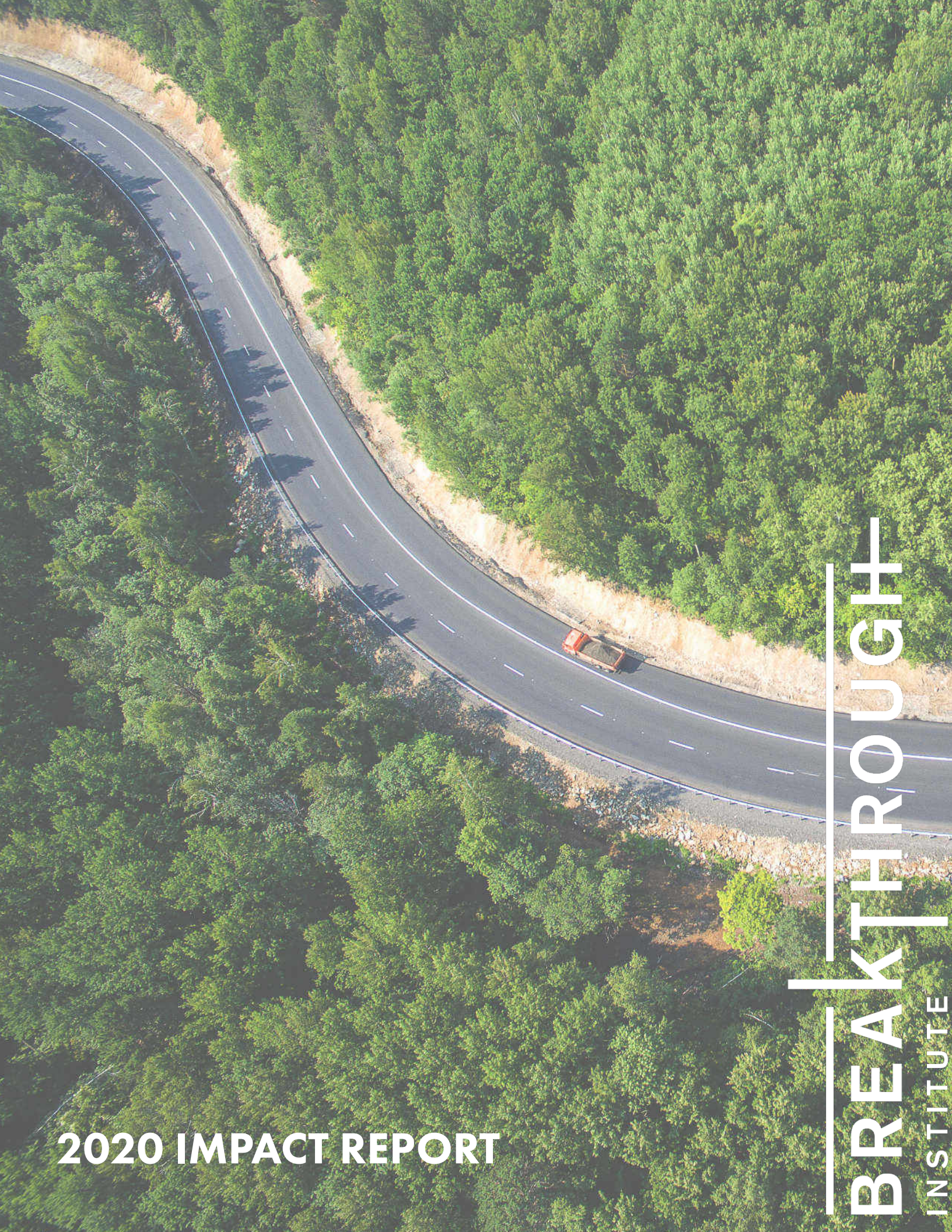


2020 IMPACT REPORT

BREAKTHROUGH INSTITUTE

MESSAGE FROM THE FOUNDER & EXECUTIVE DIRECTOR

Keeping faith with human progress hasn't been easy in 2020. A global pandemic swept across a world that was mostly unprepared for it. Economic life ground to a halt in the spring and has only slowly come back. Political polarization and racial conflict dominated headlines while populism and authoritarianism appeared to be on the march again.

If it wasn't clear before, this year should remind us that progress is not inevitable, but is rather hard won, and does not advance in either uniform or linear fashion. Crisis creates opportunity. Division and polarization invite renewal. Collapse begets reorganization and rebuilding.

As we enter a winter that many expect to bring intensifying death and disease, it is worth remembering that on the other side of it lies a vaccine and perhaps, a return to normalcy. But the post-vaccine world will also be changed in important ways — many for the better.

If initial reports are to be believed, the global biotech sector, a product of decades of public-private partnership to develop superior medical technologies, will have produced effective vaccines in a remarkably short period of time using radically innovative technologies and immunity pathways. It will be the first ever broadly effective vaccine against a coronavirus of any sort, and hence, potentially opens the door to vaccinated immunity to a range of far more common maladies, from influenza to the common cold.

For this, among other reasons, the carnage that COVID-19 has wrought will not remotely rival pandemics past. It has been common, especially in environmental circles, to imagine that modernity is fragile in all its simplified ecologies and complex, globalized economies. But as unprepared as the world was, and as interwoven as our worlds have become, modern societies are actually highly resilient to disruptions of this sort.

Even as the world locked down, modern food systems and globalized supply chains mostly kept up. The economy crashed but it didn't collapse. Workplaces reorganized, manufacturing retooled, and supply chains reoriented to the new socially distanced reality. The economy that emerges from the pandemic will look different in important ways. Where and how many of us live and work will be changed. The pandemic will disrupt some long-standing trends and accelerate others. Progress, in this way, often advances as much through crisis as by increment.

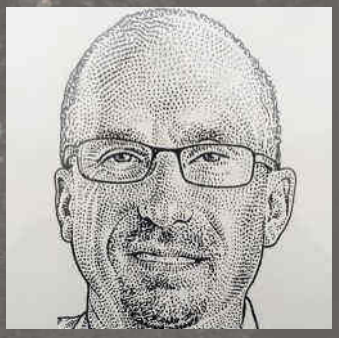
This will likely prove true of environmental concerns in the wake of the pandemic as well. Much has been made of the short-term collapse of carbon emissions at the onset of the pandemic and some even tout it as a model for future climate action. But while

forced inactivity and economic collapse in response to a massive public health crisis is no sustainable response to climate change, the economic shockwave that followed the pandemic likely did accelerate the peaking of global carbon emissions growth.

As Breakthrough has demonstrated through a series of analyses this year, long term economic and technological trends had slowed the growth of emissions significantly in the decade between the global financial crisis and the pandemic. The post-pandemic economy will likely never return to the same level of energy or emissions intensity that characterized the pre-pandemic economy, as older and less efficient capital stock shuttered in the face of falling economic output earlier this year will never return to service. The energy economy that characterizes the economic recovery will be cleaner, more efficient, and more technologically advanced than the one that preceded the pandemic

For this reason, we believe that the case for technology-first climate and environmental policy remains stronger than ever. Shocks such as the one we are presently in the midst of have proven to be the rule, not the exception, for the 21st century global economy. Bottom-up policy, focused on innovation, infrastructure, public investment, economic modernization, and human development, will continue to prove more effective and resilient to the unpredictability of the global economy than will top-down, planned, regulatory frameworks to draw down emissions at either the national or international level.

In these, as in so many other ways, progress is not inexorable. It is rather an emergent feature of our shared and collective endeavors to create better futures for ourselves, our loved ones, our compatriots, and our fellow humans. As we move toward a vaccine, an economic recovery and a post-pandemic future, I believe that Breakthrough is better positioned than ever to advance practical environmental solutions capable of addressing climate change and other global environmental challenges while assuring development and prosperity for all. May it be so, for there is much work to do.



Ted Nordhaus
Founder & Executive Director

OVERVIEW

NEAR-TERM INDICATORS

While Breakthrough takes a long-term perspective on the impact of our work, we track the breadth of our reach every year as near-term indicators of progress. Thus far in 2020 Breakthrough has had 145 mentions in major media, up from 60 in all of 2019, 74 in 2018, and 31 in 2017. Breakthrough staff have been published in over a dozen mainstream publications this year, including Foreign Policy, The Guardian, The Hill, National Review, The New York Times, Persuasion, Politico, Resources Magazine, Slate, and The Wall Street Journal. We have created more than over two dozen reports and analyses, recorded 10 episodes of our podcast Breakthrough Dialogues, and conducted six webinars that reached thousands of people. Breakthrough's website has attracted nearly 500,000 page views, and our Twitter feed has generated over 1.5 million impressions this year.

ADVANCING ADVANCED NUCLEAR

Breakthrough's decade-long work on nuclear power bore significant fruit in 2020:

In a watershed moment for the nuclear industry, the Nuclear Regulatory Commission certified NuScale's small modular reactor as safe — the first such approval for an advanced nuclear reactor. NuScale has numerous hurdles to overcome on the road to commercialization, but for those who were once concerned about the U.S. government's receptivity to new nuclear technologies, this is yet another significant milestone.

Oklo, maker of the Aurora micro-reactor, also submitted the first-ever license application to the NRC this year for a non-light water advanced reactor, with a goal of starting construction as early as 2021. Idaho National Laboratory (INL) selected Oklo to receive access to recovered spent nuclear fuel to power the Aurora.

The Department of Energy awarded $80 million each to TerraPower LLC and X-energy to build two advanced nuclear reactors that can be operational within seven years.

This progress is set to continue under the Biden administration, whose climate plan includes a focus on driving dramatic cost reductions in critical clean energy technologies such as advanced nuclear. That the Biden campaign included nuclear power in its plan despite the leftward lean of the Democratic Party demonstrates just how mainstream nuclear power has become. This is all a testament to the early work of Breakthrough and our allies to change the discourse and policy environment for nuclear's role in addressing climate change.

Finally, this year two of our closest partners, Third Way and the Energy for Growth Hub, teamed up to map the global market for advanced nuclear power and found significant potential and readiness for advanced nuclear to help countries around the world meet their energy needs. Breakthrough has long argued that nuclear will have an important role to play in helping low-income countries develop without overheating the planet.

THE DEATH OF CARBON PRICING AND THE RISE OF TECH-FORWARD CLIMATE POLICY

"Make clean energy cheap."

Today it is conventional wisdom but it wasn't always so. Fifteen years ago, when Breakthrough coined the term, it cost three to four times more to generate a kilowatt of electricity with a solar panel or a wind turbine than with fossil fuels. Few people had ever heard of shale gas or fracking. Making dirty energy expensive, via either regulations or carbon taxation, was the default climate policy across the environmental community, academia, and environmentally minded factions in both political parties.

From its very first publication, "Fast, Clean, and Cheap," published in the Harvard Law & Policy Review, Breakthrough argued that the highest priority for climate policy was to "cut the Gordian knot" that tied climate mitigation with higher energy costs via sustained public investments in clean energy innovation. Public policy was capable of not only regulating environmental bads but accelerating innovation and technological learning in order to produce environmental goods, a point we illustrated in "Where Good Technologies Come From," a report that highlighted the extraordinary role that public investment in innovation had played in seeding past technological revolutions.

Today, as Democrats have embraced an investment-centered Green New Deal while Republicans tout the importance of public sector research, development, and innovation, it is easy to forget what a radical notion technology-centered climate policy was when we first proposed it. Breakthrough was savaged by both environmentalists, for whom environmental regulation and pricing carbon was the sine qua non of climate policy, and conservatives, who believed that public investment in technology offered little more than market-distorting 'rent-seeking.'

It took a decade more of research and writing to turn the tide. That work continued to be controversial, including analyses showing that proposed US cap-and-trade legislation was, inevitably and by design, riddled with loopholes and off-ramps that would allow emissions to continue rising for years; the first investigation demonstrating that decades of federal research, development, demonstrations, and tax policy were deeply implicated in the origins of the shale gas revolution; comparative research showing that public investment in energy technology and infrastructure accounted for the most successful cases of nations deeply cutting emissions; and an analysis showing that conventional climate policies had had little observable impact on the carbon intensities of the economies in which they had been implemented.

Over those years, Breakthrough built a network of scholars, advocates, and think tanks interested in alternatives to carbon pricing, ranging from center-left groups like the Brookings Institution and Third Way to conservative strongholds like the American Enterprise Institute and the R Street Institute. Breakthrough's work on energy innovation was featured in two of President Obama's State of the Union addresses.

As a result, the focus of climate advocacy and policy has shifted substantially. Joe Biden made no mention of carbon pricing or regulation in his presidential campaign. Recent articles in the New York Times, the Atlantic, and Foreign Affairs have recognized the deemphasis of carbon pricing in climate policy-making. Making clean energy cheap has moved to the center of climate policy in the United States and far beyond.

A NEW 'BUSINESS AS USUAL'

2020 brought a reckoning of sorts for projections of future climate impacts. Both mainstream climate advocacy efforts and media coverage of the issue have increasingly trended toward the apocalyptic, focused on dire projections of future warming, drought, sea level rise, and the prospect of an "uninhabitable earth." But those projections, it turns out, have largely been based upon emissions scenarios produced over a decade ago that appear to be extremely pessimistic.

In December 2019, Breakthrough published an influential analysis demonstrating that the emissions scenario upon which almost all dire climate projections are based likely grossly overestimates the trajectory of global emissions through the end of this century, and hence warming. Climate impact studies and media coverage have consistently mischaracterized the Intergovernmental Panel on Climate Change's (IPCC) high-emissions "RCP8.5" scenario as "business as usual" when it was in fact a highly unlikely and worst case scenario.

In his analysis and a subsequent commentary in Nature, the world's foremost scientific journal, Breakthrough's Zeke Hausfather convincingly demonstrated that climate impact assessments consistent with RCP8.5, which projects as much as 5C of warming by the end of the century, are extremely unlikely and become increasingly implausible with every passing year. Emission pathways to get to RCP8.5 generally require an unprecedented fivefold increase in coal use by the end of the century, an amount larger than some estimates of recoverable coal reserves. In the real world, by contrast, global coal use probably peaked in 2013, and although increases are still possible, many energy forecasts expect it to flatline over the next few decades. Furthermore, the falling cost of clean energy sources is a trend that is unlikely to reverse, even in the absence of new climate policies.

Given central estimates of climate sensitivity, the Breakthrough analysis suggests that the world is more likely on track for around 3C of warming above pre-industrial levels by 2100. This is a far cry from the 1.5C and 2C targets enshrined in the Paris agreements, but is also well short of the dire forecasts that much of the published literature and media accounts have suggested was likely, absent dramatic and immediate action.

Against claims that addressing climate change requires remaking the global economy and reorganizing modern societies, this work has demonstrated that significant climate mitigation is being achieved through incremental, technology-focused climate policy. We have worked to give policymakers and other gatekeepers a platform to double down on this more pragmatic sort of action. Breakthrough's analysis was widely covered by the media — in venues like the BBC and Washington Post — and has changed how future emissions and warming scenarios are discussed in the scientific literature. Breakthrough recently conducted briefings for the lead authors of the upcoming US 5th National Climate Assessment and the National Academies of Sciences Board on Environmental Change. Future climate impact assessments, including the forthcoming IPCC 6th Assessment Report, will likely be grounded in emissions scenarios with much more realistic outcomes.

More broadly, our work on emissions trajectories has demonstrated once again just how uncertain energy and climate futures are. Our business-as-usual projection of 3C of warming — rather than 4 or

5C — is a testament to the progress in global decarbonization over the last few decades. The world has taken concrete steps to move away from coal in the past decade, and this progress should be reflected in our assessment of likely emissions pathways — and their resulting climate impacts — going forward.

A future of three degrees of warming is still one that promises substantial climate risks and a business-as-usual outcome is just that — a scenario that seems most likely given current trends. We may see a future in which rising nationalism and isolationism leads to high global inequality, population growth, and a resurgence in the use of domestic coal. Or we may see one in which technological advances and falling prices in clean energy lead to declining emissions, even in the absence of new climate policies. The future is open, and climate policies are just one among many social, economic, technological, and political factors that are likely to determine how much warming the world experiences and how well human societies are able to adapt.

Breakthrough's recent work on future emissions has helped refocus many policy-makers and philanthropists on the things that really matter: technology and infrastructure. Making real progress on the cost of technology and reducing trade-offs between climate mitigation efforts and economic development, not abstract temperature targets and overly confident forecasts of global temperatures and climate impacts at the end of the century, will determine how successful the world is at mitigating climate change. Accelerating economic growth, technological innovation, and investments in resilient infrastructure offer the best path toward a future that minimizes emissions while maximizing human wellbeing. That is the vision of climate progress that has long animated the research and writing of the Breakthrough Institute, and we are gratified to see it better reflected in academic and policymaking arenas than ever before.

BREAKTHROUGH GENERATION FELLOWS

Each summer, the Breakthrough Institute welcomes a new class of Breakthrough Generation fellows to join our research team for 10 weeks. Generation fellows work to advance the ecomodern project by deepening our understanding in the fields of energy, environment, agriculture, and human development.

Breakthrough Generation has proven crucial to the work we do here. Past fellows' research has contributed to some of our most impactful publications, including Where Good Technologies Come From, Beyond Boom & Bust, How to Make Nuclear Cheap, Lighting Electricity Steel, and Nature Unbound.

Kehinde Abiodun is a PhD candidate in Mineral and Energy Economics, and Payne scholar at the Payne Institute, Colorado School of Mines. His research focuses on evaluating the impact of energy on growth and development outcomes in sub-Saharan Africa. This summer, Kehinde worked with the Breakthrough staff and the Center for Global Development's Vijaya Ramachandran on the relationship between reliable electricity access and commercial profits in North African countries.

Nazanin Akrami is a PhD student in Agricultural and Environmental Chemistry at UC Davis. Her work is focused on the quantification and reduction of greenhouse gas emissions in agriculture. Nazanin worked with Dan Blaustein-Rejto on innovation in nitrogen fertilizer technologies.

Nnaemeka Odionye is a Research Intern at the International Fertilizer Development Center in Accra, Ghana. He was a micro-finance banker in Nigeria, helping smallholder farmers and SMEs grow their businesses, and holds an MSc in Fertilizer Science and Technology in Morocco and an MSc in Energy Studies in Nigeria. Nnaemeka spent the summer working with our food and agriculture analyst Saloni Shah to understand synthetic fertilizer production capacity in sub-Saharan African countries.

James Withrow is a PhD Candidate in Biology and Entomology at North Carolina State University. His research is on honey bees, studying social interactions and queen behavior to address problems with colony productivity and survival. He is pursuing a career in science policy that integrates research, regulation, and stakeholder engagement. James worked with our food and agriculture staff to identify research and technological gaps in livestock methane emissions mitigation strategies.

Andrew Fletcher uses his background in nuclear engineering to develop energy policies for a sustainable future. Andrew holds an MS in Nuclear Science and Engineering from the Colorado School of Mines, where he studied reactor waste chemistry and received a BA in Chemistry from Hamilton College. Andrew worked with our energy and climate director Zeke Hausfather to conduct a cost analysis of NuScale's innovative small modular reactor, which was published on our website in September of this year.

Lauren Lutzke is a PhD student in the School for Environment & Sustainability at the University of Michigan. Her current research examines public perceptions of carbon capture and utilization (CCU), with a focus on consumers' willingness to use products made from captured carbon. Lauren received her MS in Environment and Sustainability in 2018, and a BA in Psychology in 2015, both from the University of Michigan. Lauren worked with Breakthrough staff to create and conduct a survey on popular attitudes on carbon removal.

Maya Anthony graduated with a BA in both Public Policy and Socio-legal Studies from the University of Denver in Denver, CO. Her senior public policy thesis investigated the energy transition away from coal and its impacts on tribal lands in the Four Corners region. She studied abroad in Cochabamba, Bolivia in the fall of 2018, developing a passion for environmental justice and exploring the intersection between inequality and climate change. Maya worked with Seaver Wang this summer to develop a case study of the "just transitions" framework," focusing on the Navajo Nation's reliance on coal mining and power generation.

SENIOR FELLOWS

The Breakthrough Institute's work would not exist without the contribution of the many path-breaking thinkers with whom we have interacted and collaborated over the years.

Our Senior Fellows — now over 50 in number — are our intellectual mentors, colleagues, and fellow travelers.

The collective expertise of our newest Senior Fellows covers a remarkably wide range of topics integral to the ecomodern vision: urbanism, energy, modernization, food systems, and the social science of environmentalism. Their achievements include books, films, essays, research, and a Nobel prize.

We are grateful to these individuals and hope their work continues to help pave the way towards a bright future for humans and nature.

This year, Breakthrough welcomed four new fellows:

Paul Romer is the founding director of the Marron Institute of Urban Management at New York University, the former Chief Economist at the World Bank, and the recipient of the 2018 Nobel Prize in Economics Sciences. Romer received the Nobel in recognition of his work integrating knowledge and technological innovation into models of economic growth. In the last decade he has also become a leading voice in the evolving field of urbanist studies.

Jennifer Bernstein is a faculty member at the Dornsife Spatial Sciences Institute at the University of Southern California. She completed her PhD at the University of Hawaii, where she worked on developing quantitative metrics to assess contemporary environmental worldviews. She is also the author of multiple essays in the Breakthrough Journal, including an essay on ecofeminism titled "On Mother Earth and Earth Mothers."

Philippe Benoit an Adjunct Senior Research Scholar with Columbia University's Center on Global Energy Policy (CGEP) where he leads the Center's work on energy for development. He is also currently a Senior Associate (Non-resident) with the Center for Strategic and International Studies in their Energy and National Security Program. He has worked on the power sector around the world, including power plant financing in the US, development loans for Brazil's and Mexico's public utilities, and an ETS simulation with China's utilities.

Miriam Horn is an environmental writer and filmmaker. Her 2016 book Rancher, Farmer, Fisherman used case studies of American food producers to showcase how large-scale agricultural systems can be environmentally sustainable. She has written on environmental issues for the New York Times, the New Republic, the Smithsonian, Vanity Fair, and other leading publications. Horn worked at the Environmental Defense Fund for over a decade on clean energy and agricultural policy and practice in the United States.

Taishi Sugiyama is senior researcher at the Canon Institute of Global Studies in Tokyo, where he studies climate and energy policy. He is also a lead coordinating author for the Intergovernmental Panel on Climate Change's work on energy innovation. His research has focused on decarbonization and energy technology innovation systems. In 2016, Sugiyama also translated An Ecomodernist Manifesto into Japanese.

LEADERSHIP TEAM

Ted Nordhaus is a leading global thinker on energy, environment, climate, human development, and politics. He is the founder and executive director of the Breakthrough Institute and a co-author of An Ecomodernist Manifesto. He was among the first to emphasize the imperative to "make clean energy cheap" in the Harvard Law and Policy Review. Over the last decade, he has helped lead a paradigm shift in climate, energy, and environmental policy.

Alex Trembath is Deputy Director at the Breakthrough Institute. His research and writing on environmental policy and politics have been featured in the New York Times, the Wall Street Journal, Slate, and elsewhere. He is a graduate of UC Berkeley.

Zeke Hausfather leads the Breakthrough Institute's Climate & Energy program. He is a climate scientist and energy systems analyst whose research focuses on observational temperature records, climate models, and mitigation technologies. Zeke has worked as a research scientist with Berkeley Earth, was the senior climate analyst at Project Drawdown, and was the US analyst for Carbon Brief.

Dan Blaustein-Rejto leads the Breakthrough Institute's Food & Agriculture program. He analyzes the economics and potential of sustainable agriculture policies and practices. Dan has conducted research with the Environmental Defense Fund, International Center for Tropical Agriculture, and Farmers Market Coalition.

Kenton de Kirby is the Breakthrough Institute's Editorial Director. He is a social scientistwith a diverse intellectual background. He has published widely on issues related to education, neuropsychology, culture, linguistics, politics, and the environment.

Thia Bonadies is the Breakthrough Institute's Events Director. She has dedicated her career to using the art of storytelling as a tool for community building, and has over 10 years of experience in project management.

Ann Wang is the Breakthrough Institute's Operations Director. She brings over a decade of non-profit operations and project management experience, primarily from the education sector, where she has served in school leadership, managed national data projects, and taught public school.

OUR SUPPORTERS

Breakthrough is grateful to our growing base of supporters. As an honest broker that is dedicated to the public interest, we only accept charitable contributions from people and institutions without a financial interest in our work. Thank you to the major donors who gave Breakthrough at least $5,000 since our last Impact Report:

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